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Data Mountain: Self-Monitoring, Goal Setting, and Positive Attributions to Enhance the Oral Reading Fluency of Elementary Students With or at Risk for Reading Disabilities

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Abstract

Data Mountain is a self-determination program that has shown early promise in enhancing the oral reading fluency (ORF) of students with or at risk for reading disabilities (RD). This program supports self-determined learning behaviors through explicit teaching of self-monitoring, goal setting, and positive attributions. The present study tested the effects of Data Mountain on the ORF of 81 students with or at risk for RD in second through fifth grades, randomly assigned to one of three conditions: Data Mountain delivered in small groups, Data Mountain delivered individually, or a comparison condition. Results from hierarchical linear modeling indicated that treatment students read an average of 31 more words per minute with a growth rate twice that of comparison students ($p < .01$). The transferable possibilities of Data Mountain to provide students with an opportunity to learn self-determination skills and support ORF is significant to the field of special education.

Keywords

self-determination, self-monitoring, goal setting, attributions, reading

Reading is the foundation of learning, and reading proficiently at third grade is one of the most important predictors of earning a high school diploma (Hernandez, 2011). Despite ongoing efforts, national longitudinal data show students with disabilities, including students with learning disabilities (LD), continue to demonstrate lack of proficient reading (National Assessment of Educational Progress, 2019). Research has shown that students who are unable to read fluently often become frustrated and resistant toward academic tasks, thereby negatively influencing their effort, persistence, and willingness to engage in the learning process (Margolis & McCabe, 2006); and there is substantial evidence establishing a connection between motivation and reading achievement (Toste et al., 2020). Teaching self-determination skills has the potential to shift these motivational processes and support students in self-regulating learning. In the present study, we explore the effect of Data Mountain, a self-determined learning program, on elementary students' oral reading fluency performance.

Fluency Is Essential to Reading

Fluency, along with phonics, phonological awareness, vocabulary, and comprehension, is an essential skill for reading success (National Reading Panel [NRP], 2000). Fluency is the ability to read accurately, automatically, and with prosody (Murray et al., 2012; Pikulski & Chard, 2005; Samuels, 1979). Rate and accuracy are measures of oral reading fluency (ORF), a commonly collected assessment of word reading efficiency. A large body of research has demonstrated that ORF scores serve as global indicators of performance and progress in reading, including both decoding and comprehension skills (see review by Wayman et al., 2007; and meta-analyses by Reschly et al., 2009; Shin & McMaster, 2019; Yeo, 2010).

While the NRP (2000) has encouraged teachers to provide fluency-building opportunities for struggling readers, these practices are rarely observed in classrooms (Kent et al., 2014; Swanson, 2008; Vaughn et al., 2002). ORF growth is most often targeted through repeated reading opportunities; though explicit instruction, peer tutoring,

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Table 1. Consensus Self-Determination Definitions.

Component	Definition
Decision making	Process of evaluating the appropriateness of various outcomes
Choice making	Action of choosing based on individual preferences
Problem solving	Identify a problem, analyze possible solutions, and resolving the problem
Goal setting	Identification attainable goals
Attainment	Development of objectives, steps to achieve selected goals, and the actions necessary to bring goal to fruition
Self-advocacy	Instruction focused on how, when and what to acquire what is necessary to reach goals
Attribution of efficacy and expectancy	Acquiring knowledge that he or she has the ability to complete a specific task to achieve a desired outcome
Self-awareness	Instruction to identify strengths and weaknesses
Self-regulation	The process of self-observing, self-monitoring, self-evaluating, self-instructing, and self-reinforcing. Also referred to as self-management
Self-observing	Assessing and observing if behavior has occurred or not occurred
Self-monitoring	Assessing, observing, and recording related to a task
Self-evaluation	Using graphs, charts, to document progress toward a goal
Self-instruction	Providing their own verbal prompts for solving a problem
Self-reinforcement	Self-administration of positive or negative consequences contingent on a target behavior

modeling, and explicit feedback also are used (Chard et al., 2002; Stevens et al., 2017). Research on fluency interventions other than repeated reading for elementary students with RD is scarce (Stevens et al., 2017). In fact, Stevens and colleagues (2017) found just two studies using strategies to improve ORF other than repeated reading; these included listening to digital books (Esteves & Whitten, 2011) and supplying unknown words with encouragement to use decoding strategies (Watson et al., 2009). As it is posited that dysfluent readers may become resistant to or disengaged from academic tasks (Margolis & McCabe, 2006), it would also be beneficial to investigate alternative approaches that target readers' effort and persistence. As the nature of their disability, students with or at risk for RD experience reading failure which in turn affects their reading-oriented persistence (Valås, 2001). Teaching self-determination skills is one possible avenue for exploration that would target reading fluency performance and motivations to read.

Self-Determination

Causal Agency Theory, a widely used theory of self-determination in the disability field, defines self-determination as a "dispositional characteristic manifested as acting as the causal agent in one's life" (Shogren et al., 2015, p. 258). Through continuous engagement in processes such as self-monitoring and goal-setting, individuals learn their actions are directly related to the outcomes (Shogren et al., 2017). Repeated mastery of challenging tasks develops specific skills and increases the likelihood of engaging in that task again; the ongoing process of this experience promotes self-determination (Shogren et al., 2017) and contributes to a person's understanding of their competencies to be successful on a given task. Longitudinal meta-analyses illustrate significant relations between reading and motivation in both directions; early reading performance contributes to the development of future motivation and early motivation to read may enhance later reading ability (Toste et al., 2020). We contend that facilitating students' self-determination, as operationalized by Causal Agency Theory, has the potential to enhance motivation by promoting self-monitoring, goal setting, and positive attributions in the context of ORF passage reading. There is a real need to target students' perseverance and motivations and this study investigates the isolated impact of self-determined learning on the reading fluency performance for students with or at risk for RD.

As ORF data are often readily available in elementary schools (Stecker et al., 2008), there is an opportunity to share progress monitoring data with students to create a self-determined learning opportunity (e.g., self-monitoring, goal setting). Self-determination is made up of several related components (Shogren et al., 2015; Wehmeyer et al., 1997; see Table 1) and is a valuable lifelong skill (Shogren et al., 2015; Stang et al., 2009). Students need opportunities to learn self-determination skills beginning in elementary school (Stang et al., 2009). Research suggests that when self-determination components are included as part of interventions, positive, long-lasting effects on academic and behavioral outcomes are observed (Algozzine et al., 2001; Konrad et al., 2007). Furthermore, there is evidence that self-determination is a predictor of reading achievement (Zheng et al., 2014). For the present study, specific focus is given to three components of self-determination (i.e., self-monitoring, goal setting, and positive attributions) and

effects on the ORF performance of elementary students with or at risk for RD.

Self-Monitoring

Self-monitoring is the self-determination component most often observed as part of interventions to improve the academic outcomes of elementary students with or at risk for RD (Didion et al., 2021). Self-monitoring is defined as assessing and recording the occurrence of a target behavior (Wehmeyer et al., 1997). It is versatile and can easily be embedded into current academic interventions (Connor et al., 2010). Several reviews support the positive impact of self-monitoring on reading outcomes for students with RD (e.g., Didion et al., 2021; Guzman et al., 2018; Konrad et al., 2007). While no recent studies have examined the effects of self-monitoring on ORF outcomes for students with or at risk for RD, positive effects are evidenced for students with emotional/behavioral disorders and English learners (Albers & Hoffman, 2012; Guzman et al., 2018).

Goal Setting

Research suggests that effects of self-monitoring are improved when paired with goal setting (Didion et al., 2021; Konrad et al., 2007). This is not surprising, given that often when self-monitoring, students evaluate performance toward a target (e.g., goal). In addition, goal setting on its own has promising effects on fluency performance. In fact, meta-analytic results suggest when goal setting was an intervention component, effects on students' ORF were immediate and long lasting (Morgan et al., 2012). Research syntheses conclude when interventions include a clear plan for goal attainment, academic outcomes improve (Didion et al., 2021). Planning for goal attainment promotes discussion related to strategies so students learn to read text fluently rather than just increase speed (Murray et al., 2012). Instruction on strategy use builds students' ability to use effective means to problem solve and function independently (Lenz et al., 1996). If students are unmotivated to use learned strategies, they are not effective (Berkeley et al., 2011). Identifying strategies needed for attaining goals is aligned with teaching positive attributions. In this way, students learn to associate success and failure with the use or lack of use of reading strategies (Berkeley et al., 2011; Solís et al., 2017).

Positive Attributions

As students with persistent reading difficulties age, their perceived competence (expectancies) to successfully complete tasks decrease due to a history of failure (Nelson & Manset-Williamson, 2006). That is to say, students are unable to accurately attribute why they are unsuccessful on academic tasks (Stipek & Weisz, 1981). Positive attributions of efficacy and expectancy is defined as acquiring knowledge that they have the ability to complete a specific task to achieve a desired outcome (Didion et al., 2021; Wehmeyer et al., 1997). Students engage in tasks because they feel they have the strategies and skills to accomplish it (Wehmeyer et al., 1997). Recent intervention research examining the relationship between perceived self-efficacy and academic performance demonstrate that self-efficacy statements contribute positively to academic achievement (Solís et al., 2017).

One avenue to reshape students' self-efficacy and expectancy toward academic tasks is to teach positive attributions, commonly targeted through motivation training. Motivation training uses methods that target students' thoughts, feelings, and beliefs about self and school (Yeager & Walton, 2011; see Table 2). It is intended to improve students' perceptions of their successes and failures by altering students' self-perception and providing students with an effective way to explain their achievement through intrinsic means (Toste et al., 2017). Although research related to components of motivation training is limited, there is evidence of its positive effects on the reading skills of elementary students with RD (Solís et al., 2017; Toste et al., 2017) and more research is warranted. Taking into consideration the lack of self-determination research related to teaching attributions, specifically through motivation training, the Data Mountain program was developed.

The Data Mountain Program

The Data Mountain program is an isolated self-determination program (i.e., no direct reading instruction) and methods teach elementary students to self-monitor and set short-term goals related to individual ORF performance. Components of motivation training are taught throughout sessions to teach positive attributions and provide students' a strategic plan to achieve fluency goals. Specifically, with Data Mountain, students learn to self-monitor with a line graph and set daily personal best goals based on ORF data measured by the number of words they can read correct in 1 min. Each session, motivation training components teach students to attribute their success with their use of reading strategies (e.g., sound out the words). Evidence from three single-case, multiple baseline design studies suggest that the Data Mountain program increased fluency outcomes of grade-level text by an average of 20 wpm for 12 third grade students with or at risk for RD with visible changes to level and trend (Didion et al., 2020).

Group Size. To create a self-determined learning community, a recommended practice for teachers is to make

Table 2. Characteristics of Motivation Training Components.

Component	Characteristics
Identifying negative and positive statements	• Students recognize that positive thoughts can be self-promoting and negative thoughts can be self-defeating. • Changing negative opinion into positive statements • "Your friend thinks that he is going to fail the spelling test because spelling is hard for him, is that a positive or negative thought?"
Self-motivating statements	• Attributing success to internal reasons • Providing specific feedback to teach students to attribute outcomes to strategy use and effort • "You got a good score on this read because you worked hard and persevered."
Performance assessment	• Direct feedback to help students make connections between the use of strategies and achievement • Performance specific feedback rather than generic "Good job." • "You worked so hard to reach your 5th reading goal. Remember the first time you reached a reading goal? Now you have reached 5!"
Positive labeling	• Making phrase statements about goals and expectations about others. • "You are a hard-working student. Hard-working students keep working when things are difficult to get good grades."
External standards related to performance goals	• Connect students to concrete examples to set goals for task completion. • "Complete this task like you think the smartest person you know would complete it."
Self-reflection	• Students examine an academic situation that was hard for them and identify the thoughts they may have had in that situation. • "Think of a time when something was hard for you in school. What thoughts were going through your head?" • "Think of a time when you aced an assignment. What thoughts did you have?"

success a public and explicit conversation to support autonomous motivation (Wehmeyer et al., 2017). This study sought to extend the evidence of the single-case design research by examining the interaction of an additional component, group size, on the success of the implementation of Data Mountain. In a small group, students have additional opportunities for relatedness (i.e., feeling connected to others in social settings; Deci & Ryan, 2012). While research suggests that students learn more when receiving instruction in a one to one situation as compared with small group (Vaughn & Wanzek, 2014), it is hypothesized that the shared experience of self-monitoring and goal setting between students will increase the effectiveness of the program. The small group delivery provides students with additional models of fluent reading and application of strategies between peers, which has evidence to improve fluency (Chard et al., 2002).

Statement of Purpose. The present study seeks to investigate whether Data Mountain can extend the findings from the original single-case studies (Didion et al., 2020) using a large-scale randomized controlled trial. Specifically, we examine the isolated impact of Data Mountain on students' ORF performance. Methods will compare program group size by using two treatment groups; comparisons will be made to determine whether effects differ between students receiving the instruction in a small group (DM-G) and students receiving the program individually (DM-I). Both treatment conditions will be compared with a comparison condition. Furthermore, research demonstrates self-determination skills can be taught to a wide range of grades and learning profiles (see Algozzine et al., 2001; Didion et al., 2021; Konrad et al., 2007; Reid, 1996; Shogren et al., 2004; Webber et al., 1993; Wood et al., 2005). As such, exploratory analyses of moderating effects of participant characteristics (i.e., grade level, pretest performance, English learner status) are examined. Thus, we sought to explore three research questions:

1. Do Grades 2 through 5 students with or at risk for RD demonstrate increased ORF growth when participating in a self-determined learning program (Data Mountain) as compared with a comparison condition?
2. Does ORF growth accelerate at a higher rate when the program is delivered in a small group (DM-G) as compared with individually (DM-I)?
3. Are there participant characteristics that moderate effects of program or delivery format (i.e., grade level, pretest performance, English learner status)?

Method

Participants

Participants were recruited from two public charter schools in the Southwest region of the United States and both schools

Table 3. Participant Demographic Data.

	DM-G (n = 27) (k = 12)	DM-I (n = 30)	COM (n = 26)	Total (N = 83)	
Student Variable	*n*	*n*	*n*	*n*	%
Gender					
Male	14	17	13	44	53
Female	12	13	14	39	47
Grade					
Second	2	5	5	12	14
Third	6	7	6	19	23
Fourth	6	6	5	17	20
Fifth	13	12	10	35	42
Ethnicity					
Hispanic	22	24	23	69	83
Black	2	2	1	5	6
White	2	1	1	4	5
Other	1	2	0	3	4
FRL	21	22	18	61	73
LD	5	5	6	16	19
Dyslexia services	4	3	8	15	18
Tier 2 or 3	16	20	16	52	63
EL	7	9	9	25	30

Note. DM-G = Data Mountain small group; k = Number of small groups; DM-I = Data Mountain individual; COM = comparison; FRL = free and reduced-price lunch; LD = Learning disability; EL = English learner.

met standards for state-wide accountability. After obtaining university research ethics review approval, Grades 2 through 5 students with or at risk for RD were recruited through a two-step screening process. First, teachers and administration of recruited schools nominated students with persistent difficulties with reading fluency, including students with or without formal LD identification. Then, nominated students were screened using the Test of Word Reading Efficiency–Second Edition (TOWRE-2) and were eligible for the study if they scored below the 25th percentile on at least one of the two subtests. The final sample consisted of 83 students (44 males, 39 females). Both schools used a standardized reading curriculum within a multi-tiered system of support. Most students received supplemental reading instruction: 16 students were identified with an LD and received special education services, 15 students received dyslexia services under Section 504, and 52 students received other targeted academic support (i.e., Tier 2 or Tier 3 services; see Table 3). Based on power analysis estimates blocked on school and assuming moderate effect-size variability ($\sigma_\delta^2 = .10$) and 10% student attrition, the sample was adequately powered for three groups to detect an effect of .50 with a power of .80 (Raudenbush et al., 2011).

Attrition Analysis

In all, 96 students qualified, 83 returned parent consent and assented, 82 completed the pretest battery, 81 began the study, and 74 completed the posttest battery. Two students withdrew from the study during or right after the pretest battery. Of the students that began the study, seven students did not complete the study: four students moved schools and three students elected to withdraw. Of those that did not complete the study, one was identified with an LD, one with dyslexia, and the remaining five were identified as struggling readers receiving Tier 2 or Tier 3 reading intervention. Of those that moved, one was randomized to the DM-G condition, one to the DM-I condition, and two to the comparison condition. Of the students that withdrew, all three were randomized to DM-I. Overall attrition was 10.84%. Differential attrition between Data Mountain and comparison was 1.02% and between DM-I and DM-G was 5.93% (What Works Clearinghouse, Institute of Education Sciences, 2020). Taking into account overall and differential attrition estimates, conservative attrition standards indicate low attrition and expected bias (What Works Clearinghouse, Institute of Education Sciences, 2020). No differences were detected in pretest variables between students that were lost to attrition and included participants, $F(2, 79) = 1.29$, $p = .27$.

Research Design and Procedures

Participants were blocked on school with each grade level acting as a stratum: two-thirds of participants at each grade were randomly assigned to receive instruction with the Data

Mountain program, either designated to receive Data Mountain in small group (DM-G) or individual (DM-I) sessions. The remaining one-third of participants comprised the comparison condition and participated in reading passages only. Students across all conditions met with interventionists 3 to 5 times per week. The procedures used for the reading passages, the training lesson, and the Data Mountain program are described in subsequent sections.

Reading passages. In all conditions, students were presented with a 1-min grade-level ORF passage from FastBridge Learning (Christ et al., 2014). The interventionist read directions and started the timer as the student read the first word. Errors were marked while the student read. At the end of one minute, the interventionist calculated the words read correct per minute (wpm) score. All students had one reading passage session during the pretest assessment battery to serve as a baseline datum point. Comparison students participated in reading passages only and, as such, each of their 15 sessions lasted an average of 3.17 min. No additional reading instruction was delivered by interventionists.

Data Mountain program. The instructional program is made up of one training lesson ($M = 8.75$ min) and 15 scripted sessions. DM-G sessions were on average 12.53 min and DM-I sessions were on average 6.7 min. The total average duration of the program was 3.13 hours for DM-G delivery and was 1.75 hours for DM-I delivery. The Data Mountain program was intended to teach three self-determination components in isolation (i.e., absent of reading instruction): (a) self-monitoring, (b) goal setting, and (c) positive attributions. Implementation differences between the two treatment conditions will be discussed following an overview of the Data Mountain program procedures.

Data Mountain training lesson. All DM-G groups and DM-I students received one training lesson focused on teaching self-monitoring procedures and introducing key vocabulary related to goal setting. This explicit, scripted lesson provided instruction on data, trend, variability, goals, and line graphs. The abstraction of progress was introduced with a line graph and depicted as a "data mountain"—such that, as one makes progress, sometimes performance data increase and sometimes data decrease (variability) like peaks and valleys on a mountain, but we track data to observe performance and evaluate that data are growing similar to the incline of a mountain (trend).

First, the interventionist modeled scripted self-talk by sharing fictionalized data (i.e., running distances and times) via a line graph. Language was modeled around effort and strategy use (e.g., "I'll eat a healthy breakfast before I run") to make the data mountain go higher. The interventionist also modeled how to graph a data point. Next, the students discussed data using a researcher-created worksheet that included a line graph and eight questions pertaining to a scenario of an elementary student's self-monitoring of math scores. The training lesson concluded with conversation about the students' baseline ORF datum point collected during pretest. They were told this was the start of their individual data mountain and that next time they would set a goal to make their mountain "go higher."

Data Mountain sessions. The self-monitoring and goal setting components are the same throughout each of the 15 sessions of the Data Mountain program. Motivation training components built upon one another as the sessions progressed (adapted from Toste et al. [2017, 2019]). During the first two sessions, vocabulary taught in the training lesson are reviewed and students learn to recognize positive and negative thoughts. Sessions 3 through 7 used story vignettes to model how positive and negative thoughts can help readers identify reading strategies taught by their classroom teachers or specialists that may improve reading performance. In these sessions, goal setting and self-monitoring are explicitly tied to reading strategy use and specific strategies that improve reading performance are discussed. Finally, during Sessions 8 through 15, students continued to self-reflect on their reading fluency with focus on the generalization of learned strategies to support ORF progress. In these final sessions, students built their own reading strategy and positive thought bank to use to reach their ORF goals (see Table S1 in the online supplemental material for scope and sequence). Session details are described below.

To begin each session, students completed a motivational check-in to reflect on their current readiness by using a 5-point pictured scale (1 indicated *feeling tired*, while 5 represented *feeling awesome*). Then, students were introduced to a concept of motivation training. Throughout sessions, the interventionist modeled positive self-talk and assisted students in generating self-motivated statements to use during reading passages. This was executed through fictitious scenarios of students that have reading difficulties. Discussion was based around thoughts students may have when encountering a challenging reading task and strategies to accomplish reading goals. A sample scenario might be:

> Jin saw a lot of questions his teacher wanted him to do. He thought to himself, "There are too many. I'll never be able to finish all these questions." Can you tell me if Jin is having a positive or negative thought? (students respond) Now, can you help Jin be successful by giving him some examples of positive thoughts? (students respond) Great! Positive thoughts can be powerful and help us focus on strategies. Can you think of something Jin could do to tackle the questions when he is worried? (student responds; interventionist prompts as necessary) Jin can link his positive statements to his strategies to say things to himself like, "I know I can do all this work because I will stay focused!"

As sessions progressed, students were probed to reflect upon personal academic situations that they had difficulty with and the types of thoughts they had during these instances. Student(s) and interventionist discussed ways to change negative thoughts into positive thoughts and reading strategies they could use during future situations. It was emphasized that negative thoughts indicate we are struggling with a task, but this kind of thinking slows progress down, and positive thoughts remind us to use reading strategies that help us reach our goals. For each student, during the final eight sessions, the interventionist helped identify strengths and weaknesses related to ORF. Students brainstormed previously learned strategy knowledge to produce an individualized list based on their needs. When necessary, the interventionist suggested commonly taught reading strategies to support fluency performance (e.g., sounding out the word, chunking, track with your finger). Then, students determined positive thoughts they could generate during ORF passages. Finally, just prior to reading, students connected their positive thoughts to a reading strategy to generate positive strategic statements (e.g., "I know I can do it because I will sound out difficult words").

Following the motivation training, each student reviewed their wpm line graph from previous sessions and discussed goals. The goal for each student was their highest wpm score plus one more word. The goal was teacher-directed to prevent the elementary students from setting long term goals that were not achievable, which in turn could discourage students' progress. While the aim for attaining personal best goals was directed by the teacher, students led the process of establishing the daily wpm goal. On the graphed ORF data, each student identified their highest datum point and added one word to make their daily goal. Then, the interventionist provided students their assigned ORF passage with a pre-marked star to highlight the location of their goal to make their data mountain "go up."

After that, the interventionist read the scripted directions and the student read the timed passage. At the end of 1 min, the interventionist calculated the wpm score. Then, the student plotted their datum point on their paper line graph, with help from the interventionist. After the datum was graphed and connected to the previous point, the interventionist and student(s) conferenced on their achievement and whether the data increased, decreased, or remained stable. Students evaluated whether or not the selected strategy supported their ORF performance. For instance, if the student did not meet their goal, the interventionist discussed with the student if they thought their strategy was helpful in improving their ORF performance. In this case, students were prompted to consider using a different strategy on their next session. When goals were met, descriptive praise statements were used that connected goal success to strategy use.

Data Mountain Small Group

The procedures and script of the Data Mountain program were consistent across all students in the Data Mountain conditions (DM-G and DM-I). Instructional delivery to DM-G participants varied slightly since the self-determined learning was occurring in a shared, public space. DM-G groups were made up of two or three grade-level peers. During the Data Mountain training lesson, students were explicitly taught respectful conversation norms and briefly practiced expectations. Students were prompted to encourage each other, assist one another to reframe negative thoughts into positive, and provide one another with example strategies. While individual students were reading ORF passages, the remaining students were directed to silently observe their peer and pay attention to the strategies they noticed. After all students in the group read their ORF passage, students received their wpm score simultaneously and graphing commenced as a group. Students were encouraged to compliment their peers on strategies they observed them using. It was continuously emphasized that data for each student will be variable and that we need to support one another in their overall progress. Probes were randomized in an individual sequence for each participant and no two students in the same group read the same passage on the same day.

Interventionist Training and Fidelity of Implementation

The primary investigator (PI) trained one research assistant (RA) and both served as interventionists. The training included program rationale, explicit directions, and examples on how to deliver each component of the Data Mountain program. A follow-up meeting occurred one week prior to program commencement to observe implementation fidelity levels. Each program interventionist mock-administered various sessions of the program. Procedural fidelity was collected and greater than 90% fidelity was achieved.

All sessions were audio recorded and uploaded to a secure cloud server daily. Across all conditions (DM-G, DM-I, COM), 30% of audio for each participant or group was randomly chosen for implementation fidelity and scored by an additional RA who was not involved in instruction. A 26-item fidelity checklist was developed to assess behaviors related to general procedures, reading passages, self-monitoring, goal setting, and motivational beliefs. The checklist also included a qualitative rating. Components were scored as observed, not observed, or not applicable. The qualitative rating scored interventionists as *highly effective* (3), *somewhat effective* (2), or *ineffective* (1) on their pacing, correction procedures, and promotion of positive behavior. Scores were calculated by dividing the number of items that did occur by the total number of items

observed. The mean implementation adherence score across components, conditions, and interventionists was 97.88% (SD = 2.89). The mean quality score across conditions and interventionists was 2.89 (SD = 0.30) reflecting a highly effective rating.

Data Collection and Measures

Progress monitoring data for ORF was the primary variable of interest and was collected throughout the project as part of typical sessions. For all other measures, participants completed pre- and posttest assessment batteries that included measures of word reading, fluency, and motivation to provide descriptive information of students' performance levels. Other measures of word reading, fluency, and motivation were collected for descriptive purposes only.

Progress monitoring. One measure was used to progress monitor students throughout the program as part of regular sessions, Formative Assessment System for Teachers CBMReading (FastBridge Learning; Christ et al., 2014). These 20 ORF grade-level probes were randomized in an individual sequence for each participant (DM-G, DM-I, and comparison) to help control for effects that could be attributable to probe difficulty. For Grades 2 through 5, alternate form reliabilities range from .75 to .83 (Christ et al., 2014). In the present sample, the correlation between pretest FastBridge Learning passages and Dynamic Indicators of Basic Early Literacy Skills (DIBELS) ORF was .73.

Word reading. DIBELS ORF (Good et al., 2001), similar to the progress monitoring measures, was administered pre- and post- test. Three grade-level passages were given in one sitting and a mean wpm score is reported. Also, the TOWRE-2 was administered during the screening phase, but it also served as a measure of word reading for pre- and posttest assessment. Developers report overall average alternate-form reliabilities for subtests are .91 and .92 (Torgesen et al., 2012).

Fluency. Students were also given the Test of Silent Reading Efficiency and Comprehension (TOSREC; Wagner et al., 2010) as a measure of ORF. The TOSREC is a 3-min sentence verification measure of both silent reading fluency and comprehension. The raw score is the number of correct responses minus the number of incorrect responses. Reported alternate form reliability coefficients range from .86 to .95 (Wagner et al., 2010).

Motivation. Motivation was assessed using two measures: Motivations for Reading Questionnaire (MRQ; Wigfield & Guthrie, 1997) and Reading Attribution Scale (RAS; Shell et al., 1995 and adapted by Berkeley et al. [2011]). The MRQ is a 54-item survey that taps 11 motivation constructs. Each item has four possible points on a Likert-type scale (1 = *very different from me* to 4 = *a lot like me*). The summary score is reported with higher scores representing strong agreement with motivational processes (Wigfield et al., 1996). For the present sample, Cronbach's alpha was calculated at pretest and demonstrated good internal consistency (α = .69). The RAS consists of seven pairs of statements, one for success (e.g., "When I don't understand what I read, it is because I worked hard") and one for failure (e.g., "When I don't understand what I read, it is usually because I didn't work hard") for targeted attributions. Each item uses a 5-point Likert-type scale (1 = *never true* to 5 = *always true*). Subscale totals range from 14 to 35. Higher scores ($>$ 21) suggest high attributions for internal variables and low attributions for external variables, and lower scores ($<$ 21) indicate low attributions for internal variables and high attributions for external (Berkeley et al., 2011). For the present sample, Cronbach's alpha was calculated at pretest and demonstrated good internal consistency (α = .89). Each item of the MRQ and RSA was read aloud to students to maintain standardization and ensure comprehension.

Social validity. During the posttest battery, social validity data were collected from all participating students using a researcher-developed survey. This 8-item survey required students to rate how statements pertain to them using a 3-point picture scale: not at all, sometimes, and always. Items included statements about the usefulness and likability of Data Mountain, as well as attribution statements. The score is reported as a mean score for each item.

Data Analysis Plan

Hierarchical linear modeling (HLM) uses a set of techniques to examine individual growth (Raudenbush & Bryk, 2002). This type of linear model provides both an intercept and a slope, which is important to evaluate the effect of the Data Mountain program on ORF, as well as its effect on ORF growth over time. Visual inspection of the individual students' graphs concluded that a linear growth model was appropriate (Raudenbush & Bryk, 2002). Full maximum likelihood estimation was used. The multilevel model contained three levels not cross-classified: Level 1 represents the variability in individual student growth over time (within-student), Level 2 represents the variability around student growth (between-student) within a classroom and Level 3 represents the variability around some classroom mean. The students' reading fluency performance (wpm) is nested within individual students nested within classrooms; therefore, a time variable (ati) was added to the Level 1 model. First, the unconditional model examined whether slopes showed significant growth. Next, a conditional

model examined possible differences in growth based on receiving the Data Mountain program and comparison students. Then, a conditional model examined differences in growth between DM-G and DM-I students only. Finally, a conditional model examined possible differences in the growth based on group membership (DM-G, DM-I, comparison) with a covariate (pretest performance) and moderators of grade level and EL status. TOWRE-2 (pretest performance) total scores were grand mean centered so the adjusted means could be interpreted. Group membership, grade level, and EL status were modeled as fixed effect as they are variables that do not change over time. Intercept, slope, and pretest performance were modeled as random effects. Time was reverse coded (session 15 = 0; baseline session = −15) to determine the overall effect at the end of the study.

The unconditional model is presented as follows:

$$Y_{tij} = \pi_{0ij} + \pi_{1ij}\alpha_{ti} + e_{tij}$$

$$\pi_{0ij} = \beta_{00j} + r_{0ij} \qquad \beta_{00j} = \gamma_{000} + u_{00j}$$
$$\pi_{1ij} = \beta_{10j} + r_{1ij} \qquad \beta_{10j} = \gamma_{100} + u_{10j}$$

where Y_{tij} is the ORF score observed for an individual student i in classroom j at time t, π_{0ij} is the intercept at week 15 for student i in classroom j, π_{1ij} is the linear slope representing reading fluency growth over time (for classroom j) and e_{tij} is the error variance of $student_{ij}$ at time, t. The error effects are normally distributed with a mean of 0 and a variance of σ^2. β_{00j} is the intercept representing the mean ORF score for all participants at week 15 (time 0) in classroom j. β_{10j} is the slope representing the average growth rate of all participants in classroom j. r_{0ij} and r_{1ij} are the error variance for mean and slope of $classroom_j$, respectively. γ_{000} is the grand mean intercept and γ_{100} is the grand mean slope. u_{00j} and u_{10j} are the deviation of the mean of $classroom_j$ from the grand mean and assumed that these effects are normally distributed with a mean of 0 and a variance of τ.

The conditional multilevel model for group membership, grade level, pretest performance, and EL status will be represented as follows:

$$Y_{tij} = \pi_{0ij} + \pi_{1ij}\alpha_{ti} + e_{tij}$$

$$\begin{aligned}\pi_{0ij} &= \beta_{00j} + \beta_{01j}(group\ membership) \\ &\quad + \beta_{02j}(grade) + \beta_{03j}\left(\overline{TOWREpre}_j - \overline{TOWREpre}\right) \\ &\quad + \beta_{04j}(EL) + r_{0ij} \\ \pi_{1ij} &= \beta_{10j} + \beta_{11j}(group\ membership) \\ &\quad + \beta_{12j}(grade) + \beta_{13j}\left(\overline{TOWREpre}_j - \overline{TOWREpre}\right) \\ &\quad + \beta_{14j}(EL) + r_{1ij}\end{aligned}$$

$$\beta_{00j} = \gamma_{000} + u_{00j} \qquad \beta_{10j} = \gamma_{110} + u_{10j}$$
$$\beta_{01j} = \gamma_{010} \qquad \beta_{11j} = \gamma_{110}$$
$$\beta_{02j} = \gamma_{020} \qquad \beta_{12j} = \gamma_{120}$$
$$\beta_{03j} = \gamma_{030} + u_{03j} \qquad \beta_{13j} = \gamma_{130} + u_{13j}$$
$$\beta_{04j} = \gamma_{040} \qquad \beta_{14j} = \gamma_{140}$$

where the notations are interpreted the same as the unconditional model, but also demonstrate the conditional effect of the independent variables (group membership, grade level, pretest performance, EL status). Categorical variables such as group membership, grade level, and EL status were not centered. Group membership was dummy coded as each Data Mountain condition versus the comparison condition (reference group). Finally, pseudo effect sizes were calculated for the conditional model using the following formula: $d = 2t / \sqrt{df}$.

Results

Table 4 presents the pre- and posttest means by condition on all assessments. No significant differences between conditions were detected on any of the following variables. First, to determine baseline equivalence, chi-square analyses were conducted for categorical variables (i.e., FRL, EL, LD, dyslexia, Tier 2 services, gender). Then, one-way ANOVA was conducted to compare students' scores on FastBridge wpm mean, DIBELS wpm mean, TOWRE-2, TOSREC, MRQ, and RAS. These differences were insignificant.

Sensitivity Analysis and Assumption Adherence

A series of sensitivity analyses of the final model were conducted for various cases. First, since HLM is equipped to handle missing data at Level 1, all data from students that moved or withdrew were included in the overall analysis. In HLM, each session for individual students is treated as a separate case so only missing data points are excluded from analysis and not the whole individual with missing data. The final model was run excluding participants lost to attrition, and results indicated that there were no changes in p values for intercept, slope, and moderating variables. Residual analyses were conducted to check model fit. Analyses indicated that the Level 1 error structure is normally and independently distributed with a mean of 0 and a variance that is constant across individuals in the population. Residuals were bivariate and were approximately normally distributed. Scatterplots of wpm scores did not reveal outliers or influential observations.

Unconditional Model

In sum, 1,296 observations at Level 1, 81 included participants at Level 2, and 11 reading classrooms at Level 3 were included in the model. The unconditional model illustrated

Table 4. Pre- and Posttest Means and Standard Deviations for All Groups and All Measures.

	Pretest						Posttest					
	DM-G (n = 26)		DM-I (n = 29)		COM (n = 27)		DM-G (n = 25)		DM-I (n = 25)		COM (n = 24)	
Measure	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
FB WPM	77.92	(39.62)	76.00	(40.01)	79.50	(32.15)	103.64	(30.96)	108.16	(41.89)	87.46	(34.69)
DIBELS WPM	65.38	(31.51)	59.52	(31.51)	57.44	(28.47)	76.36	(33.81)	75.15	(32.59)	65.74	(27.67)
TOWRE	78.12	(10.67)	78.57	(9.26)	75.00	(8.44)	83.04	(9.70)	84.79	(10.89)	77.88	(11.28)
TOSREC	80.50	(14.06)	79.31	(15.41)	78.81	(16.19)	85.16	(16.01)	83.33	(13.98)	84.17	(13.50)
MRQ	153.36	(19.85)	150.03	(36.06)	144.78	(18.02)	140.12	(38.06)	128.13	(67.30)	121.56	(48.33)
RAS	40.50	(8.28)	38.83	(10.98)	40.74	(12.00)	39.44	(9.09)	39.52	(11.99)	39.46	(7.48)

Note. DM-G = Data Mountain small group; DM-I = Data Mountain individual; COM = comparison; FB = FastBridge; DIBELS = Dynamic Indicators of Basic Early Literacy Skills; TOWRE = Test of Word Reading Efficiency; TOSREC = Test of Silent Reading Efficiency and Comprehension; MRQ = Motivation for Reading Questionnaire; RAS = Reading Attribution Scale.

the average wpm score at session 15 across all participants and classrooms was 96.09 (t = 11.13, $p < .001$) and students increased their wpm by 1.40 words each session (t = 10.34, $p < .001$). The variance in end wpm score and slope suggest variability across the participants. We can reject the null and conclude that participants varied significantly in their wpm scores and growth rates (see Table 5). Further examination of variables hypothesized to explain this variation is necessary.

Data Mountain Effects

Data Mountain versus comparison. To answer the primary research question to understand if second through fifth grade students with or at risk for RD demonstrated increased ORF growth when participating in Data Mountain as compared with the comparison participants, a conditional model was run with group membership (Data Mountain versus comparison) as a moderating variable (see Table 5). Results indicated that at the end of the study, the average wpm score for comparison students across conditions and grades was 73.28 (t = 6.02, $p < .001$). Students in Data Mountain conditions (both DM-G and DM-I) read 30.57 more words than comparison students (t = 3.43, p = .006). The average growth rate for comparison students was 0.59 words each session (t = 3.39, p = .007). Data Mountain participants increased at a rate of 1.09 more words than comparison (t = 5.018, $p < .001$). To calculate the proportion of variance explained by Data Mountain the following equations were used for wpm scores intercept $\frac{\tau_{00^{unconditional}} - \tau_{00^{conditional}}}{\tau_{00^{unconditional}}}$ and for slope $\frac{\tau_{11^{unconditional}} - \tau_{11^{conditional}}}{\tau_{11^{unconditional}}}$. Results indicated that 29% of variation in participants reading scores and 63% of variation in growth rate is due to Data Mountain.

DM-G versus DM-I. To understand differences in delivery format (DM-G versus DM-I) on growth rate, a conditional model was run with Data Mountain students only (see Table 5). Comparison students were excluded from the analysis. Results indicated that at the end of the study, the average wpm score for DM-G students across grades was 103.22 (t = 10.41, $p < .001$). Students in the DM-I condition read 104.77 words at session 15 (t = 3.43, p = .87). The average growth rate for DM-G students was 1.47 words each session (t = 6.66, $p < .001$). DM-I participants increased at a rate of 0.44 more words than the DM-G students (t = 1.68, p = .12).

Final Conditional Model

Intercept. A conditional model with all covariates and moderating variables was run to answer the third research question (see Table 5). This model allowed for the examination of differences in group membership and co-varying effects of pretest performance and the moderating effects of grade-level and EL status. Results of this analysis indicated that, at the end of the study, the mean wpm score for fifth grade EL students in the comparison condition with the sample average total score on the TOWRE-2 was 108.11(t = 19.85, $p < .001$). Multiple models were run with different grade levels as the reference group to evaluate all pairwise comparisons. Holding all other variables constant, second grade students read an average of 73.23 words less than fifth grade students (t = −9.72, $p < .001$; d = −3.89), 70.2 words less than fourth grade students (t = −8.41, $p < .001$; d = −3.37), and 38.21 words less than third grade students (t = −4.63, $p < .001$; d = −1.85). Third grade students read an average of 35.02 words less than fifth grade students (t = −5.39, $p < .001$; d = −2.15) and 31.99 words less than fourth grade students (t = −4.27, $p < .001$; d = −1.71). Fourth grade students read an average of 3.03 words less than fifth grade students (t = −0.47, p = .65; d = −0.19). Holding all other variables constant, students in the DM-G group read 25.02 more words than comparison students at Session 15 (t = 4.08, $p < .001$; d = 1.63) and DM-I group read 25.86 more

Table 5. Fixed and Random Effects of Data Mountain for the Various Models.

Unconditional model				
Fixed effect	Coefficient	*SE*	*t* ratio	*p* value
Mean status, β_{00}	96.09	8.56	11.13	<0.001
Mean growth rate, β_{10}	1.40	0.14	10.34	<0.001
Random effect	Variance component	*df*	χ^2	*p* value
End status, r_{oj}	1,065.11	70	2,888.08	<0.001
Growth rate, r_{1j}	0.52	70	186.06	<0.001
Level-1 error, e_{ti}	103.14			
Conditional model with moderating effects of data mountain				
Fixed effect	Coefficient	*SE*	*t* ratio	*p* value
Model for initial status, π_{0i}				
BASE, β_{00}	73.28	12.14	—	—
Data Mountain, β_{01}	30.57	8.83	3.47	0.006
Model for growth rate, π_{1i}				
BASE, β_{10}	0.59	0.15	3.99	0.003
Data Mountain, β_{11}	1.09	0.19	5.84	<0.001
Random effect	Variance component	*df*	χ^2	*p* value
Initial status, r_{oj}	758.46	58	1,747.46	<0.001
Growth rate, r_{1j}	0.19	58	105.39	<0.001
Level-1 error, e_{ti}	103.04			
Results from conditional model with moderating effects of group membership				
Fixed effect	Coefficient	*SE*	*t* ratio	*p* value
Model for initial status, π_{0i}				
BASE, β_{00}	103.22	9.92	—	—
DM-I, β_{01}	1.55	8.86	0.18	0.87
Model for growth rate, π_{1i}				
BASE, β_{10}	1.47	0.22	6.66	<0.001
DM-I, β_{11}	0.44	0.27	1.68	0.12
Random effect	Variance component	*df*	χ^2	*p* value
Initial status,r_{oj}	815.99	33	1,071.44	<0.001
Growth rate, r_{1j}	0.15	33	49.79	0.03
Level-1 error, e_{ti}	110.15			
Results from the final model				
Fixed effect	Coefficient	*SE*	*t* ratio	*p* value
Model for initial status, π_{0i}				
BASE, β_{00}	108.11	5.45	—	—
SECOND, β_{01}	−73.23	7.54	−9.72	<0.001
THIRD, β_{02}	−35.02	6.50	−5.39	<0.001
FOURTH, β_{03}	−3.03	6.54	0.47	0.65
DM-G β_{04}	25.02	6.14	4.08	<0.001
DM-I, β_{05}	25.86	6.00	4.31	<0.001
TOWRE, β_{06}	1.90	0.26	7.23	<0.001
EL, β_{07}	−10.78	5.33	−2.02	0.054

(continued)

Table 5. (continued)

Fixed effect	Coefficient	*SE*	*t* ratio	*p* value
Model for growth rate, π_{1i}				
BASE, β_{10}	0.80	0.23	—	—
SECOND, β_{11}	−0.51	0.31	−1.67	0.11
THIRD, β_{12}	−0.11	0.29	−0.38	0.70
FOURTH, β_{13}	0.24	0.31	0.80	0.43
DM-G, β_{14}	0.85	0.20	4.28	<0.001
DM-I, β_{15}	1.29	0.20	6.51	<0.001
TOWRE, β_{16}	0.01	0.009	1.27	0.23
EL, β_{17}	−0.17	0.18	−0.96	0.35
Random effect	**Variance component**	***df***	**χ^2**	***p* value**
Initial status, r_{0j}	443.27	53	1,285.97	<0.001
Growth rate, r_{1j}	0.16	53	104.54	<0.001
Level-1 error, e_{ti}	103.08			

Note. See Tables S3 and S4 in the online supplemental materials for model output with different grade-level reference groups. DM-I = Data Mountain individual; DM-G = Data Mountain small group; TOWRE = Test of Word Reading Efficiency; TOWRE variable was grand mean centered; EL = English learners.

words than comparison students at Session 15 ($t = 4.31$, $p < .001$; $d = 1.72$). Holding all other variables constant, the amount the TOWRE-2 score increased by 1 unit, students end wpm score is greater by 1.9 words and this difference is significant in the population ($t = 7.23$, $p < .001$; $d = 4.58$). Finally, holding all other variables constant, EL students' wpm score is 10.78 words less at session 15 and this difference was not significant in the population ($t = -2.02$, $p = .05$; $d = -0.81$).

Slope. At the end of the study, the mean growth rate for fifth grade, EL students in the comparison condition with the sample average total score on the TOWRE-2 was 0.80 words each session ($t = 3.47$, $p < .01$). Holding all other variables constant, for each session second grade students' mean growth rate was 0.51 words less than that of fifth grade students ($t = -1.66$, $p = .11$; $d = -0.67$), 0.75 words less than that of fourth grade students ($t = -2.19$, $p = .04$; $d = -0.87$), and 0.39 words less than that of third grade students ($t = -1.2$, $p = .24$; $d = -0.48$). Third grade students' mean growth rate was 0.11 words less than that of fifth grade students ($t = -0.4$, $p = .70$; $d = -0.15$) and 0.36 words less than that of fourth grade students ($t = -1.09$, $p = .28$; $d. = -0.44$). Fourth grade students' mean growth rate was 0.25 more words than that of fifth grade students ($t = 0.80$, $p = .43$; $d = 0.32$). Holding all other variables constant, DM-G students read 0.85 more words than comparison students and this differed significantly in the population ($t = 4.28$, $p < .001$; $d = 1.71$). Also, students in the DM-I group read 1.29 more words each session than that of comparison students, and this differed significantly in the population ($t = 6.52$, $p < .001$; $d = 2.61$). Holding all other variables constant, the amount the TOWRE-2 score increases by 1 unit, students' growth rate is greater by 0.01 each session, and this difference is not significant in the population ($t = 1.27$, $p = .23$; $d = 0.8$). Finally, holding all other variables constant, EL students' growth rate is 0.17 words less each session than the mean growth rate of non-ELs, and this was not significant in the population ($t = -0.96$, $p = .35$; $d = -0.38$). Using the abovementioned equations to calculate the proportion of variance explained by all predictors in the model indicated that 59% of variation in participants reading scores and 69% of variation in growth rate is due to group membership, grade level, pretest performance, and EL status.

Social Validity

Students rated items with a 3-point scale: *not at all* (1), *sometimes* (2), and *always* (3). All students who completed posttest reported "always" or "sometimes" for every item and no student reported "not at all." The highest scored item was related to attributions, such that students reported that when using Data Mountain, they read more words because they tried hard. Other items with high scores were that students liked using Data Mountain and they wanted to keep using it. The items that scored the lowest were that Data Mountain made them feel smart and that it was easy to use. These items were scored as "sometimes" more frequently (see Table S2 of the online supplemental materials for average social validity scores by item).

Discussion

The purpose of this study was to determine whether the Data Mountain program bolstered the ORF rate of second through fifth graders with or at risk for RD. Three research questions explored the program efficacy. First, do Grades

2 through 5 students with or at risk for RD demonstrate increased ORF growth when participating in the Data Mountain program as compared with a comparison condition? Findings provide evidence that the students who participated in the Data Mountain program outperformed comparison students on ORF and rate of growth. Second, does ORF growth accelerate at a higher rate when the program is delivered in a small group (DM-G) as compared with individually (DM-I)? Results suggest that students performed similarly in both delivery formats. Third, are there participant characteristics that moderate effects of program or delivery format? In sum, no moderating effects were evidenced for growth rate, suggesting results did not differ regardless of grade, pretest levels, or EL status.

Data Mountain Improved Students' Fluency and Rate of Growth

When controlling for grade level, pretest word-reading fluency (TOWRE-2), and EL status, the full, conditional model indicated that DM-G and DM-I students read 25 more wpm at the end of the study as compared with comparison students ($p = .001$). Also, holding all other variables constant, the average rate of growth per session for DM-G students was 1.65 wpm and for DM-I students was 2.09 wpm ($p = .001$) while comparison students' growth rate per session was 0.80 wpm. The average increase Data Mountain students had each session is quite impactful. The growth rate was substantial and significantly impacted students' final wpm score. Based on a nationally representative normative sample of typically-developing students' wpm progress from fall to spring (National Center on Intensive Intervention, 2019), minimal acceptable rates of improvement (ROI) for second, third, fourth, and fifth grade students are 1.5, 1.5, 1.0, and 0.90 words per week, respectively. Also to note, ambitious ROIs are 2.0 words per week for second and third grade students, 1.5 words for fourth grade students, and 1.0 word for fifth grade students (Deno et al., 2001; Fuchs et al., 1993). It should be recognized that Data Mountain students on average performed close to or greater than ambitious grade-level ROIs each session—and they were completing multiple sessions each week, while norms are based on growth per week. This may indicate that educating students to set goals, interpret performance of their self-monitoring data, and attributing success with the use of reading strategies can greatly impact fluency achievement. For elementary students with or at risk for RD, research has indicated that repeated reading, explicit instruction, peer tutoring, modeling, and explicit feedback are associated with improved reading fluency performance (Algozzine et al., 2009; Chard et al., 2002; NRP, 2000; Stevens et al., 2017). Findings from this study demonstrate that teaching self-determination skills in the context of passage reading positively impacts fluency performance.

Self-Determination as a Mechanism for Change

Data Mountain was designed to teach self-determination skills in isolation and findings suggest significant impacts to ORF growth rate. No reading skills or strategies were directly taught in sessions, only the self-determination components in isolation. There are several reasons why self-determination alone positively impacted students' rate of growth. Brief, social-psychological interventions, like Data Mountain, have an impact by targeting students' thoughts, feelings, and beliefs about school, but they do not operate independently (Yeager & Walton, 2011). Instead, they are situated and dependent on contextual variables (Ryan & Deci, 2017; Wehmeyer et al., 2017) such as reading skill knowledge. To read proficiently, students need to build fluency skills (Morgan et al., 2012). Self-determination skills do not replace explicit reading skill instruction but rather students' performance using reading strategies (Berkeley et al., 2011; Didion et al., 2020; Toste et al., 2017). Data Mountain worked in conjunction with the fluency skills and strategies taught by classroom teachers; Data Mountain enhanced students' generalization of existing reading skill knowledge. Targeting students' self-determination without existing reading skills would not have provided the content needed for the self-determination processes to function.

Data Mountain supported the reading strategy instruction provided by classroom teachers and specialists. Data Mountain sessions provided students with repeated opportunities to engage in the same reading fluency task (i.e., read an ORF passage) in which they selected learned strategies to achieve their daily wpm goal. Students may have become more internally motivated as they continuously achieved personal best goals across sessions—they experienced themselves as causal agents as they observed that performance was directly related to their own actions (i.e., the strategies they used; De Charms, 2013). Feedback on whether their strategy use was effective (i.e., goal attainment) was provided through their self-monitoring graph. Goal achievement is an indicator of task mastery and competence within that skill (Diseth, 2011; Pintrich & Schunck, 2002). Continual mastery of challenging tasks helps build a persons' capacity and unique skills thus influencing the likelihood they will engage similarly in future tasks (Ryan & Deci, 2017). Students were more motivated to use reading strategies to attain their fluency goals because they had experiences of success in previous sessions. The strategy discussion included in Data Mountain contributed to helping students understand when to use strategies to improve their ORF (Berkeley et al., 2011; Toste et al., 2017, 2019). Self-determination does not change fluent reading skills but rather their performance using reading strategies.

Group Size

No significant differences in performance for students in the DM-G and DM-I conditions were observed. These findings provide evidence that Data Mountain can be effectively delivered to students in small groups and individually, which has promising implications for the feasibility of using this program in schools. It was hypothesized that students in the DM-G condition would improve at a higher rate than students in DM-I due to the shared learning experience between students that supports autonomous motivation (Wehmeyer et al., 2017). There are possible reasons why the hypothesis regarding group size was not supported. The motivation training components in each session focused on selecting a strategy to use to improve fluency performance, and no instruction or example on how to use this strategy was provided. It would be worth replicating to compare DM-G and DM-I while providing direct reading instruction and modeling specific reading strategies. In this instance, peer modeling may play a more active role (Chard et al., 2002) from the cooperative learning opportunity. In conclusion, the findings from the present study indicate that DM-G and DM-I students had similar improvements in ORF performance. Implementing the program in a small group may be more feasible for teachers given current instructional demands. Small groups are more cost effective, as more students receive the instruction using fewer resources. We recommend the program be used in either delivery format based on teachers' and students' needs.

Moderating Effects

Potential moderators of the Data Mountain program's effect were also examined. End wpm score was significantly moderated by grade level, pre-test performance, and EL status, but these differences were also observed at pretest, such that students in second and third grade, with lower pretest performance, or had EL status performed lower than their reference group. The comparable variable of interest is the rate of growth and results indicated significant differences were not observed across moderating variables except for one grade-level comparison. For all grade-level comparisons, slope differences ranged from 0.11 (fifth vs. third) to 0.75 (second vs. fourth) words each session. Only significant differences were found between second and fourth grade students' ($p = .04$) growth rates; it is possible this is an effect of the sample.

Included students represent a sample from a population of our most vulnerable learners, and results indicated program effects on growth rate were not statistically different. Research has shown that self-determination skills can be taught to students across grade levels with a wide range of disabilities (Algozzine et al., 2001; Didion et al., 2021; Konrad et al., 2007; Reid, 1996; Shogren et al., 2004; Webber et al., 1993; Wood et al., 2005), and results from this analysis indicated growth rates were positive for all subgroups from this sample of students with or at risk for RD. Published findings demonstrate large discrepancies in reading performance between ELs and their monolingual peers (Morgan et al., 2008) and ELs who struggle with reading are documented as having the lowest fluency growth trajectory when compared with students with LD and general education peers (Solari et al., 2014). However, in the current study, ELs' growth rate did not differ significantly from non-ELs with or at risk for RD. Self-determination has been studied less for populations of ELs than non-ELs, but research indicates no differences in self-reported self-determination levels between groups (LeClair et al., 2009). More research is needed to understand if differences in self-determination are present for bilingual students, but results from this study suggest Data Mountain may impact growth rate similarly for ELs and non-ELs with or at risk for RD. These findings should be taken with caution; EL status is not as strong of a moderator compared with a pretest measure of language proficiency. States and districts vary in how ELs are identified and results may not be generalizable to this population as a whole.

Study Limitations

While these findings are promising, various limitations should be discussed. First, we intended to deliver the program three times each week to all conditions. About halfway through the project, due to high absenteeism, all students across conditions began receiving 4 to 5 sessions per week. Based on the methods in the pilot and replication (Didion et al., 2020), dosage per week is not believed to have an effect other than students improved in a shorter amount of time. It cannot be ruled out that students' opportunities to review their performance data impacted their overall outcomes. Also, power did not allow two-way interactions for group membership on pretest performance and EL status. Future studies should use a larger sample to determine whether peer models in DM-G conditions had differential effects on students with lower word-reading fluency performance or EL status. In addition, no data were collected after the intervention ended and it is unknown whether effects were maintained. Subsequent studies should assess maintenance. Finally, we did not collect information from classroom teachers related to the reading strategies they were directly teaching participating students. This information would be helpful to promote the transfer of knowledge from reading instruction to the Data Mountain sessions. It would also provide relevant information to more confidently generalize findings.

Implications for Practice and Future Research

There are several implications for teachers and practitioners. Data should be used to inform individualized instruction for students with persistent reading difficulties (Vaughn

& Wanzek, 2014). There is evidence from the current study that if teachers share performance data with struggling learners, it can have a significant impact on reading fluency performance if students are receiving instruction related to reading fluency strategies. ORF wpm is the most common type of data collected for reading in elementary schools nationwide (Stecker et al., 2008). If teachers used the Data Mountain program alongside their current ORF reading instruction, the implication on growth rate could be impactful. While the Data Mountain program could be implemented alongside progress monitoring, it is not recommended that teachers use the program when progress monitoring scores will be used for placement decisions (e.g., response to intervention, screening).

There are modifications to be considered for future research of Data Mountain. First, language could be modified to not only teach students terms related to data literacy (e.g., trend, variability) but also vocabulary related to graph features. For example, the script should be revised to teach "increase" rather than "up" and "decrease" rather than "down" when describing data. In this way, the program would provide generalization opportunities related to graph knowledge vocabulary outside of mathematics instruction. Second, in the present study, significant gains were observed with little instructional time. It would be interesting to investigate the impact of Data Mountain with additional sessions (e.g., 30 sessions). Psychological processes require time to elicit change because the means through which they work is related to experiences with success and failure (Yeager & Walton, 2011). Third, in the present study, self-determination skills were taught absent of reading strategy instruction during intervention sessions. Little instructional time is spent teaching strategies to decode and comprehend text (Swanson & Vaughn, 2010), and there is opportunity within the program to provide this much needed instruction. Future research could control for the reading strategies taught by providing reading instruction alongside program implementation. One avenue would be to train teachers to use the program within their fluency instruction and collect data on the strategy discussion. In addition, research is needed to understand the program's impact on reading outcomes when used alongside evidence-based practices for reading fluency (e.g., repeated reading).

Conclusion

Findings from this randomized controlled trial testing the effects of Data Mountain are favorable. There are potential applications of Data Mountain methods to numerous existing academic and behavior progress-monitoring practices. Elementary teachers and special educators can use the program with their existing ORF strategy instruction. We recommend use alongside current progress-monitoring routines, such as Tier 2 or 3 instruction, special education, and intensive intervention. Future research is needed to understand the extent to which Data Mountain can be effective for students with or at risk for RD.

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Supplemental Material

Supplemental material for this article is available on the *Journal of Learning Disabilities* website with the online version of this article.

References

Albers, C. A., & Hoffman, A. (2012). Using flashcard drill methods and self-graphing procedures to improve the reading performance of English language learners. *Journal of Applied School Psychology*, *28*(4), 367–388. https://doi.org/10/1080/15377903.2012/731365

Algozzine, B., Browder, D., Karvonen, M., Test, D. W., & Wood, W. M. (2001). Effects of interventions to promote self-determination for individuals with disabilities. *Review of Educational Research*, *71*(2), 219–277. https://doi.org/10.3102/00346543011002219

Algozzine, B., Marr, M. B., Kavel, R. L., & Dugan, K. K. (2009). Using peer coaches to build oral reading fluency. *Journal of Education for Students Placed at Risk*, *14*(3), 256–270. https://doi.org/10.1080/10824660903375735

Berkeley, S., Mastropieri, M. A., & Scruggs, T. E. (2011). Reading comprehension strategy instruction and attribution retraining for secondary students with learning and other mild disabilities. *Journal of Learning Disabilities*, *44*(1), 18–32. https://doi.org/10.177/002219410371677

Chard, D. J., Vaughn, S., & Tyler, B. J. (2002). A synthesis of research on effective interventions for building reading fluency with elementary students with learning disabilities. *Journal of Learning Disabilities*, *35*(5), 386–406. https://doi.org/10.1177/00222194020350050101

Christ, T. J., Arañas, Y. A., Kember, J. M., Kiss, A. J., McCarthy-Trentman, A., Monaghen, B. D., & White, M. J. (2014). *Formative Assessment System for Teachers technical manual: CBMReading*. Formative Assessment System for Teachers.

Connor, C. M., Ponitz, C. C., Phillips, B. M., Travis, Q. M., Glasney, S., & Morrison, F. J. (2010). First graders' literacy

and self-regulation gains: The effect of individualizing student instruction. *Journal of School Psychology*, *48*(5), 433–455. https://doi.org/10.1016/j.jsp.2010.06.003

De Charms, R. (2013). *Personal causation: The internal affective determinants of behavior*. Routledge.

Deci, E. L., & Ryan, R. M. (2012). Motivation, personality, and development within embedded social contexts: An overview of self-determination theory. In R. M. Ryan (Ed.), *The Oxford handbook of human motivation* (pp. 85–107). Oxford University Press.

Deno, S. L., Fuchs, L. S., Marston, D., & Shin, J. (2001). Using curriculum-based measurements to establish growth standards for students with learning disabilities. *School Psychology Review*, *30*(4), 507–524. https://doi.org/10.1080/02796015.2001.12086131

Didion, L., Toste, J. R., & Benz, S. A. (2020). Self-determination to increase oral reading fluency for third grade students with and at risk for reading disabilities: Pilot and replication single-case designs. *Learning Disabilities Research and Practice*, *35*(4), 218–231. https://doi.org/10.1111/ldrp.12234

Didion, L., Toste, J. R., Benz, S. A., & Shogren, K. A. (2021). Components of self-determination integrated within reading interventions for elementary students with learning disabilities: A research synthesis. *Learning Disabilities Quarterly*. https://doi.org/10.1177/0731948721989328

Diseth, Å. (2011). Self-efficacy, goal orientations and learning strategies as mediators between preceding and subsequent academic achievement. *Learning and Individual Differences*, *21*(2), 191–195. https://doi.org/10.1016/j.lindif.2011.01.003

Esteves, K. J., & Whitten, E. (2011). Assisted reading with digital audiobooks for students with reading disabilities. *Reading Horizons*, 51(1), 21–40.

Fuchs, L. S., Fuchs, D., Hamlett, C. L., Walz, L., & Germann, G. (1993). Formative evaluation of academic progress: How much growth can we expect? *School Psychology Review*, *22*, 27–27. https://doi.org/10.1080/02796015.1993.12085636

Good, R. H., III, Kaminski, R. A., Simmons, D., & Kame'enui, E. J. (2001). Using Dynamic Indicators of Basic Early Literacy Skills (DIBELS) in an outcomes-driven model: Steps to reading outcomes. *OSSC Bulletin*, *44*(1), n1.

Guzman, G., Goldberg, T. S., & Swanson, H. L. (2018). A meta-analysis of self-monitoring on reading performance of K-12 students. *School Psychology Quarterly*, *33*(1), 160–168. https://doi.org/10.1037/spq0000199

Hernandez, D. J. (2011). *Double jeopardy: How third-grade reading skills and poverty influence high school graduation*. Annie E. Casey Foundation.

Kent, S., Wanzek, J., Petscher, Y., Al Otaiba, S., & Kim, Y. S. (2014). Writing fluency and quality in kindergarten and first grade: The role of attention, reading, transcription, and oral language. *Reading and Writing*, *27*(7), 1163–1188. https://doi.org/10.1111/j.1540-5826.2012.00351.x

Konrad, M., Fowler, C. G., Walker, A. R., Test, D. W., & Wood, W. M. (2007). Effects of self-determination interventions on the academic skills of students with learning disabilities. *Learning Disability Quarterly*, *30*(2), 89–113. https://doi.org/10.2307/30035545

LeClair, C., Doll, B., Osborn, A., & Jones, K. (2009). English language learners' and non–English language learners' perceptions of the classroom environment. *Psychology in the Schools*, *46*(6), 568–577. https://doi.org/10.1002/pits.20398

Lenz, B. K., Ellis, E., & Scanlon, D. (1996). *Teaching learning strategies to adolescents and adults with learning disabilities*. Pro-Ed.

Margolis, H., & McCabe, P. P. (2006). Motivating struggling readers in an era of mandated instructional practices. *Reading Psychology*, *27*(5), 435–455. https://doi.org/10.1080/02702710600848023

Morgan, P. L., Farkas, G., & Hibel, J. (2008). Matthew effects for whom? *Learning Disability Quarterly*, *31*(4), 187–198. https://doi.org/10.2307/25474651

Morgan, P. L., Sideridis, G., & Hua, Y. (2012). Initial and over-time effects of fluency interventions for students with or at-risk for disabilities. *The Journal of Special Education*, *46*(2), 94–116. https://doi.org/10.1177/0022466910398016

Murray, M. S., Munger, K. A., & Clonan, S. M. (2012). Assessment as a strategy to increase oral reading fluency. *Intervention in School and Clinic*, *47*(3), 144–151. https://doi.org/10.1177/1053451211423812

National Assessment of Educational Progress. (2019). *The nation's report card: 2017 mathematics and reading assessments*. http://www.nationsreportcard

National Center on Intensive Intervention. (2019). *Academic progress monitoring tools chart*. https://charts.intensiveintervention.org/progress-monitoring/fast-cbmreading-reading-4

National Reading Panel. (2000). *Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction* (National Institute of Health Pub. No. 00-4769). National Institute of Child Health and Human Development.

Nelson, J. M., & Manset-Williamson, G. (2006). The impact of explicit, self-regulatory reading comprehension strategy instruction on the reading-specific self-efficacy, attributions, and affect of students with reading disabilities. *Learning Disability Quarterly*, *29*, 213–230. https://doi.org/10.2307/30035507

Pikulski, J. J., & Chard, D. J. (2005). Fluency: Bridge between decoding and reading comprehension. *The Reading Teacher*, *58*(6), 510–519. https://doi.org/10.1598/RT.58.6.2

Pintrich, P. R., & Schunck, D. H. (2002). *Motivation in education*. Merrill Prentice Hall.

Raudenbush, S. W., Bloom, H., Spybrook, J., & Martinez, A. (2011). *Optimal design software for multi-level and longitudinal research* (Version 3.01) [Software]. www.wtgrantfoundation.org

Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods* (Vol. 1). SAGE.

Reid, R. (1996). Research in self-monitoring with students with learning disabilities: The present, the prospects, the pitfalls. *Journal of Learning Disabilities*, *29*(3), 317–331. https://doi.org/10.1177/002221949602900311

Reschly, A. L., Busch, T. W., Betts, J., Deno, S. L., & Long, J. D. (2009). Curriculum-based measurement oral reading as an indicator of reading achievement: A meta-analysis of the correlational evidence. *Journal of School Psychology*, *47*(6), 427–469. https://doi.org/10.1016/j.jsp.2009.07.001

Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness*. Guilford Press.

Samuels, S. J. (1979). The method of repeated readings. *The Reading Teacher*, *32*(4), 403–408.

Shell, D., Colvin, C., & Bruning, R. (1995). Self-efficacy, attribution and outcome expectancy mechanisms in reading and writing achievement: Grade-level and achievement-level differences. *Journal of Educational Psychology*, *87*, 386–398.

Shin, J., & McMaster, K. (2019). Relations between CBM (oral reading and maze) and reading comprehension on state achievement tests: A meta-analysis. *Journal of School Psychology*, *73*, 131–149. https://doi.org/10.1016/j.jsp.2019.03.005

Shogren, K. A., Faggella-Luby, M. N., Bae, S. J., & Wehmeyer, M. L. (2004). The effect of choice-making as an intervention for problem behavior: A meta-analysis. *Journal of Positive Behavior Interventions*, *6*(4), 228–237. https://doi.org/10.1177/10983007040060040401

Shogren, K. A., Little, T. D., & Wehmeyer, M. L. (2017). Human agentic theories and the development of self-determination. In M. L. Wehmeyer, K. A. Shogren, T. D. Little, & S. J. Lopez (Eds.), *Development of self-determination through the life course* (pp. 17–26). Springer. https://doi.org/10.1007/978-94-024-1042-6

Shogren, K. A., Wehmeyer, M. L., Palmer, S. B., Forber-Pratt, A. J., Little, T. J., & Lopez, S. (2015). Causal agency theory: Reconceptualizing a functional model of self-determination. *Education and Training in Autism and Developmental Disabilities*, *50*, 251–263.

Solari, E. J., Petscher, Y., & Folsom, J. S. (2014). Differentiating literacy growth of ELL students with LD from other high-risk subgroups and general education peers: Evidence from grades 3–10. *Journal of Learning Disabilities*, *47*(4), 329–348. https://doi.org/10.1177/0022219412463435

Solís, M., Scammacca, N., Barth, A. E., & Roberts, G. J. (2017). Text-based vocabulary intervention training study: Supporting fourth graders with low reading comprehension and learning disabilities. *Learning Disabilities*, *15*(1), 103–115.

Stang, K. K., Carter, E. W., Lane, K. L., & Pierson, M. R. (2009). Perspectives of general and special educators on fostering self-determination in elementary and middle schools. *The Journal of Special Education*, *43*, 94–106. https://doi.org/10.1177/0022466907313452

Stecker, P. M., Fuchs, D., & Fuchs, L. S. (2008). Progress monitoring as essential practice within response to intervention. *Rural Special Education Quarterly*, *27*(4), 10–17.

Stevens, E. A., Walker, M. A., & Vaughn, S. (2017). The effects of reading fluency interventions on the reading fluency and reading comprehension performance of elementary students with learning disabilities: A synthesis of the research from 2001 to 2014. *Journal of Learning Disabilities*, *50*(5), 576–590. https://doi.org/10.1177/0022219416638028

Stipek, D. J., & Weisz, J. R. (1981). Perceived personal control and academic achievement. *Review of Educational Research*, *51*(1), 101–137. https://doi.org/10.3102/00346543051001101

Swanson, E. A. (2008). Observing reading instruction for students with learning disabilities: A synthesis. *Learning Disability Quarterly*, *31*(3), 115–133. https://doi.org/10.1002/pits.20484

Swanson, E. A., & Vaughn, S. (2010). An observation study of reading instruction provided to elementary students with learning disabilities in the resource room. *Psychology in the Schools*, *47*(5), 481–492. https://doi.org/10.1002/pits.20484

Torgesen, J. K., Wagner, R. K., & Rashotte, C. A. (2012). *TOWRE-2 examiner's manual*. https://www.linguisystems.com/Products/13911/towre2-examiners-manual.aspx

Toste, J. R., Capin, P., Vaughn, S., Roberts, G. J., & Kearns, D. M. (2017). Multisyllabic word-reading instruction with and without motivational beliefs training for struggling readers in the upper elementary grades: A pilot investigation. *The Elementary School Journal*, *117*(4), 593–615. https://doi.org/10.1086/691684

Toste, J. R., Capin, P., Williams, K. J., Cho, E., & Vaughn, S. (2019). Replication of an experimental study investigating the efficacy of a multisyllabic word reading intervention with and without motivational beliefs training for struggling readers. *Journal of Learning Disabilities*, *52*(1), 45–58. https://doi.org/10.1177/0022219418775114

Toste, J. R., Didion, L., Peng, P., Filderman, M. J., & McClelland, A. M. (2020). A meta-analytic review of the relations between motivation and reading achievement for K–12 students. *Review of Educational Research*, *90*(3), 420–456. https://doi.org/10.3102/0034654320919352

Valås, H. (2001). Learned helplessness and psychological adjustment II: Effects of learning disabilities and low achievement. *Scandinavian Journal of Educational Research*, *45*(2), 101–114.

Vaughn, S., Levy, S., Coleman, M., & Bos, C. S. (2002). Reading instruction for students with LD and EBD: A synthesis of observation studies. *The Journal of Special Education*, *36*(1), 2–13. https://doi.org/10.1177/00224669020360010101

Vaughn, S., & Wanzek, J. (2014). Intensive interventions in reading for students with reading disabilities: Meaningful impacts. *Learning Disabilities Research & Practice*, *29*(2), 46–53. https://doi.org/10.1111/ldrp.12031

Wagner, R. K., Torgesen, J. K., Rashotte, C. A., & Pearson, N. A. (2010). *Test of silent reading efficiency and comprehension*. Pro-Ed.

Watson, M., Fore, C., III, & Boon, R. T. (2009). Corrective feedback of oral decoding errors for diverse learners with reading disabilities: The effects of two methods on reading fluency. *International Journal of Special Education*, *24*(1), 20–31.

Wayman, M., Wallace, T., Wiley, H. I., Tichá, R., & Espin, C. A. (2007). Literature synthesis on curriculum-based measurement in reading. *The Journal of Special Education*, *41*(2), 85–120. https://doi.org/10.1177/00224669070410020401

Webber, J., Scheuermann, B., McCall, C., & Coleman, M. (1993). Research on self-monitoring as a behavior management technique in special education classrooms: A descriptive review. *Remedial and Special Education*, *14*(2), 38–56. https://doi.org/10.1177/074193259301400206

Wehmeyer, M. L., Sands, D. J., Doll, B., & Palmer, S. (1997). The development of self-determination and implications for educational interventions with students with disabilities. *International Journal of Disability, Development and Education*, *44*(4), 305–332. https://doi.org/10.1080/0156655970440403

Wehmeyer, M. L., Shogren, K. A., Toste, J. R., & Mahal, S. (2017). Self-determined learning to motivate struggling learners in reading and writing. *Intervention in School and Clinic*, *52*(5), 295–303. https://doi.org/10.1177/1053451216676800

What Works Clearinghouse. (2020). *WWC standards brief*. https://ies.ed.gov/ncee/wwc/Docs/referenceresources/wwc_brief_attrition_080715

Wigfield, A., & Guthrie, J. T. (1997). Relations of children's motivation for reading to the amount and breadth or their reading. *Journal of Educational Psychology*, *89*(3), 420–432. https://doi.org/10.1037/0022-0663.89.3.420

Wigfield, A., Guthrie, J. T., & McGough, K. (1996). *A questionnaire measure of children's motivations for reading* (Instructional Resource No. 22). National Reading Research Center, University of Georgia and University of Maryland.

Wood, W. M., Fowler, C. H., Uphold, N., & Test, D. W. (2005). A review of self-determination interventions with individuals with severe disabilities. *Research and Practice for Persons With Severe Disabilities*, *30*(3), 121–146. https://doi.org/10.2511/rpsd.30.3.12

Yeager, D. S., & Walton, G. M. (2011). Social-psychological interventions in education: They're not magic. *Review of Educational Research*, *81*(2), 267–301. https://doi.org/10.3102/0034654311405999

Yeo, S. (2010). Predicting performance on state achievement tests using curriculum-based measurement in reading: A multilevel meta-analysis. *Remedial and Special Education*, *31*(6), 412–422. https://doi.org/10.1177/0741932508327463

Zheng, C., Gaumer Erickson, A., Kingston, N. M., & Noonan, P. M. (2014). The relationship among self-determination, self-concept, and academic achievement for students with learning disabilities. *Journal of Learning Disabilities*, *47*(5), 462–474. https://doi.org/10.1177/0022219412469688