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CURRICULUM & TEACHING STUDIES | RESEARCH ARTICLE

The effects of a growth mindset on self-efficacy and motivation

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Abstract: The purpose of this study was to investigate whether a growth mindset intervention would improve adolescent special education students' self-efficacy and motivation. The sample included sixth, seventh, and eighth grade students receiving learning disability services in the area of reading. The study was quasi-experimental in design which included both a comparison group and a treatment group. The treatment group received a growth mindset intervention called Brainology. The Reader Self-Perception Scale 2nd Edition and the Motivation for Reading Questionnaire were used to measure whether there were differences in the mean scores for self-efficacy and motivation in reading. Results suggested that a growth mindset intervention had a significant difference in the motivation, but not self-efficacy, of adolescent special education participants.

The National Assessment of Educational Progress results and high-school dropout rates (Uline & Johnson, 2005) have suggested that some special education students experience low academic performance in the United States. For example, the University of New Hampshire's Institute on Disability (2013) documented 78,653 students who identified as needing special education services who dropped out of school in the United States between 2010 and 2011. Identifying the causes of

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PUBLIC INTEREST STATEMENT

The purpose of this study was to investigate whether a growth mindset intervention called Brainology would improve adolescent special education students' self-efficacy and motivation. The sample included sixth, seventh, and eighth grade students receiving learning disability services in the area of reading in the United States. The treatment group received a growth mindset intervention called Brainology and the comparison group did not. Results suggested that a growth mindset intervention had a significant difference in the motivation, but not the self-efficacy, of adolescent special education participants.

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nonsuccess has been problematic because low academic performance among students with special needs is influenced by several different factors (Rumberger, 2001).

Students who repeatedly fail to achieve become fearful of new challenges and devastated by setbacks (Dweck, 1999, 2006). Finding alternative methods to improve self-efficacy and motivation while facilitating the academic success of special education students may decrease the dropout rate. Dweck's (2006) research indicated that students' beliefs in fixed intelligence might raise their concerns about aptitude while also increasing their anxiety when being challenged. As a result, those students attribute their failures to intelligence, which reinforced a defensive and helpless behavior, worsening their performance. Students with a fixed-intelligence mindset may feel threatened at the notion of their flaws being unmasked because they believe their flaws result in failures. Therefore, they might be unwilling to attempt challenging tasks (Dweck, 1999, 2006). A belief that intelligence was malleable and could improve with effort created a desire for learning, and obstacles were viewed as a natural part of learning (Dweck, 1999). Improving the mindset of special education students may have a positive, long-lasting impact on students' learning and performance (Dweck, 2006).

Because of the rigorous expectations associated with the Common Core State Standards, shared standards adopted by many states in the United States, and high-stakes standardized assessments, all students are required to successfully master difficult concepts. Following the implementation of the Common Core State Standards, the gap widened between students who have reading difficulties and their peers. According to Burris and Aja (2014), students with disabilities of all nationalities, income levels, and backgrounds experienced plunging achievement scores in 2012. In fifth grade, 75% of students with disabilities scored "Below Standard" on the English Language Arts and Literacy Common Core tests. Tabassam and Granger (2002) found that students with disabilities scored drastically lower scores in academic self-efficacy than peers without a disability.

In educational contexts, success is often attributed to high capability and hard work, and failure is credited to low capability and lack of trying (Weiner, 1985). However, students with special needs frequently attributed their failure to internal causes (Bryan, 1986). Consequently, students with special needs may perceive that lack of success in school indicates an inability to succeed academically, or that it is proof that they did not exert enough effort to achieve. Though there is some research that examined the relationship between self-efficacy, motivation, and achievement following students receiving a growth mindset intervention (Saunders, 2013), there is limited research on how growth mindset interventions support adolescent special education students.

1. Related literature

1.1. Mindset
Dweck (1999) explored why certain students enjoyed learning, even though the work was difficult, while other students were anxious or unwilling to attempt tasks that appeared challenging. She developed a theory of mindset with a spectrum ranging from the fixed mindset to the growth mindset. The spectrum illustrated how people could have different mindsets—fixed or growth—toward varying areas within their lives. For example, students with a fixed mindset toward their ability to complete academic tasks may simultaneously experience a growth mindset toward their ability to play baseball. Students with a fixed mindset deem intelligence as a factor that cannot be changed (Dweck, 1999, 2006; Mueller & Dweck, 1998). Normally, students with a fixed mindset saw their failures, whether academic or not, as a reflection of their intelligence. Even more debilitating for students was the combination of exerting effort and still enduring failure; this blend left the fixed mindset students with no other excuse for their failure except perceived lack of intelligence (Dweck, 2006).

Students with a fixed mindset characteristically ignore constructive feedback and feel threatened by the success of their peers (Saunders, 2013). They may blame outside factors for their failure. For instance, if they failed a test, fixed mindset students might blame teachers by

suggesting, "They did not teach us that," or, "That was not on the study guide." As a result, students with a fixed mindset tended to believe that their failure was not due to their lack of skill or determination, but rather the result of other people's actions (Dweck, 2006).

Conversely, students with a growth mindset believed that intelligence was malleable and could change, and through their failures, they learned and grew. Belief in the importance of effort permitted students with a growth mindset to view failure as a motivator that drove them to continue learning (Blackwell, Trzesniewski, & Dweck, 2007; Plaks & Stecher, 2007). Eventually, growth mindset students' persistence and desire to persevere resulted in success (Dweck, 1999, 2006). Furthermore, students with a growth mindset used constructive feedback to improve and learned from the success of others (Saunders, 2013). Dweck (2006) found student improvement even when the feedback was negative. Students with a growth mindset did not blame outside factors for their failures, and they looked for ways to improve on the subsequent assessments. Boosting students' self-esteem through praise did not improve students' motivation and academic success. Feedback from teachers could "convey messages that affect students' opinion of themselves, their motivation, and their achievement" (Dweck, 2006, p. 207). Furthermore, the praise might be interpreted as an indication that their teacher did not perceive that students were capable of accomplishing more (Dweck, 1999).

Hartmann (2013) suggested that special education students tended to possess a more fixed mindset compared to their typical peers. Students requiring special education assistance for a specific learning disability did not achieve with the same propensity as their typical peers (Frederickson, Simmonds, Evans, & Soulsby, 2007). These students were accustomed to receiving failing or otherwise unacceptable grades (Hartmann, 2013). When educators or parents instilled the idea that students were measured by their accomplishments, the students further surmised that they were measured by their failures and tended to focus on their performance rather than on knowledge acquisition (Hartmann, 2013).

1.2. Self-efficacy

Psychologist Albert Bandura (1986) described self-efficacy as a belief in one's own ability to be successful in particular circumstances. Self-efficacy attitudes governed how prospects and hindrances were observed and affected not only people's choices, but how much they were willing to strive and persist until they were successful (Bandura, 1997). An individual's self-efficacy was built upon past successes, especially ones that challenged the individual and were overcome with abundant effort. Otherwise, failures easily shattered an individual's sense of self-efficacy, especially if the individual only achieved accomplishments effortlessly (Bandura, 1995).

In addition, if individuals with a growth mindset observed others succeeding at a task, they perceived that they had the potential to be successful. When individuals with a fixed mindset observed others failing at a task or if individuals were given negative verbal feedback about their ability to achieve, these individuals put forth less effort or would not attempt the task at hand (Bandura, 1995).

Academic self-efficacy significantly affected students' success at the secondary level and in higher-education coursework. "Self-efficacy beliefs have shown convergent validity in influencing such key indices of academic motivation as choice of activities, level of effort, persistence, and emotional reactions" (Zimmerman, 2000, p. 86). Therefore, students who had greater levels of academic self-efficacy were more likely to work harder to complete a challenging task. Students with high academic self-efficacy tended to be eager to participate in an activity, persevered through trials, and had fewer emotional frustrations or negative feelings when they were not successful than students who had lower academic self-efficacy (Zimmerman, 2000).

For students with special education needs, low self-efficacy could be a barrier to academic success. Past performance was considered the most powerful element in fostering self-efficacy. Subsequently, special education students who experienced repeated academic failures or

difficulties were likely to have lower self-efficacy (Hampton, 1996). Special education students with low self-efficacy may be less willing to attempt a challenging task and to sustain effort (Hampton, 1996). This outcome may reinforce the poor perceptions that special education students maintained about their academic abilities.

Special education students may dedicate significantly more time and effort to achieve the same results as their typical peers. As a result, when students who have a learning disability observe that they must put in extra effort, they experienced a lowered sense of self-efficacy (Bergen, 2013). Having both low self-efficacy and a disability is a "dangerous dynamic" because it was essential for special education students to have increased perseverance to meet the same standards as their typical peers (Bergen, 2013, p. 1). Klassen (2007) studied special education students and found that, while adolescent special education students were highly confident in their performance in a specific academic domain, they were completely unaware that they were performing poorly. Klassen (2007) asserted that teachers could address this miscalibration of efficacy and low self-efficacy.

Self-efficacy was an essential component to students' ability to complete daily classroom activities, perform well on standardized assessments, and succeed overall in school (Pajares & Schunk, 2001). "Compared with students who doubt their learning capabilities, those who feel efficacious for learning or performing a task participate more readily, work harder, persist longer when they encounter difficulties, and achieve at a higher level" (Pajares & Schunk, 2001, p. 2–3). Self-efficacy "makes a difference in how people feel, think and act" (Schwarzer, 2014, p. 1). For instance, low self-efficacy caused feelings of depression and anxiety as well as an overall feeling of helplessness (Schwarzer, 2014). Klassen, Krawchuk, and Rajani (2008) found that undergraduate students with lower self-efficacy had significantly lower GPAs and higher tendencies to procrastinate on daily academic work.

Students with more of a growth mindset characteristically had higher levels of self-efficacy than students with more of a fixed mindset (Dweck & Master, 2009). Furthermore, students with a growth mindset were usually willing to participate and persevere in a task and to put forth additional effort (Urdan & Turner, 2005). Thus, students with a growth mindset were likely to have had high academic self-efficacy and persisted through challenging tasks, resulting in academic achievement (Dweck, 2009). Encouragement or praise from others increased a student's self-efficacy. When praise focused on effort, strategies, and overcoming obstacles, students learned to believe they could accomplish challenging tasks (Dweck, 2009). The manner in which educators discussed success, failure, and challenges with students had a strong effect on increasing self-efficacy (The Scientific Foundation for Mindset, 2015).

1.3. Motivation and achievement

Motivation was a primary reason for discrepancy in achievement and was considered a possible predictor of how a student would perform academically; students with high academic motivation were likely to be academically successful (Hodis, Meyer, McClure, Weir, & Walkey, 2011). With the transition to middle school, motivation and academic achievement drastically changed (Ryan, 2001). For some students, adolescence launched a downward movement in achievement and motivation due to the increase in academic demands and expectations (Ryan, 2001). Students who were intrinsically motivated to learn were fascinated and inquired about the process, and focused on the task itself, rather than just the end result and alternatively, students who were extrinsically motivated were concerned with the end results (e.g., grades, prizes) more than the task-completion process (Clinkenbeard, 2012).

Motivation changed with age, based on individuals' needs, because needs and desires differed throughout stages of development. According to McDermott and Barik (2014), the change of motivation toward education during adolescence paralleled Maslow's Hierarchy of Needs.

Motivation is a critical component for academic success in all students (Christensen, Horn, & Johnson, 2008). Students who have learning disabilities or difficulties in school often maintained a devalued sense of self-confidence, which in turn, reduced their motivation to participate in and persist through academic challenges, creating a cycle of low motivation and low achievement (Morgan, Fuchs, Compton, Cordray, & Fuchs, 2008). When students deemed that outside factors controlled their success, they accepted less accountability for their achievements or failures (Jordan, 2010). Students with internal motivators developed a sense that they were able to succeed academically and perceived more control through the process. As a result, students who had internal motivators tended to take responsibility for their own achievements and failures. Furthermore, for special education students who struggled with academic success, there was an increased probability for reduced levels of intrinsic motivation (Jordan, 2010).

Motivation may have two underlying components—task persistence and self-evaluation (Zentall & Morris, 2010). Students who developed negative self-evaluations might comment, "I am not good at math." As a result, prior to attempting the task, these students perceived that they would not be successful, leading to lack of task persistence. Furthermore, these students chose an easy task to hide their inability or to prevent negative results. These perceptions resulted in lower self-efficacy, regardless of success at the task (Dweck, 2006).

Students with an academic fixed mindset eventually developed "low-effort syndrome" (Dweck, 2006, p. 58). To protect their egos, students with low-effort syndrome stopped attempting challenging tasks because by avoiding the task, they avoided failure. As a result, low-effort syndrome lowered students' motivation to learn and led to a decline in their overall academic achievement. In contrast, students with a growth mindset were resilient and continued to attempt perplexing tasks because they viewed challenge and even failure as an opportunity to learn (Dweck, 2006).

1.4. Brainology

Brainology is a computer-based program intended to teach students to develop a growth mindset. As part of the program, students watch characters as they complete five instructional units. The units teach students that their brains constantly change and that they can alter their intelligence, with specific emphasis on ways to apply the growth mindset theory to schoolwork. Two and a half hours of computer-based instruction are divided into five sections, an introduction, and four instructional units. The program also offers up to 10 h of supplementary materials focusing on the growth mindset (Snipes, Fancsali, & Stoker, 2012).

In a study conducted in Scotland, a group of students were unsystematically chosen and participated in the Brainology program for 6 weeks, while another group of students were randomly chosen to take a pre-survey and a post-survey without engaging in a growth mindset intervention (Snipes et al., 2012). The treatment group evidenced higher scores on reading achievement assessments than the students who did not participate in the intervention (Paunesku, Goldman, & Dweck, n.d.). In another study, researchers found that Latino adolescent students in the American Northwest who completed the Brainology program achieved a 0.21 increase in final grades and observed fewer work avoidance behaviors (Romero, Master, Paunesku, Dweck, & Gross, 2014).

There is limited research regarding the influence of a growth mindset on the self-efficacy and motivation of adolescent special education students in middle school. Self-efficacy and motivation may be two predictors with a significant impact on academic achievement (Hanushek, 2010). Consequently, this study investigated whether a growth mindset intervention would improve special education students' self-efficacy and motivation in reading.

2. Method

The purpose of this quasi-experimental pretest–posttest study was to measure the effects of a growth mindset intervention on sixth, seventh, and eighth-grade special education students' self-efficacy and motivation in the area of reading. The research question was: Is there a significant difference in

reading self-efficacy and motivation between middle-school special education students who partici-pate in the growth mindset program and those who do not?

The independent variables were program type (growth mindset intervention/no growth mindset intervention). The scores on the Reader Self-Perception Scale 2nd Edition (RSPS-2) and the Motivation for Reading Questionnaire (MRQ) were the dependent variables used to measure whether there were differences in the mean scores for self-efficacy and motivation in reading. The analysis compared group means for self-efficacy and motivation in reading for students participating in reading programs with and without the growth mindset intervention, Brainology. This research underwent Institutional Review Board protocol.

2.1. Setting and participants

The participants in the treatment and comparison groups were from an urban school district in western Connecticut, United States. At the time of the study, the city's population consisted of 80,893 residents. The district's student population was 41.9% Caucasian, 8.3% African-American, 40.1% Hispanic, 7.6% Asian or Pacific Islander, and .1% American Indian. Over 45% of the students within this district were considered economically disadvantaged.

The study site had 1,920 students in the middle schools in the study; 264 of these students received special education support. Out of the 264 special education students, only 126 met the criteria to be part of the study: (a) Special education students with a learning disability or dyslexia (b) who were receiving special education services (3) with goals in the area of reading. Seventy students met these criteria and agreed to participate in the study (23 students in the sixth grade, 25 in the seventh grade, and 22 in the eighth grade). A total of 68 students ($n = 68$) completed the study (23 students in the sixth grade, 23 in the seventh grade, and 22 in the eighth grade).

One class was randomly placed into the comparison group and one into the treatment group. There were 12 males and 16 females in the comparison group. Teacher participants ($n = 3$) administered the pretest and posttest during the students' advisory period. For the duration of the study, these students continued to attend their classes as usual. There were 21 males and 19 females in the treatment group. Teacher participants administered the pretest and posttest during the students' advisory period, similar to the comparison group. However, unlike the comparison group, the student participants in the treatment group were provided the growth mindset intervention during the time when they would regularly be attending their advisory period.

Prior to the treatment, the researchers met with all the teacher participants to review the admin-istration of the RSPS-2 and MRQ and to answer any questions about administering and collecting the surveys. At this time, the teacher participants received the RSPS-2 and MRQ to administer to the student participants prior to the intervention. The researchers provided the three teacher participants working with the treatment group a short informational session on Dweck's theory of mindsets. The researchers modeled a tutorial of the intervention program that their students would be using during the 8-week intervention. Teacher participants had the opportunity to complete a growth mindset lesson that their student participants would complete as part of the intervention. The researchers held a question-and-answer session. The researchers also supplied headphones to the teacher participants, which they provided to the students who did not have headphones.

The researchers selected two teacher participants—one in the comparison group and one in the treatment group—as designated observers. These observers ensured that the intervention and study protocols were followed with fidelity through weekly communication with the researchers. The lead researcher conducted site visits once a week and addressed concerns or questions arose in between site visits, through e-mail.

2.2. Instrumentation

2.2.1. The RSPS-2
The RSPS-2 has been administered to students in Grade 6 and above to gain knowledge on how their perceptions as readers. There were 33 items for students to complete on a scale of 1 ("strongly disagree") to 5 ("strongly agree"). There were four scales: (a) Progress, (b) Observational Comparison, (c) Social Feedback, and (d) Physiological States. Out of the 46 items, 16 items relate to Progress, 9 relate to Observational Comparison, 9 relate to Social Feedback, and 12 relate to Physiological States.

The items on the RSPS-2 have statements that contain elements of reading (Henk, Marinak, & Melnick, 2012). The Progress (PR) subscale has statements relating to how a student perceives their progress, while Observational Comparison (OP) has statements relating to how a student feels they compare to their peers. Social Feedback (SF) has statements relating to the feedback the student receives, and Physiological States (PS) has statements relating to how their progress makes them feel internally (Henk et al., 2012). The scores for the RSPS-2 were based on the amount of points a student participant achieved in each scaled area.

The internal reliability for each scale measured within the range of .88 to .95, an appropriate level for an effective measure, which should have a minimum of .70 (Melnick, Henk, & Marinak, 2009). The RSPS-2 "provides evidence of construct validity through principal components analysis of the factor structure" (Melnick et al., 2009, p. 2).

2.2.2. Motivation for Reading Questionnaire
The purpose of this instrument was to gain knowledge on various aspects of participants' motivation in the area of reading. There were 53 questions for each participant to complete on a Likert-type scale of 1 ("very different from me") to 4 ("a lot like me"). The subscales on the MRQ were: (a) self-efficacy, (b) challenge, (c) curiosity, (d) involvement, (e) importance, (f) recognition, (g) social (h) grades, (i) competition, (j) compliance, and (k) work avoidance.

The scores for the MRQ were based on the total points students received on all the scaled areas, except for work avoidance: Reading Efficacy (RE), Reading Challenge (RCH), Reading Curiosity (RC), Aesthetic Enjoyment of Reading (AER), Importance of Reading (IR), Reading Recognition (RR), Reading for Grades (RG), Social Reasons for Reading (SRR), Reading Competition (RCOM), and Compliance (C). A total score was calculated by, "…summing the scores of all the items, with the exception of Work Avoidance items" (Wigfield, Guthrie, & McGough, 1996, p. 10). Separate scaled scores were computed by summing the Likert responses for each item within a subscale; then, dividing the sum by the total number of items within a scale (Wigfield et al., 1996). The MRQ has internal consistency reliabilities for reading motivation ranging from .43 to .81 (Baker & Wigfield, 1999). Unrau and Schlackman (2006) found the MRQ has an alpha coefficient at .76 for intrinsic motivation to read.

Table 1 contains a summary of the instruments used to collect data on self-efficacy and motivation of reading with the RSPS-2 and MRQ.

2.2.3. Growth mindset intervention
After the treatment group had been administered the RSPS-2 and MRQ pretests and the purpose of participating in the Brainology program was shared, the student participants began the growth mindset intervention. Brainology is an online computer program that allows students to independently progress through lessons about growth mindsets. The program has an audio component. Therefore, students' reading levels did not interfere with their ability to complete the program. Brainology lessons focused on how the brain functions and learns, with the aim of demonstrating to student participants that they were in control of their own learning and development. Most importantly, Brainology taught student participants how to

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Table 1. Instrumentation		
	RSPS-2	**MRQ**
Purpose	A measure of self-efficacy in reading	A measure of motivation to read
Response Format	5-point Likert-type scale	4-point Likert-type scale
Items	33 items	53 items
Subscales	Progress, Observational Comparison, Social Feedback, Physiological States	Reading Efficacy, Reading Challenge, Reading Curiosity, Aesthetic Enjoyment of Reading, Importance of Reading, Reading Recognition, Reading for Grades, Social Reasons for Reading, Reading Competition, Compliance, Reading Work Avoidance
Age Level	Applicable to students in Grades 6 and above	Applicable to students in Grades 4–8

apply the lessons in their academic work. According to Yeager and Dweck (2012), "It [Brainology] gave them a practical set of skills and strategies for tackling academic challenges" (p. 1). A sample task that a student participant might be expected to complete would be to type in an e-journal a response to a direct question or reflection on what they learned about mindsets and the brain. In addition, student participants were given a "quest" or challenge to complete at the end of each unit to demonstrate what they learned. If participants answered incorrectly, they had the opportunity to review the unit, look back in the e-journal, or attempt the challenge again.

As part of the intervention, student participants attended a computer lab 5 days a week for 15 min a day over the course of 8 weeks to complete the 10 and one-half hour intervention. Participants used their own computer, along with a set of headphones, and moved through the lessons at their own pace. Implementation time and schedules were flexible and were adjusted to fit the participants' needs. The program included a short introduction and 4 instructional units that took a total of 2.5 h to complete, with up to 8 h of additional materials and resources. The program also offered up to 10 h of supplementary materials focusing on the growth mindset (Snipes et al., 2012).

When the student participants used the Brainology program, they progressed through the lessons at their own pace. Implementation time and schedules were flexible and were adjusted to fit the user's needs.

The RSPS-2 and MRQ were administered to all the student participants in the comparison group and took a total of 30 min to complete (15 min for each survey). The comparison group completed the RSPS-2 and MRQ on 11 April 2016; the treatment group received the growth mindset intervention. Then, pretest data results from the RSPS-2 and MRQ were collected and analyzed to ensure that the groups were comparable.

2.2.3.1. Comparison group. While the treatment group received the growth mindset treatment, the comparison group continued with an advisory period, a period of study while receiving support from their special education teachers, without a growth mindset intervention. At the conclusion of the intervention, the comparison group again took the RSPS-2 and MRQ surveys for posttest data. The researchers analyzed the results to determine if there was a significant difference between the treatment and comparison groups. If there were a significant difference between the comparison and treatment groups at the end of the study, the comparison group would be given the opportunity to take part in the growth mindset intervention.

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2.2.4. Data collection and analysis

The RSPS-2 and MRQ were administered to all the student participants in the treatment group. After the treatment group had been administered the instruments, the student participants began the growth mindset intervention, Brainology. At the conclusion of the intervention, the treatment group again took the RSPS-2 and MRQ surveys for posttest data.

The RSPS-2 and MRQ were administered to all the student participants in the comparison group. While the treatment group received the growth mindset treatment, the comparison group continued with their advisory period without a growth mindset intervention. At the conclusion of the intervention, the comparison group again took the RSPS-2 and MRQ surveys for posttest data.

A multivariate analysis of variance (s) (MANOVA) for the RSPS-2 and an independent-samples *t*-test (*t*-test) for the MRQ between groups were analyzed. For this study, the researchers compared the means to determine if there were significant differences between the reading self-efficacy and motivation of participants in the treatment and comparison groups, based on the interval data collected prior to and at the end of the study from the RSPS-2 and MRQ. The same data were used in the analysis of the MANOVA for the RSPS-2 and the MNRQ; therefore, the researchers used a Bonferroni adjustment and set the alpha level at .025 ($a = .025$) for this study.

3. Results

3.1. The RSPS-2 results

Inspection of data and testing for assumptions for the RSPS-2 pretest data were conducted through an examination of (a) outliers, (b) independence of samples, (c) multivariate normality, (d) linearity, (e) homogeneity, and (f) no multicollinearity. Table 2 provides the descriptive statistics for the pretest scores for the RSPS-2 (comparison and treatment).

With the assumptions having been met, the researchers conducted a one-way MANOVA using pretest scores from the RSPS-2. The results of the one-way MANOVA for the pretest RSPS-2 indicated that there was not a statistically significant difference in reading self-efficacy scores, Wilks' $\lambda = .91$; $F_{(4,63)} = 1.56$; $p = .20$, partial $\eta^2 = .090$, trivial. The results of the one-way MANOVA for the RSPS-2 pretest scaled scores indicated no significant main effect for program type for Progress, $F_{(1,66)} = 3.60$, $p = .06$, partial $\eta^2 = .052$, trivial, Observational Comparisons, $F_{(1,66)} = .09$, $p = .76$, partial $\eta^2 = .001$ trivial, Social Feedback, $F_{(1,66)} = .41$, $p = .52$, partial $\eta^2 = .006$, trivial, and Physiological States, $F_{(1,66)} = 2.64$, $p = .11$, partial $\eta^2 = .038$, trivial. These results indicated that there was equalization between the comparison and treatment groups prior to the intervention. Table 3 presents the pretest one-way MANOVA results.

Table 2. Descriptive statistics for RSPS-2 pretest scores by group				
Subscale	Mean	Standard deviation	Minimum	Maximum
Treatment (*n* = 40)				
PR	42.55	5.83	32.00	54.00
OC	27.00	2.34	21.00	30.00
SF	26.45	2.26	22.00	31.00
PS	33.45	3.77	27.00	42.00
Comparison (*n* = 28)				
PR	45.07	4.68	38.00	55.00
OC	26.04	2.78	21.00	32.00
SF	26.11	2.03	22.00	30.00
PS	35.21	5.20	25.00	44.00

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Table 3. One-way MANOVA results for mean RSPS-2 pretest scores						
Source	Type III sum of squares	*df*	Mean squares	*F*	Sig.	Partial eta Squared
PR	104.71	1	104.71	3.60	.06	.052
OC	.59	1	.59	.09	.76	.001
SF	1.94	1	1.94	.41	.52	.006
PS	51.27	1	51.27	2.64	.11	.038

Note. p = .025.

Table 4. Descriptive statistics for RSPS-2 posttest scores by group				
Subscale	Mean	Standard deviation	Minimum	Maximum
Treatment (*n* = 40)				
PR	43.48	4.71	34.00	51.00
OC	28.00	2.17	24.00	32.00
SF	27.78	2.06	23.00	31.00
PS	35.78	4.78	28.00	47.00
Comparison (*n* = 28)				
PR	44.43	4.19	36.00	51.00
OC	27.07	1.92	24.00	30.00
SF	27.07	2.37	23.00	33.00
PS	36.32	5.93	25.00	46.00

A procedure similar to the RSPS-2 pretest data was conducted with the posttest data. The researchers tested the assumptions for a one-way MANOVA through an examination of (a) outliers, (b) independence of samples, (c) multivariate normality, (d) linearity, (e) homogeneity, and (f) no multicollinearity. Table 4 provides the descriptive statistics for the posttest scores for the RSPS-2 (comparison and treatment).

With the assumptions having been met, the researchers conducted a one-way MANOVA using posttest scores from the RSPS-2. There was not a statistically significant difference in reading self-efficacy scores, Wilks' λ = .91; $F(4,63)$ = 1.66; p = .17, partial η^2 = .095, trivial. The results of the one-way MANOVA for the RSPS-2 posttest scaled scores indicated no significant main effect for program type for Progress, $F(1,66)$ = .73, p = .40, partial η^2 = .011, trivial, Observational Comparisons, $F(1,66)$ = 3.30, p = .07, partial η^2 = .048 trivial, Social Feedback, $F(1,66)$ = 1.70, p = .20, partial η^2 = .025, trivial, and Physiological States, $F(1,66)$ = .18, p = .68, partial η^2 = .003, trivial. Table 5 presents the posttest one-way MANOVA results.

3.2. MRQ results

The researchers tested the assumptions for an independent-samples *t*-test for the pretest data through an examination for (a) outliers, (b) normality, and (c) homogeneity, and (d) descriptive statistics. Table 6 demonstrates the descriptive statistics for the pretest scores for the MRQ (comparison and treatment).

With the assumptions being met, an independent-samples *t*-test was conducted to test if there were differences in pretest scores from the MRQ between student participants with the growth mindset intervention and those without the intervention.

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Table 5. One-way MANOVA results for mean RSPS-2 posttest scores						
Source	Type III sum of squares	df	Mean squares	F	Sig.	Partial eta squared
PR	14.98	1	14.98	0.74	.40	.011
OC	14.20	1	14.20	3.30	.07	.048
SF	8.15	1	8.15	1.70	.20	.025
PS	4.92	1	4.92	0.18	.68	.003

Note. p = .025.

Table 6. Descriptive statistics for MRQ pretest scores by group				
Program type	Mean	Standard deviation	Minimum	Maximum
Treatment (n = 40)	129.70	10.26	111.00	149.00
Comparison (n = 28)	133.61	8.17	117.00	146.00

The results of the independent-samples t-test for the MRQ pretest scores indicated no significant main effect for program type, $t(66) = -1.68$, $p = .10$. These results indicated that there was equalization between the treatment ($M = 129.70$, $SD = 10.26$) and comparison groups ($M = 133.61$, $SD = 8.17$) prior to the intervention. Table 7 presents the pretest t-test results.

The researchers tested the assumptions for an independent-samples t-test for the posttest data through an examination for (a) outliers, (b) normality, and (c) homogeneity, and (d) descriptive statistics. Homogeneity of Variance for the MRQ was statistically significant $p = .03$ ($p < .05$), suggesting that the assumption of homogeneity of variances was violated, as assessed by the Levene's test for equality of variances (Meyers, Gamst, & Guarino, 2013). Since there were differences in sample sizes, the researchers used the Welch t-test for analysis (equal variances not assumed) to interpret and report (Howell, 2010). Table 8 demonstrates descriptive statistics for the MRQ posttest scores.

With the other assumptions having been met, the researchers conducted an independent-samples t-test using posttest scores from the MRQ. The results of the independent-samples

Table 7. T-test results for MRQ pretest scores									
	F	Sig.	T	df	Sig. (2-tailed)	Mean difference	Std. error difference	Lower	Upper
Equal variances assumed	1.14	.29	−1.68	66.00	.10	−3.91	2.33	−8.56	.75
Equal variances not assumed			−1.74	64.82	.09	−3.91	2.24	−8.38	.57

Note. p = .025.

Table 8. Descriptive statistics for MRQ posttest scores by group				
Subscale	Mean	Standard deviation	Minimum	Maximum
Treatment (n = 40)	159.13	12.27	129	179
Comparison (n = 28)	141.64	8.27	126	158

Table 9. T-test results for MRQ posttest scores									
	F	Sig.	*T*	*df*	Sig. (2-tailed)	Mean difference	Std. error difference	Lower	Upper
Equal variances assumed	5.39	.03	6.56	66.00	.001	17.48	2.66	12.16	22.80
Equal variances not assumed			7.02	65.93	.001	17.48	2.50	12.51	22.46

Note. p = .025.

t-test for the MRQ posttest scores indicated a statistically significant difference in mean MRQ posttest scores between program type, with the treatment group (*M* = 159.13, *SD* = 12.27) scoring significantly higher than the comparison group (*M* = 141.64, *SD* = 8.27), on the MRQ posttests, $p < .001$, *M* = 17.48, 95% CI [12.51 to 22.46], $t(65.93) = 7.02$, $p < .001$. Table 9 presents the posttest independent-samples *t*-test results.

3.3. Summary of results

The results of the quasi-experimental pretest–posttest study suggested that a growth mindset intervention had no statistical significance on the self-efficacy for reading of adolescent special education students in the treatment group when compared to the student participants in the comparison group, as measured by the RSPS-2. The independent-samples *t*-test results suggested that a growth mindset intervention had a statistically significant difference on mean scores for the treatment group when compared to the student participants in the comparison group, as measured by the MRQ.

3.4. Limitations and future research

This section addresses limitations and the steps the researchers took to minimize those limitations and possible areas of future research. Internal validity was addressed through subject-selection variable by using intact special education advisory classrooms from the sixth, seventh, and eighth grades that were randomly assigned to either a treatment group or a comparison group for this research study. The use of the pretest determined if differences existed prior to the study. Analysis for normalization and a MANOVA showed equalization among the groups.

A potential history threat was addressed by maintaining the same the length of data collection for both groups (8 weeks). To address the variable of maturation, the researchers randomly assigned intact classrooms to either a treatment or a comparison group. The two groups were composed of student participants who were similar in age, grade level, and special education needs.

Gall, Gall, and Borg (2007) defined experimental mortality of the loss of participants during the research study. During the research study, two student participants in the comparison group did not partake in the posttest, which required removing their data from the analysis. Because the study ended at the completion of the school year, there were no options for the student participants to complete the posttest at that time. As a result, the researchers consider experimental mortality a moderate threat.

The researchers regarded population validity as a moderate threat since student participants came from the same school district and were in intact classes. To address experiment effect (Gall, Gall, & Borg, 2007), the researchers provided professional development for teacher participants on two occasions to the treatment and the comparison groups prior to the study beginning. The researchers shared all materials with teacher participants, including the RSPS-2 and the MRQ. The researchers modeled the growth mindset intervention and allowed time for the teacher participants in the

treatment group to interact with the program independently. There was also a question and answer session allotted at the end of the professional development and researchers were in weekly communication with the teacher participants.

Klassen (2002) found that students with learning disabilities tended to miscalculate their self-efficacy positively, suggesting a limitation to a survey like the RSPS-2 as a measure of self-efficacy for special education students. Based upon this miscalibration, it may be difficult to obtain an accurate measure of self-efficacy for this population.

Future research would be justified to examine whether completing a growth mindset intervention also affects achievement scores of adolescent special education students. Because previous research has indicated that motivation is a significant predictor toward achievement (Hodis et al., 2011), a growth mindset intervention could have a significant effect on achievement scores, as it did on motivation in this study.

4. Discussion of the findings

Previous research has indicated a significant gap between special education students' self-efficacy (Klassen, 2002) and motivation (Hodis et al., 2011) when compared to their typical-performing peers. When examining research pertaining to self-efficacy and motivation, Pajares and Schunk (2001) found that, "[c]ompared with students who doubt their learning capabilities, those who feel efficacious for learning or performing a task participate more readily, work harder, persist longer when they encounter difficulties, and achieve at a higher level" (p. 2–3). Therefore, students with low self-efficacy were more likely to lack effort or motivation to attempt difficult tasks. Pajares and Schunk (2001) findings contradicted the findings of the current study because, though there was not a significant difference in self-efficacy between the student participants in the treatment and the comparison group in this study, there was a significant difference in the student participants' motivation scores in the treatment group. Although the student participants did not have high self-efficacy in the area of reading, they had a higher level of motivation to attempt tasks pertaining to reading (Pajares & Schunk, 2001).

Bergen (2013) found that children with a learning disability were more likely to inaccurately gauge their self-efficacy, suggesting that students' supposed ability and aptitude to confront an academic undertaking was not aligned with their actual abilities. Meanwhile, Klassen (2007) observed that although adolescent special education students were very confident about their performance in a specific academic domain, they were unaware that they were performing poorly academically in the class. These studies suggested that special education students may not be the best interpreters of their own self-efficacy. This effect could explain why there was not a significant difference between the treatment and the comparison groups' scores on the RSPS-2 in the current study.

The researchers observed that for three subtests in the RSPS-2: (a) progress, (b) observational comparison, and (c) social feedback, the student participants in both the treatment and comparison group scored in the low range on both their pretest and posttest scores, which may support Bergen (2013) and Klassen's (2007) research suggesting that special education students under calibrated their self-efficacy. The current study also reflects Kessens's (2002) research that found special education students tended to have lower self-efficacy than their typically performing peers.

5. Implications and conclusion

This study examined whether a growth mindset intervention affected adolescent special education students' self-efficacy and motivation, using the pretest and posttest scores from the RSPS-2 and MRQ. While there was not a significant difference in the self-efficacy scores on the RSPS-2, there was a significant difference in the motivation scores on the MRQ.

The findings of the current study suggest that educators can focus specific instruction around mindsets, motivation, and the influence of both theories when working with special education students who have low motivation and more of a fixed mindset toward academics. Educators

should attend to academic scores, but also to how students perceive learning and influence their own achievement. Educators should consider emphasizing a curriculum that incorporates a growth mindset model of instruction that focuses on persevering, utilizing constructive feedback to improve, and accentuating the flexibility of intelligence. While interventions, such as a growth mindset intervention, can influence academic achievement (Walton & Cohen, 2011), the interventions must be aligned to the academic curriculum for the interventions to be effective (Saunders, 2013). As a result, a growth mindset model of instruction is more successful when it interweaves with the daily curriculum of the classrooms.

Teacher feedback to students should focus on the process and the effort put forth in a task. Consequently, professional development for teachers and support staff may support methods to phrase questions and give constructive feedback that alters classroom language to be more consistent with a growth mindset model. In addition, teachers and support staff should expect students to play an active role in establishing growth mindset attitudes within the classroom by providing opportunities to discuss and share the process and the difficulties they encounter in learning.

While this study showed a significant difference in motivation for reading, there was no significant difference for self-efficacy in reading after the treatment group completed the growth mindset intervention. However, over the past few decades, self-efficacy has surfaced as an efficient predictor of students' achievement (Zimmerman, 2000). Students receiving special education support may work harder to attain the same results as their typical peers, which eventually affects students' self-efficacy (Bergen, 2013). Therefore, educators should consider measuring motivation, and/or mindsets for students who are struggling academically to discern if these students would benefit from a growth mindset intervention such as Brainology.

There has been a demand to close the achievement gap between special education students and their typical performing peers on standardized assessments. Self-efficacy and motivation are two predictors with a significant impact on academic achievement (Hanushek, 2010). Therefore, it is pertinent for researchers and educators to explore additional practices to help students with special education needs to thrive academically by learning about growth mindset concepts.

6. Key highlights
A quasi-experimental study examined a growth mindset treatment, Brainology.

We measured motivation and self-efficacy pre-/posttreatment.

The treatment impacted the motivation, but not the self-efficacy, of adolescent special education participants.

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