A GROWTH MINDSET INTERVENTION WITH ELEMENTARY-AGE CHILDREN

BY

JACLYN N. WOLFERD

A DISSERTATION

SUBMITTED TO THE FACULTY OF

ALFRED UNIVERSITY

IN PARTIAL FUFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

DOCTOR OF PSYCHOLOGY

IN

SCHOOL PSYCHOLOGY

ALFRED, NY

FEBRUARY 2020

A GROWTH MINDSET INTERVENTION WITH ELEMNTARY AGE CHILDREN

BY

JACLYN N. WOLFERD

DOWLING COLLEGE, B.A. (2007)

LONG ISLAND UNIVERSITY, M.S. (2010)

ALFRED UNIVERSITY, M.A. (2016)

APPROVED BY **Andrea Burch, PsyD**
Committee Chairperson

Michele Lowry, PsyD
Committee Member

Rachel Gardner, PhD
Committee Member

ACCEPTED BY **Kevin Curtin Ph.D.**
Chairperson, Division of Counseling & School Psychology

ACCEPTED BY **John D. Cerio, Ph.D.**
Dean, School of Graduate Studies and Continuing Education

ACCEPTED BY **Beth Ann Dobie, Ph.D.**
Interim Provost and Vice President for Academic Affairs

Copyright page

DEDICATION

For my mother, Janet

Who I am, and the successes I have achieved in my life, are because of your strength, your dedication, and the unconditional love you have shown me.

Thank you

ACKNOWLEDGEMENTS

I am so grateful for the support and encouragement I have received throughout my career and graduate studies. While this does not begin to adequately express my gratitude, there are so many people I wish to acknowledge. First, I would like to thank my dissertation chair, Dr. Andrea Burch, for her unwavering support and guidance throughout this process. I am so grateful that you really knew what I needed to be successful and you took that into consideration at every possible step. You inspire me every day with your dedication and passion for this profession and I am honored to have gone through this process with you. Similarly, I would like to thank my committee members, Dr. Michele Lowry, Dr. Rachel Gardner, and the recently retired Dr. Jana Atlas. I am so appreciative of each and every one of your perspectives, strengths, and dedication to this research and I am grateful for your guidance.

I would also like to acknowledge my mentor, Robert Alberti who guided my early practice as a clinician; first as an intern and then as a mental health counselor. He helped shape me into the person I am today, and I only wish he were able to share in this moment with me. I am so appreciative to my cohort at Alfred University and the incredible friendships I have made along the way. I especially want to thank Sophia and Lauren for not only your friendship and words of encouragement, but a place to stay during my long travels. Thank you so much.

I want to thank my parents, sister, friends, and family for their support and love. It is not easy to dedicate yourself to this process without having a strong, loving support system at home. I want to especially thank Jason for your love, encouragement, sense of humor, and help during my defense preparations. Finally, to Cody, the cutest puppy ever. Thank you for traveling all those miles with me, laying on my feet while I typed, and greeting me when I got home after a long day of work. You truly are the best dog.

Table of Contents

ABSTRACT

Growth Mindset has become a popular topic in education over the last decade. It refers to a theory of intelligence developed by Carol Dweck in which it is believed that a person can increase their intelligence through hard work, dedication, and commitment to the educational process. Many of Dweck's research has consisted of work with middle school and high school students. However, this theory has gained significant popularity in elementary schools, with many hallways adorned with popular growth mindset phrases and classroom activities. *Brainology* is a research-based intervention program created by MindsetWorks, Inc. with the purpose of developing a growth mindset for students. This quasi-experimental study sought to be the first of its kind by utilizing *Brainology* in an elementary school setting while examining this interventions' effectiveness with third grade students. The *Brainology* program was delivered to students over a six-week time period from May 2019 through June 2019. Pretest and posttest data were collected via the Mindset Assessment Profile (MAP) and a comparison group was used as a control for the experimental group. At the end of the intervention, a multiple regression analysis was used to examine the data. This model was chosen in order to determine the influence that a growth mindset intervention would have on student mindset, when controlling for gender, prior mindset, and participation in the intervention. Overall results were significant, especially for gender (females) and pretest score. The results indicated that students began the study endorsing a high score on the MAP indicating a growth mindset. However, the validity of the MAP assessment was questioned based on a review of past studies utilizing a similar measure created by Dweck. Therefore, further research in needed to establish this intervention as a reliable method for increasing mindset with all elementary-age children.

CHAPTER 1

INTRODUCTION

The growing popularity of growth mindset, as it applies to intelligence, can be seen on social media and in the hallways of academic settings throughout the country. When someone possesses a growth mindset, they believe that one can increase their intelligence and develop their aptitude over time through hard work and application. In contrast, those who possess a fixed mindset view their intelligence as a fixed trait that will remain stable over time, despite hard work and application (Blackwell et al., 2015). In *Mindset, the Psychology of Success* (2006), Carol Dweck popularized the theory of growth mindset and expanded on what she referred to as self-theories of intelligence in prior research. The theory of growth mindset was essentially an expansion of Dweck's self-theory of intelligence (Dweck, 2006).

Dweck's self-theory of intelligence is an implicit theory of intelligence, which means that people possess an understanding of interpersonal attributes such as intelligence and personality (Levy, Stroesser, & Dweck, 1998). Dweck (2000) conceptualized self-theories of intelligence as being part of a meaning system, or a personal narrative. A meaning system organizes a person's views of himself or herself and the world in which they live. It offers a framework for how they navigate each situation that they experience.

According to Dweck, self-theories of intelligence play an influential role in that personal meaning system. Dweck states that there are two opposing beliefs of intelligence within this system. The first is an entity theory of intelligence where an individual views' their aptitude and abilities as being a fixed trait, one which they cannot improve. The second is an incremental theory of intelligence, or a malleable theory of intelligence. After the original conceptualization, the incremental and entity theories of intelligence have been renamed and widely disseminated

through popular nonfiction literature. Now, the term *fixed mindset* is used to refer to the entity theory, and *growth mindset* is used to refer to the incremental theory. By repackaging the theories of entity and incremental intelligence into the framework of fixed and growth mindset, Dweck has been able to reach a new audience, including teachers and school administrators. From this point on, the terms growth and fixed mindset will be used to discuss these concepts in this study, though the terms incremental and entity theories of intelligence can be found in the earlier literature.

Schools have been adapting lessons and curriculum to advance and teach the theory of growth mindset to their students. Teaching students these concepts can be appealing to many educators who are looking to increase student motivation, task completion, and test performance. Research has shown that growth mindset interventions have increased growth mindset in children, while also promoting academic achievement and increasing student performance, motivation, and self-concept (Ahmavaara & Houston, 2007).

Growth mindset interventions are designed to teach students that persistence on challenging tasks is rewarding because it is an opportunity to learn, grow, and increase their abilities. These interventions are intended to teach students to view this struggle as a demonstration of their capacity to learn and not a confirmation that they are incapable of completing difficult tasks (Blackwell, 2002; Paunesku et al. 2015). Students of all ages may potentially benefit from such an intervention.

Growth Mindset and Elementary-Age Children

Carol Dweck's earliest work was conducted with fifth grade students in the area of learned helplessness, or the inability to overcome failure. It was during her work studying learned helplessness that she formulated the theory for growth mindset after observing

elementary age children's responses to failure (Diener & Dweck, 1978). However, Dweck and her colleagues have focused almost all of their recent research with middle school, high school, and college-age students. Dweck (2006) wrote that adolescence is a time of great change, and therefore, adolescents themselves would be both emotionally and cognitively open to the theory of growth mindset. However, as demonstrated by past research, both a fixed mindset and feelings of academic inferiority are present in elementary-age children. Stipek and Gralinski (1996) surveyed students from third through sixth grade and found that students who endorsed a fixed mindset also had lower grades and scores on tests of academic achievement than their peers who endorsed a growth mindset.

Droege and Stipek (1993) found that up until the third grade, students believed that a person may make significant improvements academically and socially. Therefore, one can assume that primary students would be able to recognize feelings and behaviors associated with both mindsets and with academic goal setting based on these mindsets. Such research strengthens the argument to conduct growth mindset interventions with elementary-age children, as they have been shown to begin to adopt a growth mindset early in their academic careers.

According to research conducted by Nicholls (1978), children aged five through eight were able to correctly identify tasks of increasing difficulty. Eventually, they developed a preference for increasingly difficult tasks when assessing success as they matured, suggesting an awareness of the rigors of certain academic tasks. Furthermore, in order to examine children's beliefs about intelligence, Kurtz-Coates et al. (2005) interviewed children in both American and German schools to assess their beliefs about intelligence as well as their social behaviors associated with intelligence. The study concluded that children often made a connection between social skills, individual intelligence, and academic ability. American children were

more likely to connect effort to ability than German children; this was the same for younger children of both countries when compared to older children in the sample. When asked if they believed "smart children work hard at school," there was a significant effect for *yes* responses both for grade, $x^2(3) = 31.3$, as well as country, x^2 (1)- 7.8. Additionally, they determined that second grade students endorsed a connection between ability and effort at a higher rate than fifth grade students, $x^2(1) = 10.2$. This supports the assumption that primary school students are able to conceptualize effort, hard work, and ability.

Ricci (2013), in her best-selling book *Mindsets in the Classroom*, recalled being inspired by Dweck's research to conduct her own study with elementary-age children. At the beginning of the academic school year, Ricci surveyed students in kindergarten, first, second, and third grade. She was curious as to what percentage of students possessed a growth mindset at the start of their educational careers. Ricci reported that 100% of kindergartners endorsed a growth mindset at the beginning of the school year, followed by 90% of first graders, 82% of second graders, and only 52% of third graders. While her methods for obtaining this data were not disclosed in the book, Ricci believed that the data she collected indicated that educators should begin interventions as early as possible to maintain the student's growth mindset.

While current research in the area of growth mindset is focused on the transitional time of adolescence, there is evidence that younger children would benefit from these concepts and interventions as well. This limited research shows that there is a need for further study of elementary aged children and mindset.

Mindset and Gender

In an attempt to research the relationship between mindset and gender, Verniers and Mariniot (2015) conducted a study of French secondary students. They wanted to determine if

both male and female students projected a fixed mindset onto girls. The purpose of this study was to examine stereotypes regarding female intelligence. In order to examine this perception, 85 ninth grade students were asked to rate the intelligence of girls and boys using a modified version of the *Implicit Theories of Intelligence Scale (*Dweck, 1995*).* They were split into two groups and assigned a version of the *Implicit Theories of Intelligence Scale* to complete: one was modified to ask about the intelligence of females and the other asked about males. Students were then asked to read a small paragraph describing a student (male or female) and the effort they put forward on a task. They then rated the likely performance for that student based on the information provided. The results indicated that a growth mindset was associated with boys. The difference in scores was statistically significant when comparing growth mindset and boys (M= 5.03, SD= 1.31) when compared with girls (M- 4.41, SD= 1.36). However, there was no statistical significance found when examining the perception of a fixed mindset for both boys (M = 3.66, SD = 1.44) or girls (M = 3.31, SD = 1.37). As anticipated, both male and female students attributed boys' intelligence with a growth mindset. Based on the outcomes, Verniers and Mariniot (2015) indicated that the attributes of a growth mindset were consistently associated to the performance of boys, and they theorized that it has far reaching consequences. One possible area of consequence was academic achievement in math and science, where girls tend to perform worse than boy classmates despite an aptitude for the material.

In addition to considering age when planning a mindset intervention, one should also look to marginalized populations that may benefit the most from such interventions, specifically girls. This study seeks to expand upon these ideas and confirm whether female students may in fact experience a greater benefit in growth mindset interventions than their male peers.

Growth Mindset Interventions

Due to the popularity of growth mindset, there are many resources available to educators to teach these concepts, which include lesson plans, classroom activities, educational videos, and manipulatives available online. The structured interventions frequently involve expositional writing, science lessons on brain plasticity, computer modules, or student mentors. In addition to these resources, in September of 2009, Carol Dweck and her colleagues released a more formal computer-based intervention program called *Brainology* that was designed to teach students to have a growth mindset. According to Mindset Works Inc. (2011), *Brainology* is a research-based program designed to develop a growth mindset in students, in addition to improved study skills in order to increase their academic achievement and engagement. The *Brainology* curriculum uses a multi-method instruction model that includes four 45-minute online video tutorials, including a brief introduction. This curriculum also offers additional classroom or homework activities and discussions to solidify these concepts; the program is further described in chapter 3.

In previous research, the adaptation of a growth mindset has been shown to improve students' academic achievement, goal setting, and self-regulation (Burnette et al., 2013; Corpus & Lepper, 2007; Diener & Dweck, 1978, 1980; Dweck, 1986). Therefore, it is not surprising that intervention programs have been developed for school systems to easily implement with students. However, an important critique of the available literature raised by the University of Chicago's Consortium of Chicago School Research was that many of the reviews of the effectiveness of these interventions were completed by researchers and psychologists who themselves created the programs (Farrington et al. 2012). Although the authors argued that systemic wide change was best for strengthening a student's positive academic mindset, they

also recognized that smaller, short-term programs were a cost effective and successful way to promote growth mindset and improve academic achievement. Therefore, the authors encouraged independent analysis of these programs while having acknowledged the strong theoretical framework on which growth mindset is built.

Current Study

Research has shown that when students are introduced to the concepts of growth mindset, they are able to change their own view of intelligence. The adoption of a growth mindset has been shown to improve academic achievement, goal setting, and student self-regulation (Burnette et al., 2013; Corpus & Lepper, 2007; Dweck, 1986; Diener & Dweck, 1978, 1980). Until recently, the majority of research-based intervention programs for growth mindset have focused solely on implementation with adolescents. It is possible that fostering a growth mindset could be a long-term process and elementary school children would benefit from being taught these concepts sooner (Phillips-Martines, 2017).

The purpose of the current study is to examine the effectiveness of the *Brainology* intervention on third grade students. Conducting research with students this age would contribute to an area lacking in the growth mindset literature. This research-based intervention program has been selected based on a number of factors. First, though it has had mixed results when used with adolescents, it has been shown to be an acceptable intervention to teach growth mindset. Second, it will be easily accessible for the students and teachers to use in the classroom. Additionally, previous feedback had noted that the quality of the *Brainology* computer-based learning program, specifically the graphics, may be more appealing to a younger audience (Baldridge, 2010; Wilkins, 2014).

Dweck (2000) argues that times of great transition impact students' perception of their intelligence. Third grade is arguably a time of great transition for many students, especially students who begin the process of standardized state-wide testing. It has been shown that high-stakes testing causes children to experience a wide range of negative emotions, such as nervousness, anxiety, worry, isolation, and anger (Triplett & Barksdale, 2005). One could argue that these global tests increase students' awareness of their academic performance relative to peers, and therefore they begin to evaluate their intelligence. Therefore, students may benefit from this intervention as their anxiety over performance and academic grades could possibly be mitigated by the adaption of a growth mindset. This study is looking to examine growth mindset by addressing the following hypotheses:

Hypotheses

- Participation in the *Brainology* intervention program will result in an increase of growth mindset for all students.
- Students who endorsed a fixed mindset will exhibit a greater change than students who began the study endorsing a growth mindset.
- Female students who participate in this intervention will see a greater increase in growth mindset than male students.

CHAPTER 2

REVIEW OF THE LITERATURE

Throughout history, intelligence has been viewed as a fixed and stable characteristic –a hereditary trait. According to Sternberg (2003), "the theory of general intelligence has been the longest lasting and perhaps the most widely accepted in all of the psychological literature" (p. 27). In fact, the study of intelligence has become a defining pursuit throughout the history and practice of psychology. One of the most popular contemporary theories of intelligence is the Cattell-Horn-Carroll, or CHC, Theory of intelligence, which will be discussed in greater detail below. Psychologists such as Charles Spearmen, Edward Thorndike, and Henry Goddard argued that intelligence is a fixed trait and is heavily influenced by heritable genes (Ortiz, 2015).

Blackwell, Rodriguez, and Guerra-Carrillo (2015) contend that the general public views intelligence as an "innate attribute that one possesses in a relatively fixed quantity, for better or worse" (p. 263). Furthermore, Blackwell et al. (2015) claim that the way one conceptualizes their intelligence influences decisions, choices, and life outcomes. Research has expanded in the past three decades to include self-theories of intelligence as well. Implicit or self-theories of intelligence look to explore how an individual perceives their own intellectual ability and whether intelligence is a fixed trait or an attribute that is malleable. The theory of growth mindset, which refers to the ability to increase intelligence through dedication and hard work, looks to change how one views the trait of intelligence. At this time, however, there has been a lack of research on whether possessing this mindset actually increases your intelligence and not only your academic achievement outcomes.

Contemporary Theories of Intelligence

The study, measurement, and even definition of intelligence has captivated the attention of psychologists for the past two hundred years. While many have dedicated their careers to studying human intelligence, it is often difficult for researchers and practitioners to agree on a definition of intelligence or theoretical framework for understanding it. In 1994, the American Psychological Association's Board of Scientific Affairs (BSA) commissioned a report on the current issues, theories, and practices regarding intelligence. After establishing a task force, the BSA published a report in 1998 entitled *Intelligence: Knowns and Unknowns.* According to the BSA, intelligence can be described as the level of processing, comprehension, ability, and adaption each individual exhibits when introduced to increasingly complex ideas and situations. This report further indicated that the ability to grow from adversity when solving unique problems or to adapt one's way of thinking are essential to the construct of intelligence (Neisser et al., 1998).

The Cattell-Horn-Carroll (CHC) Theory, one of the most well-regarded modern theories of intelligence, integrates theories of intelligence developed sequentially by Cattell, Horn, and Carroll (Ortiz, 2015). It is the most widely regarded contemporary theory of intelligence, so much so that many modern intelligence tests are designed and interpreted within this conceptual framework (Alfonso, Flanagan, & Radwan, 2005; Keith & Reynolds, 2010). Raymond B. Cattell, a student of Spearmen's, initially espoused the views of Spearmen in regard to intelligence malleability. Specifically, he said that it was hereditary and that one's genes resulted in one's level of intelligence (Ortiz, 2015). However, through his own research, Cattell expanded Spearmen's conceptualization and began to develop his own theory of intelligence. According to Ortiz (2015), Cattell's theory of intelligence included two separate but equally

important processes that complimented one another yet were distinct. Cattell (1943) referred to these two cognitive processes as crystalized and fluid ability.

Crystalized ability was defined as the skill and knowledge that is gained throughout a lifetime of experiences (Sternberg 2003). Fluid ability refers to the capacity one has to take in new information, problem solve, think abstractly, and discern relationships between factors. According to Cattell (1943), fluid ability consistently develops throughout adolescence and then deteriorates throughout adulthood. Additionally, Cattell began to view intelligence as vulnerable to human development, acknowledging that some abilities decreased as one aged, but his theory did not adequately account for the cognitive processes of adults (Ortiz, 2015).

Horn, who was a student of Cattell's, expanded upon his work by analyzing Cattel's data. Horn was then able to further identify four additional factors that he believed contributed to intelligence in addition to fluid and crystalized ability: processing speed, long-term memory, short-term memory, and visual processing (Alfonso et al., 2005; Ortiz, 2015). Carroll (1993) further synthesized the work of Cattell and Horn to organize and define what today is known as the CHC Theory of Intelligence. The CHC theory seeks to define the construct of intelligence as a multidimensional, multi-process operation as opposed to one specific global skill. The CHC theory proposes that "there are many distinct individual differences in cognitive ability and that the relationships among these individual differences can be classified into three strata" (Sattler, 2008, p.228). The three strata group abilities into the categories of narrow, broad, and general. The eight broad factors of the CHC theory are: fluid intelligence, crystalized intelligence, general memory and learning, broad visual perception, broad retrieval ability, broad cognitive processing speed, and processing speed.

Recently, Furnham (2014) sought to connect implicit theories of intelligence with CHC Theory, arguing that they in fact shared common concepts. Furnham argued that crystalized ability is interrelated with the concept of growth mindset because crystalized ability can develop over time. Fluid ability, he argued, was related to a fixed mindset in that it becomes stabilized in adolescence and there is a finite amount we possess. Therefore, an argument could be made that crystalized intelligence could increase if a student possessed a growth mindset, while fluid intelligence remains a fixed trait. Furnham does make a compelling argument that both CHC Theory and mindset are connected; however, as of now, there have been no studies that confirm his hypothesis. While the theory of growth mindset has increased in popularity and entered into mainstream and academic settings, CHC Theory remains the most common framework to discuss cognitive abilities by practitioners and researchers.

There are other theories of intelligence that are not as widely accepted as CHC Theory, but nonetheless, they have impacted school climate and pedagogy in America. In 1983, Howard Gardner published a book entitled *Frames of Mind: The Theory of Multiple Intelligences* in which he presented a theory and concept of intelligence that was unique, but impactful, to the world of educational psychology (Gardner & Hatch, 1989). In his theory, Gardner propositioned that the standardized IQ assessments were missing out on capturing the full extent of an individual's intelligence by solely focusing on only two psychological processes. Gardner (1983) proposed that an individual's intelligence could be classified into seven distinct categories: spatial intelligence, linguistic intelligence, logical-mathematical intelligence, bodily-kinesthetic intelligence, interpersonal intelligence, musical intelligence, and intrapersonal intelligence. Gardner argued that modern cognitive assessments often failed to capture one's

true potential and did not account for these culturally sensitive areas of intelligence (Gardner & Hatch, 1989).

The theory of multiple intelligences ushered in a new approach to education that was reflected in a growing number of school programs and institutions, putting this theory into practice (Fisher, 1997; Gardner & Hatch, 1989). Teams of educators and psychologists sought to move away from traditional cognitive testing and embraced this theoretical framework; however, many schools continued to rely on traditional methods of testing cognitive abilities.

In recent years, Gardner has expressed concern that his theory has been misinterpreted by some educators as a solution to learning styles, as opposed to a conceptualization of human intelligence (Gardner, 2003). In 2013, Gardner published an article in the *Washington Post* that elaborated on this misconception by reflecting on the last 30 years that his theory has been in practice. According to Gardner, these eight intelligences sometimes work in conjunction with one another, in a simultaneous process that highlights an individual's strength or weakness in that area. Therefore, his theory was designed to move the field away from a singular focus of intelligence and highlight the multiple facilities that we utilize (Gardner, 2013).

While the CHC Theory and Theory of Multiple Intelligence have both made an impact on the field of psychology, in the latter half of the twenty-first century, another recent and notable theory was developed by Das and Naglieri. This team of researchers developed a cognitive assessment system known as the Das and Naglieri Cognitive Assessment System (DN:CAS) or the PASS Model. It consists of four major domains, which are planning, attention, simultaneous, and successive, and it is based on the three-tier model created by A. R. Luria. In Luria's conceptualization of cognitive functioning, he described three systems that are working both independently and simultaneously. According to Das and Naglieri, "the description of the three

functional units presented by Luria gives us an organizational framework to view human cognitive functioning. The first is responsible for arousal and attention; the second for reception, analysis, and storage using simultaneous and successive processes; and the third for planning, regulating, and verifying mental activity (1990, p. 310)." Each of the domains for planning processing, attention processing, simultaneous processing, and successive processing are assessed using the D-N: CAS. The PASS Model is used to define the processing systems measured by the D-N: CAS and while this new model has had some influence over the discussion and assessment of cognitive theories, it is not as widely used as the CHC theory.

The CHC Theory, the Theory of Multiple Intelligence, and the PASS Model are just a few of the contemporary models utilized in cognitive assessment today, and these are some of the most widely accepted theories of intelligence. However, Dweck's theory of growth mindset offers an additional conceptualization of the trait of intelligence, one that has gained popularity in recent years.

Implicit Theories of Intelligence

Though previous longitudinal studies have indicated the trait of intelligence stabilizes throughout one's life, there are some researchers who have challenged this concept. The theory of growth mindset makes the argument that despite intelligence being a fixed trait, one's own perception of their intelligence can result in the ability to become smarter through their own thoughts and behaviors. Interestingly, Dweck was not the first researcher to view intelligence as malleable. According to Blackwell et al. (2015), Alfred Binet and Theodore Simon shared this view as well. Binet and Simon developed the first test of intelligence for children, the Binet-Simon scale, in France in 1905. Simon and Binet cautiously stressed the "limitations of their scales, given their belief in the malleability of intelligence and the inherent margin of error"

(2015, pp. 129-130). However, when the scale was adapted for use in the United States, this caution was ignored in favor of viewing intelligence as a fixed trait, which was widely accepted.

In addition to the theory of growth mindset, Dweck identified through her work three components that will foster a growth mindset in students. These three components are mastery orientation, process praise, and learning goals. In each of the sections below, all three will be discussed in detail to establish how each one contributes to the development of a growth mindset.

Mastery Orientation

Dweck's development of the Implicit Theories of Intelligence evolved from her previous research studying learned helplessness in children. Learned helplessness is the feeling of loss of control over one's life after experiencing repeated setbacks or failures. Through this research, Dweck identified qualities in successful children that she came to categorize as being *mastery oriented*. This resulted in Dweck determining four common beliefs or *mastery-oriented qualities* of successful persons, which are possessing a love for learning, being someone who engages in challenging tasks, being tenacious when presented with difficulties or setbacks, and appreciating and expounding effort (Dweck, 2000). These mastery-oriented qualities, Dweck theorized, had an undeniable association to intelligence. Dweck speculated that possession of these qualities not only influences the way one feels about one's own intelligence, but it impacts their response to failure (Diener & Dweck, 1978).

While looking for a pattern of helplessness in student response styles, Diener and Dweck (1978) identified a mastery-oriented response style by observing the emotions and behaviors of the fifth-grade students with tasked to complete problems of increasing difficulty. Diener and Dweck (1978) used two different methods to track student responses. First, they asked children to show their work while completing the tasks in order to examine their problem-solving

strategies and to watch how their problem solving changed as the task became more difficult. Then, Diener and Dweck asked the children to verbalize their thoughts, feelings, and emotions while completing the tasks. By asking the children to express their emotions in real time, regardless of the kind of thoughts they were having, Diener and Dweck were able to ascertain the child's emotional state. This occurred during increasing task difficulty, which they then compared to the response style of same-age peers in the study. After a comparison of student performances, a connection was noted between displays of helplessness and the child's expressed view of their own intelligence. Diener and Dweck (1978, 1980) subsequently identified two types of students from this research study: those who were mastery-oriented and those they referred to as helpless.

In an attempt to further study these diverging response styles, Diener and Dweck (1978) conducted a study with elementary-age children. They sought to examine the children's attributes and beliefs in response to success and to identify divergent responses to failure. They did this by asking fifth and sixth grade students to solve problems of increasing difficulty. The last four problems were designed to be beyond the threshold of their ability. Diener and Dweck tracked not only the student's problem-solving abilities but the self-talk in which students engaged in while attempting to solve the problem (Diener & Dweck, 1978; Dweck, 2000). The students were split into two groups (confusion and non-confusion) in order to compare their response to success. Therefore, the students in the *non-confusion group* and the *confusion group* possessed members who represented each response style. The children identified as most likely to respond in a helpless way quickly blamed their failure on a lack of intelligence and skill, with more than half of the children in this group responding in such a manner. In contrast, children with mastery-oriented response styles never associated their lack of success to their intellectual

abilities (Dweck, 2000). Furthermore, students who possessed mastery-oriented qualities were more likely to view their success as replicable and also indicative of their aptitude. In contrast, helpless children were more likely to view their failures as the result of a lack of aptitude.

In a follow-up study to this research, Dweck continued to examine mastery-oriented and helpless traits by studying if response styles affected student's ability to learn. In order to examine this connection, Licht and Dweck (1984) developed a 2 x 2 factorial design study, where fifth-grade students were grouped into two different treatments (confusion and non-confusion) as well as identified by two different response styles (mastery-oriented or helpless). Booklets were then created that taught the students about psychology and were designed specifically for the different treatments as one booklet was meant to confuse the reader while another booklet was presented in a straightforward manner. Therefore, both sets of response styles (mastery-oriented and helpless) were exposed to each treatment condition.

The booklet about psychology that was presented to the children was broken into five chapters that included brief multiple-choice questions at the end. The first chapter was an introduction to the topic, and all children received the same chapter. However, chapters two and three were designed to baffle the children in the confusion group and that was accomplished in the following way: children in the confusion group were given passages that included vocabulary words within their reading levels but the sentence composition was arranged in a manner that made it difficult to comprehend. An example of this would be: "How can one describe the nature of the people who will most of all be that way which will make the imitating of others happen most often? Is it that these are the people we want to be like because they are fine or is it that these are the people we want to be liked by?" (Licht & Dweck 1984, p. 631).

The final two chapters of the booklet were identical and presented all the information clearly. Afterwards, children were administered a test to assess their comprehension of the material. It was found that children with helpless response styles were significantly more likely to master the materials in the non-confusion group than in the confusion group; meaning there was a significant interaction between the learning condition and the attribution styles ($F(1, 87) = 6.218$, p .025). Through their research, both Diener and Dweck (1978) and Licht and Dweck (1984) found that in comparison to the mastery-oriented group, children in the helpless group often reacted negatively to failure, and this reaction was often common in children who later endorsed a fixed mindset. Dweck's findings in the area of learned helplessness helped to influence and expand her research into the area of intelligence.

One of the most surprising results of Diener and Dweck's (1978) study was "how quickly students began to denigrate their abilities and blame their intelligence for the failures, saying things like 'I guess I'm not very smart,' 'I never did have a good memory,' and 'I'm no good at things like this'. More than a third of the students in the *helpless* group spontaneously denigrated their intellectual ability; none of the students in the *mastery-oriented* group did so" (2000, p.7). When asked to recall their previous success at the task at hand, students in the mastery-oriented group were able to accurately recall the number of correct responses. Students who exhibited helplessness incorrectly minimized their success, endorsing a higher level of task failure.

Learning Goals

Elliott and Dweck (1988) sought to expand on the initial research on mastery-oriented response styles by examining why students who were equivalent in ability responded in divergent ways. First, they identified two contrasting goals that a student may work towards in

regard to their academic achievement: (a) performance goals, where a student may seek to affirm their intelligence by completing *easy* tasks to highlight their competency or (b) learning goals, where a student seeks to complete tasks that do not call their intelligence into question but rather will increase their ability. In this study, Elliott and Dweck gave the students either a performance goal or learning goal in order to determine the influence goals have over response style.

Based on the results of their study, Elliott and Dweck believed that students who exhibit helplessness were more likely to choose performance goals in the classroom, which reinforced their views of failure or success in relation to their intelligence. When a student's orientation is on a performance goal, they are focused on how they do on any given task and what that conveys to others about their intelligence. Students who pursued learning goals were found to be concerned with acquiring and developing both skills and aptitude. Mastery-oriented students were not concerned over the perception of their performance and were more likely to choose a performance goal (Elliott & Dweck, 1988). Additionally, when mastery-oriented students failed at a task, it was not viewed as representative of their intellect but rather signified that the student must change their problem-solving strategies or approach. Again, Dweck (2000) clarified that while there was no difference in the students' ability to perform the tasks, it was their reaction to their performance that separated them.

After these significant findings, Dweck began to work with Mary Bandura on examining relationships between achievement goals and student self-perception of personal intelligence. They began to conduct studies with fifth and sixth grade students in order to assess their mindset and belief about their own intelligence (Dweck, 2000). Dweck and Bandura gave students a survey that identified their view of intelligence, as well as a list of tasks to choose from that were

associated with a specific achievement goal (i.e., performance or learning). A total of 80 fifth and sixth grade children participated in this study in a public school. Bandura (1983) created a measure whereas children were asked about intelligence and then asked to choose a learning objective and goal. These results were analyzed using a chi square analysis and indicated a strong correlation between the students' view of their own intelligence and the goal they chose (x^2= 2.90, n=80, df=1, p<.09; Phi=.19, p<.10). Specifically, students who endorsed a fixed mindset were more likely to choose a performance goal, whereas students who endorsed a growth mindset were more likely to choose the learning goal.

Process Praise

An important contributing factor in the adaptation of a growth mindset is using what Dweck calls *process praise,* or praise that targets the child's problem-solving strategies. A fixed mindset may be strengthened by *person praise,* which is to make statements connecting performance with perceived intelligence. The type of praise that a student receives has been shown to make a significant difference, and process praise has been shown to improve student performance. Studies have shown that students who are praised for their intelligence following a difficult assignment are more likely to endorse a fixed mindset. Meanwhile, students who are praised for their problem-solving strategies and commitment are more likely to persevere when met with difficult assignments (Dweck, 2006; Mindset Works Inc, 2011).

According to Dweck, it is important to cultivate a climate in the classroom that encourages risk-taking without avoiding difficult challenges. In the course of her work Dweck examined the effects of praise on both genders and discovered that girls were more affected by the kind of praise that they received. Dweck (2000) believed that the frequency at which female students endorsed a fixed mindset was closely associated with the type of praise that they

received from teachers. Dweck theorized that the type of praise received was connected to how children view intelligence (Dweck, 2007). Dweck encourages parents and educators to praise the process, not how *smart* the child is.

Corpus and Lepper (2007) conducted a study with fourth and fifth graders to examine the effects of process praise and person praise on student motivation while completing a puzzle task. The results indicated a statistically significant main effect ($F\ [1,85] = 7.01$, $p < .05$, partial $\eta^2 = .08$). Female students reported an increase in motivation ($M = 5.17$, $SD = .55$) when compared to boys after they received process praise ($M = 4.82$, $SD = .69$). A decrease in motivation for girls was also demonstrated after they received person praise. Corpus and Lepper (2007) concluded that female students receiving frequent process praise would result in a considerable shift in motivation and performance by girls. The adoption of both a growth mindset for girls, and process praise in the classroom, have shown encouraging results in regard to motivation.

Children are not only influenced by their own personal goals, but also by the classroom environment. The style of teaching, and the goals that this instruction are influenced by, also impact the student's perception of their intelligence. In a dissertation to examine the professional identity of teachers and the context in which growth mindset is taught, Menanix (2015) observed the same teacher throughout summer school and then during an academic school year and studied the way she taught the concept of growth mindset to her mathematics class. During summer school, the teacher (Mrs. M) was less constrained in the curriculum, affording her the opportunity to teach mathematics in an environment that promoted student learning, opportunities for failure, and problem-solving discovery. Mrs. M also taught the tenets of growth mindset to her class. Unexpectedly, this also resulted in Mrs. M focusing many of her

students on learning goals as opposed to performance goals, with the latter being shown to reinforce a fixed mindset.

During the academic year, Mrs. M was required to follow the standardized curriculum in order to prepare her students to complete high stakes testing at the end of the year. While Mrs. M continued to teach her math class about the tenets of growth mindset, she also changed the type of praise given to her students. According to Menanix (2015), this contrast in praise had a counter-effect to the growth mindset intervention that Mrs. M was conducting. When analyzed, students' behaviors (attempts at problem solving) and content learning in the summer school cohort showed a statistically significant increase from pretest to posttest (t (12) = 1.90, $p < 0.05$). Additionally, there was a statistically significant increase in the number of problems students attempted as well (t (12) = 2.058, $p < 0.05$). When compared to the summer school cohort, those students in the academic year cohort did not demonstrate any significant changes in their mindsets, despite their ability to speak broadly on the tenets of growth mindset theory. Their focus on performance goals was theorized to be responsible for a lack of behavioral change, resulting in a non-significant change in scores. Additionally, students in the academic year attempted to solve fewer problems as the school year progressed. Menanix (2015) also found that students with a fixed mindset were more concerned with getting the correct answer on their test, while not exerting the maximum effort possible in obtaining the correct answer.

As stated previously, three important factors that a student must possess in order to cultivate a growth mindset are mastery orientation, selection of learning goals, and exposure to process praise by teachers. Past research has shown a relationship between these factors and academic achievement as well, and are an important piece of any growth mindset intervention.

Intelligence and Lifespan Stability

The trait of intelligence is typically measured through the administration of an intelligence test that is grounded in both theory and practice. Many psychologists and theorists argue that intelligence is a trait that demonstrates predictable stability over time and that the cognitive abilities of young children can be predicted into adulthood (Gottfried, Gottfried, & Guerin, 2006, 2009; Schneider, Niklas, & Scmiedeler, 2104; Watkins & Smith, 2013). However, Kamphaus (2001) noted that the stability of intelligence measured at infancy was not as strong a predictor of intelligence as compared to the test scores obtained from older children. Numerous longitudinal studies have corroborated this finding, including a study completed by Bradway and her colleagues (Bradway & Thompson, 1962; Kangas & Bradway, 1971), the Fullerton Longitudinal study (Gottfried, Gottfried, & Guerin, 2006), the Rochester Longitudinal study (Sameroff, Seifer, and Zax, 1982; Sameroff, Seifer, Baldwin, & Baldwin, 1993), and the Fels Longitudinal study (Moss & Kagan, 1964) to name a few.

Recently, Schneider, Niklas, and Schmiedeler (2014) sought to validate previous findings through their own research, expand upon previous sample size, and differentiate stability of intelligence from two different starting points: pre-school age and school age. Their findings were consistent with other longitudinal studies. When intelligence is measured at the preschool age, around 4 years old, IQ scores could be used to predict intelligence across the lifespan. Schneider et al. (2014) concluded that intelligence scores first recorded during preschool and measured through adulthood were stable and reliable over time, with correlations that ranged from .36 through .59. However, when scores were obtained at the school age (7 years old), IQ exhibited a stronger correlation, .79. Therefore, one can assume that IQ scores obtained from elementary aged children are more reliable than earlier scores. According to Bjorklund (2012),

between the ages of 4 and 6 years old, children undergo a large period of development in the brain, specifically in the area of the prefrontal cortex. This may result in more strongly correlated results for children ages 7 and older.

Furthermore, it has been argued that an individual's IQ score, as determined by a cognitive assessment, does not often capture the full extent of their capabilities, such that it only accounts for an individual's capacity to complete a set of tasks. These assessments often do not take into consideration cultural factors or how a person may respond successfully to novel situations (Armstrong, 1993; Fisher, 1997; Gardner & Hatch, 1989). Kamphaus (2001) referenced the research of Sameroff et al. (1993) that discussed how environmental factors affect the stability of intelligence over time, such that the stability of a child's environment, may contribute to the consistency of intelligence scores throughout one's life. Sameroff et al. (1993) found similar correlations between measures of intelligence (r =.72) and the collective risk factors in the environment of the children (r =.76). A few of the collective risk factors that were examined included: minority status, mother's education, family size, family support, mental health, etc. Sameroff believed that multiple factors were related to a child's environment and that biology was not the only factor influencing the stability of intelligence. Kamphaus (2001) theorized that hereditary factors were not the only stable elements that should be considered when one seeks to explain the stability of intelligence over time. Multiple stable elements could contribute to these scores as well, mainly environmental influence and the consistent presence of risk factors. Neither of these factors, Kamphaus suggested, are immune to malleability.

Mindset and Grit

Growth mindset is not the only popular theory making an impact on school systems and pedagogy currently. Another concept related to growth mindset that has begun to gain

popularity is that of grit. Duckworth et al. (2007) conceptualized grit as the persistence and passion one displays when working towards long-term goals. It entails effort in the face of failure, motivation when instant gratification is not present, and interest in long term success despite a lack of progress. Like growth mindset, grit refers to another noncognitive variable that has been shown to have an association with increased academic achievement, goal attainment, perseverance through challenge, and motivation (Duckworth, Peterson, Mathews & Kelly, 2007; Duckworth & Quinn, 2008; Farrington et al., 2012). The research surrounding the variable of grit has expanded in recent years. During their initial study of grit, Duckworth et al. (2007) sought to demonstrate that an individual's IQ would not be related to their grit. Duckworth also reasoned that one of the pathways toward becoming *grittier* is, in essence, to develop a growth mindset.

In order to demonstrate this connection, Duckworth et al. (2007) created the *Grit Scale,* a brief, self-report measure created to quantify the amount of grit an individual possessed. In her first study, Duckworth and her colleagues examined the relationship between grit and IQ, as it was hypothesized that grit may be as fundamental to academic performance as intelligence. They studied these concepts by using the *Grit Scale* to assess a number of different groups: undergraduate students in psychology and cadets at the WestPoint Academy military school (Duckworth, 2007; Duckworth & Quinn, 2009). The grit of undergraduate students was assessed using the Grit scale and it was determined that students who endorsed grit performed higher than those who did not and their GPAs were correlated ($r= .25$, $p<0.1$). This relationship was even stronger when using SAT scores as an additional variable ($r= .34$, $p< 0.1$).

Duckworth and her colleagues also assessed the grit of WestPoint cadets and while they did not find any correlation between scores on tests of leadership potential, grit was related to

self-control ($r= .63$, $p< .01$). Similarly, grit predicted a successful completion of their summer training program and cadets who were at least a standard deviation higher that the average score on the grit scale were more likely to finish ($\beta= .48$, $OR= 1.62$, $p< 00.1$).

Duckworth did acknowledge that one limitation of her studies was that the subject groups tended to be comprised of high achieving, highly intelligent populations, and thus would have some difficulty being generalized to the public who do not fit those descriptions. Duckworth acknowledged that researchers "have necessarily limited the external validity" of the study and therefore expressed reservations inferring results on a generalized sample (Duckworth, 2007, p. 1099).

Recently, Credé, Tynan, and Harms (2016) conducted a meta-analysis and found that the research conducted by Duckworth and her colleagues did not hold up upon further inspection. Specifically, they found that Duckworth and Quinn incorrectly analyzed and interpreted data from their studies. Credé et al. (2016) reported that Duckworth and her colleagues appeared to "confuse odds ratios with probabilities in their discussion of logistic regression results, resulting in incorrect inferences about the size of observed effects" (2016, p. 494). Despite this, the results of her research have encouraged many school districts to adapt programs that promote grit with the hope of increasing student academic success. However, at this time there is still inconclusive evidence that attempting to improve grit has an impact on students' actual academic achievement or that it can be generalized to a larger population (Farrington et al., 2012; Phillips-Martinez, 2017).

Farrington et al. (2012) found that when a student's grit was measured prior to the inclusion of additional variables such as self-control or academic achievement, a smaller relationship was shown, indicating that the relationship may not be as noteworthy as originally

thought. Based on these results, Farrington et al. (2012) reasoned that while the field is continuing to find ways to promote academic mindsets and determination, it should be noted that context, teaching styles, and environment play the biggest role in encouraging students to develop both grit and growth mindset.

Effects on Academic Achievement

The increasing popularity of growth mindset in schools has resulted in increased research in this area, especially in regard to academic achievement and achievement goals. As previously stated, a growth mindset is one in which the individual believes that they can become smarter. They believe that through hard work and commitment to learning, they can increase their own knowledge. It is founded on the belief that one grows and changes from their experience and that intelligence can increase through practice and skill development. Interventions that seek to expand upon a growth mindset often targets the way one views intelligence, in order to increase a student's academic performance (Donohue, Topping, & Hannah, 2012).

Dweck (2006) believes that possessing a fixed mindset leads to an overwhelming drive to prove oneself to one's family, community, or teachers. Dweck wrote that most children are indoctrinated in school with the concept that intelligence is not something that can be changed and that students should prove themselves in the classroom. This results in a negative association with learning that may remain with someone throughout his or her adult life. Dweck proposed that through the development of a growth mindset, children can change the way the feel about themselves, how they feel about their aptitude and abilities, and foster a desire for lifelong learning.

Possessing a malleable view of intelligence has been positively associated with academic achievement. Blackwell, Trezseniewski, and Dweck (2007) conducted a longitudinal study that

had two separate parts. First, Blackwell and her colleagues sought to find a relationship between growth mindset and academic performance by following four cohorts of students in a New York City high school in a five-year period when they entered the seventh grade and exited the eighth grade. At the beginning of each semester, the students were given a survey that assessed mindset, response to failure, and beliefs about effort and goals. Math test scores were monitored, and the results showed that students who endorsed a growth mindset outperformed those students who endorsed a fixed mindset.

Blackwell et al. (2007) then conducted a second study with approximately 100 seventh grade students in a New York City public school. Half of the students were placed into a control group, while the other half received a growth mindset intervention. The students attended workshops where they learned about the physiology of the brain, study skills, and cognitive techniques to reverse stereotype thinking. After the eight-week intervention, the math scores of students in the experimental and control groups were compared across a predicted trajectory to assess if the intervention effected their performance in math. Data was taken at three separate times in the student's school year: spring of sixth grade, fall of seventh grade, and spring of seventh grade. The results showed that those students in the control group had a decline in their math grades, which was expected based on the performance of previous years' students. However, students in the experimental group performed better than expected, and there was a significant change in grades between the fall and spring of seventh grade ($b = .53$, $t = 2.93$, $p < .05$). Therefore, one could assume that if you could shape a students' belief about intelligence toward a growth mindset, then you could positively impact their academic performance.

In another study that sought to examine mindset and academic achievement, Yeager and Dweck (2012) analyzed the effect of mindset on student academic and social behaviors by

examining published research in the area of student mindsets, including their own published work. Based on this meta-analysis, they concluded that the literature shows that when a student possesses a growth mindset, it affects their ability to learn and set personal goals. They also determined that when a student exhibits an increase in effort, this often resulted in an increase in their academic performance. Additionally, they assessed the effects that setbacks had on the students' view of their own abilities and their performance.

Yeager and Dweck (2012) believed that the current literature established that students who possessed a growth mindset were able to persevere through a difficult task, often attempting multiple ways to solve a problem. In contrast, students who possessed a fixed mindset gave up easily and were not able to problem solve difficult tasks. While research in this area has been limited, it is a growing field that promises to further examine the strength of these results in the next decade.

In a study that sought to examine the association between math and reading scores and mindset over time, McCutchen et al. (2015) collected longitudinal data in the form of standardized test scores for third through sixth grade students. Student's mindset was determined using the *Mindset Assessment Profile* (MAP), developed by Dweck, in the fall and spring semesters. Their scores on reading and math testing were also collected, and the data was collected four times per school year over the course of two calendar years. Students first completed mindset questionnaires and then their reading and math scores were collected. A linear growth model was used to predict student's academic performance across three points in time. The results of this study indicated that of the students who showed a decline in performance, the students who endorsed a fixed mindset had a sharper decline in test scores than those who endorsed a growth mindset. While there were no significant differences related to

mindset in either reading or math, there was a significant interaction for math with regards to "time and mindset (b = .65, p =.03), indicating that both a student's growth rate and intercept are conditional on mindset" (McCutchen et al., 2016, p.211).

Recently, two meta-analyses were conducted by Sisk, Burgoyne, Sun, Butler, and Macnamara (2018) that sought to synthesize the field of research between growth mindset and academic achievement. These findings indicated a weak relationship between mindset and academic achievement. In the first meta-analysis, Sisk et al. (2018) looked at several moderating factors known to be included in the research on growth mindset: academic achievement, student age (development), academic performance (if students are at-risk for failure), and socio-economic status. They also sought to analyze research studies that were either publicized or not submitted for publication in order to scrutinize the results for biases. The results of the first meta-analyses showed that the relationship between mindset and academic achievement was weak (r= 10). Additionally, the moderating factors previously mentioned did not affect the variance of the model, specifically socio-economic status and academic achievement.

For the second meta-analysis, Sisk et al. (2018) examined growth mindset interventions at schools who had the promise of increasing student achievement. Multiple factors were examined including the type of intervention (computer-based, teacher/researcher administered, or a combination of the two) and whether it was passive, feedback driven, or interactive. They also examined whether a study had a control group and what kind of control group, the timing of implementation (during classroom activity or afterschool), socio-economic status, academic achievement, student age (development). The results were mixed.

Sisk et al. (2018) discovered that the interventions that significantly impacted student's academic achievement had the following moderating factors: students from a home that was

determined to be of a low socio-economic status had a significantly higher effect when administered a growth mindset intervention (d= 0.34, 95% CI = [0.07, 0.62], p= .013); students who participated in the intervention outside of regular classroom activities showed a significant change when compared to interventions that took place during daily classroom activities (d= 0.09, 95% CI = [0.03, 0.16], p= .003); when students read about mindset as opposed to completing a computer program (d= 0.20, 95% CI = [0.09, 0.30], p= .001) and the interaction was active as opposed to passive (d= 0.09, 95% CI = [0.02, 0.16], p= .011). The second meta-analyses found that the following moderators did not affect student achievement when a mindset intervention was given: developmental age, risk for academic failure or history of poor performance, or assignment to condition or control grouping. Furthermore, results of publication bias were inconclusive.

According to the results of the two meta-analyses of the current literature both published and unpublished in the field of growth mindset, the following conclusions may be made: mindset interventions showed a weak relationship with academic achievement for at-risk student populations. However, the results did show a significant change in academic achievement for students who came from low socio-economic households. With such varied results, this study hopes to add to the literature available by examining the effectiveness of a computer-based intervention in a low socio-economic school district.

Mindset Interventions

With the potential to increase academic performance in students, a growing need for school-based mindset interventions has emerged. Currently, there are two research-based programs that are designed to increase mindset that are available to use with students, the Stanford University *Project for Education Research that Scales* (PERTS) program and the

Brainology curriculum. Mindset Works Inc. has also developed an intervention for younger children, *Growing Early Mindsets*, that will be discussed, and was released at the end of 2019. All three programs will be discussed in the following sections.

Project for Education Research that Scales (PERTS)

The Stanford University PERTS program is a non-profit entity associated with a wide-ranging research collective compromised of Carol Dweck and her colleagues at Stanford. According to the PERTS website, Academic Motivation (2016), their main goal is to *bridge the gap* between research, practice, and application for traditionally underserved communities and schools. Their free online program, *Growth Mindset for 9th Graders*, has been designed to increase motivation, growth mindset, and resiliency in adolescents. This is done through two 30-minute online modules that teach students about a variety of topics from the malleability of their brain to successful study strategies. These two modules are given one to four weeks apart, and the information is then solidified through writing exercises requiring the student to explain the concepts of growth mindset to their peers.

For his study, Paunesku (2013) analyzed data collected from the PERTS program on student mindset, school mindset, and student grades, which were compiled from twenty-three different schools and over 1500 students, using linear mixed effect models. Students completed two separate modules online at the beginning and end of their spring semester. Mindset was assessed prior to the intervention, and the students were monitored by teachers who were blind to testing conditions.

In regard to student grade point average (GPA), "mindsets pre-intervention were positively associated with GPAs, $b = .056$, $se = .020$, $t = 2.878$, and school mindsets were positively associated with GPA, $b = .54$, $se = .17$, $t = 3.141$" (Paunesku, 2013, p.113).

Additionally, the results of the intervention increased student likelihood that they would endorse growth mindset on a follow up measure, $b = .17$, $se = .037$, $t = 4.45$, $x^2(1) = 19.759$, $p < .001$. The PERTS intervention positively impacted students by fostering a growth mindset. The outcomes showed a relationship between school climate, academic achievement, and student mindset.

In another study, Paunesku et al. (2015) sought to examine the efficacy of large-scale interventions with students from various regions across the United States to determine whether two mindset interventions, one for growth mindset and the second for a sense of purpose, would increase the academic achievement of students. Paunesku et al. (2015) obtained a large sample of 1,594 students from varying educational institutions across the country such as public schools, charter schools, and one private school. In this study, students were randomly assigned to three groups: one group that only received the PERTS growth mindset intervention, one group that only received the sense-of-purpose intervention, and one group that received a combination of both interventions.

Students who received only the sense of purpose intervention or the combined intervention did not demonstrate a change in academic performance. However, based on a regression analysis, students who were in the intervention-group had a greater chance of earning passing grades post-intervention when compared to students in the control group (OR= 1.58, $Z = 2.68$, $p = .007$). Paunesku et al. (2015) hypothesized that this result occurred because it was too challenging for students to change two such distinctive belief systems at the same time. One could then hypothesize that an intervention looking to target growth mindset and have the highest impact on academic achievement should focus solely on student mindset, eliminating other factors or beliefs for intervention.

Growing Early Mindsets

Recently, researchers have created a growth mindset intervention program to be used with kindergarten through third grade students titled Growing Early Mindsets (Coates, in publication). Coates (2016) is an academic researcher at Mindset Works Inc. who developed the Growing Early Mindsets program and recently conducted a study to examine the effects of this intervention on the mindset of teachers and students. Coates (2016) designed Growing Early Mindsets to incorporate the tenets of growth mindset, mindfulness, and social-emotional learning because these areas often overlap and are addressed through the administration of separate programs. Coates (2016) found that teacher reports were statistically significant for student approaches to social-emotional learning when comparing the pretest scores (M= 3.003) to the posttest scores (M= 3.868). However, when student surveys were analyzed the results were not statistically significant (p = .260, d = - .128).

Growing Early Mindsets was designed to be a preventative measure in order to improve academic, social, and emotional learning for students, as opposed to an intervention to correct maladaptive behaviors after their onset. At this time, Coates is the first known researcher to have measured either a prevention or intervention program designed to increase growth mindset with early learners, younger than fifth grade. This program is newly designed and recently published; therefore, it has not been independently assessed at this time. While previous studies have shown positive changes in student's mindsets, they were interventions that were conducted with older students (Blackwell et al., 2007).

Brainology

The *Brainology* program was created to foster a growth mindset in children and adolescents. In *Brainology* (Mindset Works, 2011), students watch videos that feature two

animated characters named Dahlia and Chris. These characters introduce students to the main concepts of growth mindset and brain plasticity. Chris and Dahlia visit the lab of a neurologist named Dr. Cerberus. At the lab they "learn about the basic structure and function of the brain: how thinking occurs, how learning and memory work, how to develop and change the brain, and how to improve their study habits and skills in light of this knowledge" (Mindset Works, 2011, p.10). Through viewing this video and participating in interactive activities and classroom exercises, these concepts are then personalized when students are asked to journal their thoughts, feelings, and experiences.

Wilkins (2014) conducted a study to examine the effects of growth mindset on academic achievement using the *Brainology* curriculum. This study had a mixed method, experimental design whose primary purpose was to evaluate *Brainology* as an intervention. The quantitative data collected for this study were from pre- and post-student surveys, teacher observation forms, teacher surveys, and quarterly math and science grades. The qualitative data collected was in the form of teacher and student focus groups. The participants were from 30 seventh grade science classrooms. Students were required to complete the *Brainology* online program, and then researchers conducted focus groups with students to discuss what they had learned. Wilkins sought to determine if *Brainology* "would have a positive effect on student's (a) beliefs about intelligence, (b) effort beliefs, (c) academic self-efficacy, (d) interest and engagement in science, (e) effort in science, (f) motivation in science, (g) use of study skill strategies for learning, and (h) achievement in math and science" (Wilkins, 2014, p. 59).

The results indicated that there was no statistically significant increase or decrease in the above domains, except for a significant gain in student motivation following the *Brainology* intervention. However, Wilkins (2014) believed that the absence of significant change may be

attributed to methodological and implementation problems. One major barrier of this study was the fact that many students only partially completed the *Brainology* intervention, and none of the student groups completed the entire *Brainology* curriculum. Teachers noted a lack of access to a computer lab and insufficient laptops and headphones as a barrier to implementing the program with fidelity. These barriers prevented students from learning even the basic tenets of growth mindset research, which was supported during lack of response in focus groups.

In a dissertation that sought to examine the effects of the *Brainology* intervention on mathematical achievement and anxiety about math, Wieland (2011) administered the program to 10th grade, general education students. Their mindsets were assessed pre-and post-intervention utilizing the *Implicit Theories of Intelligence Scale for Children- Self-Form.* Additionally, their academic achievement in math and their anxiety about math were also assessed pre and post intervention. The results showed that students who endorsed a fixed mindset prior to the completion of the *Brainology* intervention were more likely to demonstrate a significant change in their mindset at the end of the four-week intervention (*MD*= 30, t (18) = 2 18, p <0.5). Similarly, students who exhibited anxiety when asked to complete math assignments showed a decrease in their anxiety symptoms following the intervention when compared to the control group (*MD*= -5.76, *SE*= 9 41, *t* (16), p <0.5). Finally, there was no significant difference in their math achievement, as there was an overall positive increase in performance that was likely due to instruction and maturity (Wieland, 2011).

Another study of the *Brainology* curriculum resulted in a change in growth mindset, but it also had design flaws. Baldridge (2010) completed a study using the *Brainology* curriculum to examine whether students with a learning disability would change their beliefs about intelligence, academic self-efficacy, effort, and achievement after completing the *Brainology*

intervention. In this mixed methods study, the researcher selected a treatment group of 12 students, each was classified as a special education student with reading difficulties. These 12 students received the *Brainology* intervention and there was no control group. Pre-and posttest surveys were completed, and data was collected in regard to students' beliefs about intelligence, effort, academic goals, and self-efficacy. Additionally, qualitative data was collected through the review of student journals, individual interviews, and group discussions.

The results showed a slight, overall positive change in student's belief towards a growth mindset with an increase from a mean pretest score of 11.75 to a mean posttest score of 12.41. The data was not statistically significant and did not reflect large changes in the areas in which Baldridge was studying. It was determined that less than 50% of the students surveyed changed their beliefs regarding intelligence, and Baldridge (2010) speculated that this was due to methodological problems in the construction of the study, most specifically the wording of the surveys and the confusion respondents may have experienced.

Additionally, while the program was designed to be used with high school students, Baldridge (2010) indicated in her discussion that the design of the Brainology program might have impacted the reception; she speculated that it would have been better received by younger students. During group discussions, the students reportedly did not like the presentation of the information and believed that it lacked the sophisticated graphics of modern computer games and movies. Furthermore, Baldridge (2010) theorized that high school students with learning disabilities, or those who have struggled academically in the past, may have well-formed beliefs about their intelligence and abilities. The strength of this perception is formed by the environment and the attitudes of teachers and peers before the student enters high school.

Therefore, one may conclude that the *Brainology* program may be more acceptable for typically developing students.

Current Study

Students in elementary schools have been increasingly exposed to the theory of growth mindset; however, there has been no research utilizing these computer-based programs with elementary-age students. The theory of growth mindset has become popular in primary school settings, but the majority of current research has been completed in secondary school settings with adolescents. There are limited interventions available for younger students (Baldridge, 2010; Blackwell et al, 2007; Yeager & Dweck, 2012). This study seeks to examine the effectiveness of the *Brainology* program at establishing a growth mindset with young children. The *Brainology* program will be administered to third grade students, and pre-test and post-test data will be analyzed for an impact on student mindset. Hypothetically, students who participate in the intervention program will develop a growth mindset, while students who are in the control group will see no change in their mindset. Based on previous research, one can conclude that conducting a growth mindset intervention with elementary-age children would be both appropriate and necessary to further the research in the field of implicit theories of intelligence.

CHAPTER 3

METHODOLOGY

Participants

The participants in this research study were third grade students at a rural elementary school in Western New York. The school currently has 536 students enrolled, with approximately 80 third grade students. Within the elementary school, 45% of students are eligible for a free or reduced lunch and 8% are classified as a student in need of special education services. There was a total of four, third-grade classrooms at this setting. Each classroom contained approximately 20 children, with one teacher. The intervention program was conducted in two classrooms, the other two classrooms served as the comparison group. The classrooms were paired based on proximity in the hallway to one another along with the fact that each pair currently switches teachers for Math and English instruction, therefore reducing the opportunity for contamination. The intervention groups were randomly selected.

Variables

Participation in the *Brainology Program* was selected as the independent variable and has two levels, those who participated in the intervention and those assigned to the comparison group/classroom. Additionally, gender was examined, as one of the researcher's hypotheses was that female students would show a larger increase in growth mindset than male students. The dependent variable was *student mindset* and was measured through the *Mindset Assessment Profile* (MAP; see Appendix A). The MAP is an eight-question survey that uses a six-point Likert scale to measure student mindset. The scores range from 8-48, and scores between 8-28 are considered a fixed mindset; whereas, growth mindset scores range from 29-48. This score helps to identify a range of mindset groups that have a classification and description associated with each range of scores. Please refer to *Appendix A* for further information.

The MAP was used to collect pre and post intervention data. The MAP has been shown to have a reliability of .76 (Cronbach's Alpha), which is an acceptable level for internal consistency (Wilkins, 2014). Although the MAP has not been previously used in research with third grade students, all participating third grade teachers examined the wording and vocabulary of the measure prior to the start of the intervention and agreed that the MAP was appropriate for their students.

Study Design

This research was quasi-experimental in design due to the use of pre-existing groups and lack of random assignment of participants to the experimental or comparison group. The design of the experiment was both a within-subjects design, as well as a between-subjects comparison. The within subject design allowed the researcher to examine changes within the students pre and post intervention. The between-subjects comparison allowed the researcher to compare student's mindset between the experimental and comparison groups by comparing both pretest and posttest scores obtained on the MAP. Due to this being a school-based intervention, and the researcher having a prior working relationship with the school, a convenience sample was utilized to study the effects of mindset following the implementation of the *Brainology* program. However, classrooms were paired, and treatment groups were randomly chosen. Students were designated to participate in either the treatment or comparison groups based on their preexisting enrollment in that classroom.

Procedures

The Brainology program was administered to third grade students, and two classrooms of students were in the comparison group and two were in the experimental group. These students were recruited to participate in the *Brainology* program through a letter that was sent home to

their parent/guardian to inform them of the program and asked for signed consent that their child be allowed to participate. A copy of this letter may be found in *Appendix B*. Parents were given the option to opt-out of the experiment, and four children were not given permission to participate. These students were assigned to the library during intervention times in the classroom and they were allowed to work on homework while the class completed the *Brainology* program. *Brainology* was administered to students during the same two periods every week, one was during a technology block in their schedule when they used laptops in the classroom to complete computer based academic intervention and benchmarking. The second period was during a character education block in the schedule. The comparison group continued to participate in these activities as they normally would, while the experimental group received the computer based *Brainology* intervention.

In total, 76 students participated in this study, 34 students were in the experimental group while 39 students were in the comparison group. Data was collected for 73 students as there were three students absent for post-test data collection. Classrooms were paired off and the pair designated as the treatment group was randomly drawn by the researcher. The district administration requested that the program be delivered over a six-week timeline from May 2019 through June 2019. The intervention program was administered in the classroom via each student's individual laptop computer, which was given out at the start of the year. The *Brainology* program consists of four core lessons, with three or four optional mini lessons that last for 30 minutes each. Each week the classroom teacher administered one computer lesson and one mini lesson. Teachers in the experimental classroom chose which breakout lesson they would complete, and they administered the same one to both classes in the experimental group.

Training was provided to the teachers who implemented this program prior to the start of the intervention. Teachers met with this researcher for three hours each to conduct a training. During this time, a thorough review of the *Brainology* computer program was conducted, and each teacher completed the Introduction module in order to ascertain the structure of the program. Afterwards, both teachers identified and agreed to each break out session, as well as the weekly schedule (days and times) for the intervention to occur. At the end of the individual trainings, this researcher provided both teachers with a written copy of the schedule to confirm that the implementation of the intervention was simultaneous. Furthermore, each teacher agreed to complete weekly logs and email them back to the researcher in order to address any concerns the teachers had while running the intervention.

After the initial training session, this researcher made copies of all necessary paperwork (lesson plans and handouts) for each classroom. Breakout session handouts were copied for each classroom and placed into a folder labeled to indicate the teacher, unit number, and lesson of each packet. These folders were then arranged in chronological order of instruction and placed into a box. All of this was done in order to ease the delivery of the intervention for the teachers.

At the start of the intervention and after completion, the researcher administered the paper version of the Mindset Assessment Profile (MAP) to all third-grade students. Each teacher reported that they completed the intervention concurrently and in the same manner, in order to assure fidelity of implementation. Fidelity was encouraged through a log provided to the teachers, see Appendix C. The log was designed to keep track of the lessons that they completed each week, which students participated in the lesson, and if the lesson was finished in the allotted time frame. In addition to tracking their lessons, teachers were required to email the researcher at the end of each week with an update on the progress of the intervention. Furthermore, both

teachers were encouraged to call or skype with the researcher when issues arose during the implementation of the program. The teachers agreed to all of these conditions prior to the start of the study.

Brainology

The *Brainology* program is a research-based program that has been shown to have an effect on student mindset (Baldridge, 2010; Wieland, 2011; Wilkins, 2014). The *Brainology* curriculum (Mindset Works, Inc., 2011) is divided into an introduction and four units. There is a total of 12 lessons, organized into four separate units, designed to be delivered over a minimum of four weeks to students from fourth through ninth grade. These four separate units are 30 minutes in length and are accessed online through a license obtained when a school district purchases the program. During the introduction, students are asked to complete a Mindset Assessment Profile before the start of the program. The purpose of this assessment is to measure growth mindset and to obtain a baseline for the students' current mindset. However, it is important for the students to not feel as though this is a test. The assessment is an eight-question survey that asks students to choose an answer from a six-point Likert scale. After the Mindset Assessment Profile has been completed, students then participate in three additional unit activities conducted by teachers to introduce them to the topics covered in the Brainology program.

In Unit 1: Brain Basics (Mindset Works Inc., 2011), students learn about the structure and function of the brain, how learning is related to attention, and active learning and study skills. In this unit, students learn ways to keep their brain and body healthy by developing good habits in regard to their sleep, nutrition, and exercise. Additionally, this unit focuses on teaching children about the relationship between their five senses and how they learn.

In Unit 2: Brain Behavior, students are taught about brain functions and are introduced to such concepts as neurons, nerve cells, dendrites, and chemical messaging. Students are provided with a foundation that discusses how learning can change the brain. In this unit, students also learned social-emotional skills and that emotions can affect one's thoughts or behaviors. In this unit, students learn about stress symptoms and the effects that these symptoms can have on their bodies and their ability to learn in the classroom. This unit covers both physical and emotional symptoms of stress. Students are asked to complete a Stress Symptom Inventory, which requires them to identify five symptoms that they believe can negatively impact their academic achievement. Additionally, students learn that such negative emotions such as test anxiety can limit their performance and that through preparation and a growth mindset, they can manage those feelings and emotions.

Unit 3: Brain Building, helps students to make the connection between learning and neuron development. After the completion of the unit's three activities, students are expected to be able to connect how effort and practice lead to the development of new neural pathways. This is one of the key tenets of growth mindset--that by growing the neurons and their connections in their brain, students are able to increase their intelligence. These activities are designed to teach students that the brain is a muscle that they can grow and develop through exercise. Practice and repetition are designed to grow the connections of neural pathways in their brain.

Unit 4: Brain Boosters, is designed to build upon all the previous lessons and activities, tying learning, practice, and effort to increased intelligence and neuron growth with memory. In this unit, students learn that good study strategies can increase their academic achievement and strengthen their memory. Students learn that new information becomes long-term memory and knowledge through repeated practice of new materials. Students are taught strategies that

teachers are familiar with such as chunking, visual imagery, and mnemonics. As such in every module, students are asked to reflect on their own mindsets and whether they possess a fixed or growth mindset. Then students engage in additional activities designed to enhance their study skills. These lessons culminate in an end-of-course activity. This activity is a presentation designed to be given to the class, and students may use any media available to them. This teaching component is intended to solidify the concepts and ideas of growth mindset (Mindset Works Inc., 2011).

Throughout the *Brainology* program, each unit utilizes assessments to track student progress for the classroom teacher and identifies which students need help in mastering these concepts. The *Brainology* program curriculum and manual offers teachers a Re-Teaching Guide. The purpose of this guide is to provide teachers with a variety of options when re-teaching the curriculum to students who are struggling. The assessments are included at the end of every unit (Mindset Works Inc., 2011).

Analysis

After the completion of this intervention, the pre and post data was analyzed using an OLS simultaneous multiple regression analysis. Although regression analysis is typically used in correlational research, it can be used with a between-subjects design by including membership in the intervention or control group as a binary independent variable. By completing a multiple regression, pre-test scores were studied as an additional statistical control variable. This was done in order to determine if the program had a different effect on students with various levels of growth mindset. In the analysis, change in mindset was regressed with gender, pretest scores, and participation in the intervention. Gender was further examined by utilizing a paired samples t-test to examine the means of female and male students.

Chapter 4

Results

The Brainology intervention was delivered over a six-week period in the Spring of 2019. The outcomes of this intervention were analyzed using quantitative data from the Mindset Assessment Profile (MAP) to examine pre-test and post-test performance of third grade students in a rural elementary school. Half of the third-grade students were assigned to a comparison group while the other half were administered this research-based intervention. The results of the MAP where then examined using a multiple regression model and an independent samples t-test. This chapter provides the results of the analyses that were conducted to answer the following questions:

- Will participation in the Brainology intervention program result in an increase of growth mindset for all students?
- Will students who initially endorsed a fixed mindset exhibit a greater change than the students who endorsed a growth mindset?
- Will female students who participate in this intervention see a greater increase in growth mindset than male students?

Sample description

In total, data from 73 students was analyzed in this study, 34 students were in the experimental group while 39 students were in the comparison group. There were two experimental classrooms (A and B) as well as two control classrooms (C and D). In classroom A there were 18 students, 8 boys and 10 girls. In classroom B there were 16 students, 8 boys and 8 girls. For the comparison group, in classroom C there were 20 students, 11 boys and 9 girls. In classroom D there were 19 students, 10 boys and 9 girls. There was a total of four students who

were not included in the study because their parents did not consent to their participation in the intervention, and all of those students were from classroom B. During the time of the intervention, these students went to the library for forty-five minutes to work on assignments they had yet to complete from the previous school week. Additionally, three students were not present on the day that post-test data was collected, therefore, their pre-test scores were not included in the analysis, resulting in a final sample size of 73 students. At the beginning of the analyses, an examination of the frequencies of pretest scores was conducted to determine the number of students who began the experiment possessing either a growth mindset or a fixed mindset.

Group equivalence

In order to determine equivalency between groups prior to the intervention, all classrooms completed the paper version of the MAP with the researcher present in the room. There were three students who were absent, and they completed the MAP upon their return to the classroom. The range of possible scores on the MAP are as follows: fixed mindset (8-28) and growth mindset (29-48). The overall mean score for the sample as reported by students on the MAP pre-test, was 33. The experimental group mean was 32.89 (SD= 6.27), and the comparison group mean was 33.26 (SD= 6.13), indicating that there was an approximate equivalence in regard to the scores reported. An independent samples t-test was conducted to examine differences in the groups prior to the start of the intervention and the results were not significant ($t= -.257$, $p= .798$). Overall, the means of the sample indicated that on average, the pretest scores reported by the MAP fell within the range indicating a growth mindset. Specifically, it was determined that 74% of the students who participated in this study reported a score that fell

within the growth mindset range while 19% of students began the study endorsing a fixed mindset.

In addition to the overall mindset of students, mindset per classroom was examined as well. The pre-intervention MAP scores were analyzed to determine the average mindset for the students, and the results are as follows: Classroom A *M*= 33.833, *SD* = 6.25; Classroom B *M*= 31.81, *SD*= 6.30; Classroom C *M*= 32.95, *SD* = 5.34; Classroom D *M*= 33.58; *SD* = 7.00. Additionally, a one-way analysis of variance was conducted to test for differences between classrooms at the start of the intervention. The results were not statistically significant (F [3, 69] = .351, p= .788), therefore at the start of the intervention there were no significant differences between the groups.

Multiple Regression Analyses

This study was designed to determine the influence that a growth mindset intervention would have on student mindset, when controlling for gender, prior mindset, and participation in the intervention. Results from preliminary analyses confirmed that there were no violations of the assumptions of normality, linearity, and homoscedasticity. The overall multiple regression was statistically significant (R2 = .202, F [3,69] = 5.085, p < .001), and the three variables accounted for 20% of the variation in mindset change. Two of the independent variables, gender and pretest, were significantly associated with mindset change. Of more direct interest was the lack of significant change in the group variable. The unstandardized regression coefficient (b) for the group assignment was 1.115 (t (69) = .846, p = 0.401). This finding indicates that the placement in either the experimental or control group did not produce a significant effect in regard to the outcome of the intervention. Therefore, hypothesis one was not supported by the results.

Furthermore, the unstandardized regression coefficient (b) for total pretest was -.384 (t (69) = -3.574, p = .001). This indicated that mindset at the start of the intervention significantly impacted change in mindset. Specifically, those with a higher mindset score changed less than those with a lower mindset score. As previously reported, the mean score for the pretest was 33, which indicates a growth mindset. By including pretest scores as an additional independent variable, the researcher was able to control for the different levels of pretest scores. Students with higher scores changed less than students with lower scores. Therefore, hypothesis two was partially supported, because students who initially endorsed a fixed mindset exhibited a greater change than students who began the study endorsing a growth mindset.

Finally, the third hypothesis sought to examine the extent to which gender could predict a change in mindset. The unstandardized regression coefficient (b) for gender was 2.654 (t (69) = 2.017, p = 0.048). This finding suggests that the gender of the student significantly impacted change in mindset. In particular, as a result of the intervention, girls' MAP scores changed 2.654 points more on average than boys. An additional paired samples t-test was conducted in order to further examine this hypothesis. The results indicated that female students in the experimental group displayed a significant, positive change in mindset, with an average increase of 3.44 points on the MAP when compared to the male students whose scores decreased an average of 1.13 points, t (32) = -2.046, p=.049. Both female and male students exhibited no significant difference in the comparison group, t (37) = -.371, p= .713. These results will be further discussed in the following chapter.

Follow up analyses. After running the multiple regression analysis, paired samples t-tests were performed on the data from each classroom in order to investigate the possibility that one of the classrooms performed better than the other. A paired samples t-test was conducted to compare

the differences between the pre-test and post-test results in each of the four classrooms. While the results of the analyses did not yield any statistically significant differences, one classroom was approaching significance in the findings. In Classroom A, the results were approaching a meaningful difference in the pretest (M=33.83, SD= 6.25) and the posttest (M=36.72, SD=5.53) conditions; t (17) =-2.036, p= .058). Based on these results, a mixed factorial ANOVA was conducted on classroom A. The pre-test scores were used as the within-in subjects variable and gender was used as the between subject's variable. The results of the ANOVA were not statistically significant; F (1, 16) = .440, p= .516.

The variables of prior mindset and gender were both found to be significant predictors of mindset change post intervention. The following chapter will discuss possible reasons and factors that may have contributed to these results. The analyses will be discussed in further detail as well as an examination of the study design and implications for future research.

Chapter 5

Discussion

The purpose of this study was to examine the effectiveness of the *Brainology* program on elementary-age children. The two classrooms were given the same instructions, program, and breakout sessions to be conducted over a six-week period. The multiple regression model explained 20% of the variance in change in mindset scores, but only gender and pre-test scores were associated with mindset change. The *Mindset Assessment Profile* (MAP) was used to determine a students' mindset at the beginning and end of the intervention. Findings also indicated that a majority of students in both the experimental group and the control groups began the study endorsing a high score for growth mindset as assessed by the MAP. The results of the statistical analysis indicated that the group that participated in the intervention did not have significantly higher scores than the group that did not participate.

The results were surprising considering that there was no overall effect on mindset for the students who participated in the intervention relative to those who were in the comparison group. Most surprising, however, was that the results on the MAP were fairly consistent across all classrooms and that a majority of the students began the study already indicating that they had a growth mindset. These scores may have been the result of a ceiling effect, which will be discussed in greater detail later in this chapter. Also, the present study's results were different from previous studies where no effect was shown. The MAP was not used to assess the student's mindset in the previous studies, therefore limiting comparisons with the results for this study.

Initial analyses did not reveal significant findings between experimental and comparison groupings; however, subsequent analysis determined a significant effect for gender. This suggests that *Brainology* was an effective intervention for female students. In regard to gender,

the results of this study showed that participation in the intervention group was a statistically significant predictor of change in mindset for female students when compared to male students in both groups and female students in the control group. One possible reason for the outcome is that girls benefited from the teachers utilizing process praise within the classroom in conjunction with the intervention. This is a speculation based on the fact that the *Brainology* program manual includes a section on process praise, describing what it is and when to utilize it in the classroom when providing student feedback. Specifically, it discusses how to cultivate a growth mindset through process praise and past research that links fixed mindsets to praise related only to intelligence, not process (Mindset Works, 2011).

Previous research had established a connection between gender and types of praise and concluded that combining growth mindset and process praise in the classroom have shown encouraging results in regard to motivation and academic achievement for girls in particular (Corpus and Lepper, 2007; Dweck, 2000; Dweck, 2007; Vernier & Mariniot, 2015). The encouragement of teachers to utilize process praise in the manual may have resulted in the increase in growth mindset for female students in this study. Further exploration in this area should be considered, especially with students that have not been introduced to the concepts of growth mindset either in the class or in their school environment, as will be discussed later on in the chapter.

As previously mentioned, on average, the pretest score was high for the entire sample and the average score of 33 placed the students within the range of a growth mindset at the onset of the study. One possible cause for this result is that student scores on the pretest were unnaturally inflated due to the measure itself. The *Mindset Assessment Profile* was created and influenced by the *Implicit Theories of Intelligence Scale for Children – Self Form* created by Dweck (2000).

This measure was not only used by Dweck in her earlier work with growth mindset but in studies conducted by other researchers as well (Blackwell et al, 2007; Baldridge, 2010; Wieland, 2011). According to Dweck (2000), when the scale was first created, only items associated with a fixed mindset were included. This was due to the fact that using items targeting a growth mindset often resulted in disproportionately high ratings. Dweck hypothesized that this may have been the results of wanting to make themselves 'look good,' also known as social desirability, and may have affected the truthfulness of their responses. Additionally, when conducting longitudinal studies, Dweck found that there was a tendency for participants to move towards growth mindset over time. In fact, Dweck recommended only administering the fixed mindset scales to participants in the case of multi-administrations to measure how the fixed mindset changed over time. These considerations and behaviors associated with the *Implicit Theories of Intelligence Scale for Children – Self Form* created by Dweck (2000) may have also been present for the administration of the MAP. The *Implicit Theories of Intelligence Scale for Children – Self Form* and the *Mindset Assessment profile* are worded similarly, but not identically, and seek to draw similar information from the respondent. Additionally, the MAP has questions that seek to assess both a fixed and growth mindset. It is possible that the higher initial scores on the MAP in this study were a result of the same phenomenon Dweck experienced with the initial scale.

Moreover, the school in which the current study took place already promoted a culture where growth mindset was part of the norm of the school, possibly resulting in a higher than anticipated score on the MAP pre-test. As previously discussed, a study by Paunesku (2013) found that school culture and norms contributed to the outcome of a growth mindset intervention with high school students. Because the school system and climate promoted the values and theory of a growth mindset, the students were more open to an intervention to improve growth

mindset. As indicated in the results, Paunesku (2013) found that students in schools with a fixed mindset culture did not respond as strongly to the intervention. In regard to the present study, both the experimental and comparison groups scored within the growth mindset range on the MAP before the implementation of the intervention. This may have been a contributing factor as to why group assignment was not a significant predictor of change in mindset. There was no data collected as to the connection of a growth mindset with the overall school culture and further studies might seek to explore this connection should the school climate be similar to the one in which this study took place.

Possible threats to the internal validity of this study are history and diffusion. History refers to events that may have occurred during the experiment that produced a change that would affect the study (Furlong, Lovelace, & Lovelace, 2000). One potential event that could be related to the threat of history was the past exposure and prior knowledge of growth mindset for the students, classroom teachers, and school community as a whole. Teachers who participated in this study had conducted a book study as a grade level two years prior and were already exposed to the concept and prior research surrounding growth mindset. In previous years, they incorporated growth mindset concepts and statements into their lessons plans, activities, and pedagogy. Therefore, the teachers of the comparison group may have been integrating these concepts into their teaching without realizing they were using the strategies or considering how it may impact the results of the current study. Additionally, teacher mindset was not measured in this study. Future research would benefit from including a teacher mindset measure, especially considering it is possible that teacher implementation of the program impacted the results of the study.

In addition to the third-grade teachers and classrooms, many teachers in the building have also begun to adopt the tenants of growth mindset in their own classrooms. Within the halls of the building, posters and classwork describing growth mindset and *the power of yet*, a common growth mindset phrase, are displayed. Therefore, students have been exposed to the ideas and framework of growth mindset separately from the *Brainology* program. The exposure to these concepts may have influenced the MAP scores of the students within the comparison classrooms who were not exposed to the intervention, resulting in similar MAP scores across all four classrooms despite intervention participation. While the researcher was familiar with both the prior knowledge and school environment, at the time the concern was not enough to amend the study as conceptualized.

Another possible threat to internal validity is diffusion. Diffusion occurs when the subjects in both groups become exposed to the intervention, and in this case, it would be specifically in regard to the teachers in all groups. Each teacher was aware that a growth mindset study was being conducted, however, based on the historical fact that these teachers participated in a group book club about growth mindset and it was becoming part of the school culture and norms, they may have exposed all students to these concepts prior to the start of the intervention.

Barriers to implementation

Several barriers to the program implementation became apparent both prior to and during the course of the study. First, there was a delay in the planned start date for the study. This resulted in the study being pushed back four months. The result of this delay caused a change in both the length of time available to complete the intervention as well as the time of the school year designated for the intervention to take place. The intervention was subsequently conducted at the end of the school year as opposed to during the second quarter. It is possible that this may

have negatively impacted both teacher and student participation in the study, though it is unknown. Similar to Baldrige (2010) and Wieland (2011), issues implementing the program may have contributed to the results of the study, and therefore, should not rule out this program's use in future research.

With regard to the length of time to implement the intervention, previously the program was planned to be conducted over a ten-week period. This would allow for make-up lessons or additional time to complete assignments if some students were working at a slower pace. Unfortunately, due to the delay, additional time was unavailable because the school year was coming to a close. This resulted in some students not completing the *Brainology* program in its entirety, with only 24 out of 41 total students completing the program through to the final quiz in Chapter 4. There were 36 students out of 41 who completed Chapter 3 and had been in the process of completing Chapter 4 at the end of the school year. Unfortunately, due to the school year ending, additional time could not be given for students to complete this program. Interestingly, Classroom A was the classroom where a majority only began Chapter 4 and that classroom showed the only statistically meaningful changes.

Limitations

In regard to the present study, there are some limitations that may have affected this experiment. Firstly, a convenience sample was utilized, thereby limiting the generalizability of the findings to the sample that was used. The participants in this research were from third grade classes at a rural elementary school in Western New York. The school currently has 536 students enrolled, with approximately 80 third grade students. Within the elementary school, 45% of students are eligible for a free or reduced lunch and 8% are classified as a student in need of special education services. The school is fairly large for this region; there are a total of four,

third grade classrooms at this setting. Each classroom contains approximately 20 children, with one teacher. Within the district, students who require a specialized learning environment or more restrictive placement are referred to a BOCES program within the district. Therefore, each class contained a mix of both general and special education students who were placed in a general education classroom.

As far as the diversity of students, this district contained a high population of low socio-economic families. As far as racial diversity: 94% of students are white, 2.6% are African American, < 1 % are Hispanic, < 1% are multiracial, and 2.4% identify their race as *other.* The demographic information reported by the school is equal to the overall racial makeup of the county where students reside. According to the United States Census Department, in the state of New York 63.3% of its residents are white, 15.7% of residents are Black or African American, < 1% are American Indian and Alaska Native, 8.5% are Asian, and 3.3% identify as multiracial (US Census Bureau, 2019). Additionally, the racial diversity of New York reflects the overall diversity of the country, with race being similarly dispersed throughout the United States.

Therefore, based on the above reported demographical variables of the school district when compared to New York state, the sample from this school lacked the racial diversity reflected in the overall state. The majority of the students who participated in this study were white. Further research in this area should consider using a diverse student population in order to generalize the findings of this study.

Another limitation of this study was the use of pre-existing groups, which may have possibly contributed to the results of the study. Future considerations for implementing this program or conducting research would be to do this after school, allowing for the implementation of a true experimental design with control groups. Because this study was of a

quasi-experimental design, the researcher attempted to control for both internal and external threats to validity (Stangor, 2015). While examining the validity of the study, it possible that both external and internal factors may have contributed to the results.

One threat to external validity may have been a ceiling effect, which occurs when a test or questionnaire is used to assess a specific criterion. On such a measure there is a spread of possible scores that one may obtain, and the high pretest score may be representative of a ceiling effect in that students have already reported some of the highest scores allowed for on the measure itself. Based on how this measure was constructed, there is not enough variability on the higher end of the scale to demonstrate growth for individuals who began the study endorsing a higher mindset (Howe, 2018).

While the resulting high scores may be due to a ceiling effect it could also be due to the previously mentioned concerns surrounding the measure itself and its relation to the issues with the *Implicit Theories of Intelligence Scale for Children – Self Form.* As reported, the average pretest score was high for the entire group (M=33), which fell within the growth mindset range. In this case, had a ceiling effect occurred it may indicate that the MAP did not accurately measure reported mindset, affecting the outcome of the study (Salkind, 2010). Overall, it was determined that 74% of the students who participated in this study scored in the growth mindset range while only 19% of students began the study endorsing a fixed mindset.

Additionally, the results indicated that there was a significant difference between Classroom A and Classroom B. Additional data provided by the *Brainology* program measured student attitude towards the intervention itself. Out of the total students in Classroom A, 40% reported that the enjoyed the *Brainology* Program and 60% believed that it was helpful. Only 20% of students in Classroom B reported that they enjoyed the program and only 13% reported

that they believed it was helpful. Therefore, student attitude towards the program itself may have contributed to a lack of mindset change in Classroom B. As previously discussed, Baldridge (2010) suggested that the design of the *Brainology* program may have impacted the reception it received from the students. During group discussions, many of the high school students reportedly did not like the presentation of the information and believed that it lacked the sophisticated graphics of modern computer games and movies. Similarly, Wilkins (2014), suggested the absence of significant change in that study may have been credited to methodological and implementation problems in the classroom and not the program itself. While students in this study were not interviewed on their reception of the program and graphic design details, it is clear from the data provided that only half of the students found it to be enjoyable.

During implementation of the program the teacher in Classroom A was significantly more interactive with the researcher than the teacher in Classroom B. The teacher in Classroom A filled out the weekly logs and emailed the researcher with any concerns, once including a concern both teachers had with students and scheduling. One concern was that students were taking longer to complete the computer unit activities than the allotted time frame, causing the teachers to push back lessons from the scheduled days. This may be one reason that many students began Unit 4 but were unable to complete it by the end of the school year. While the researcher was not present to attest to the fidelity of program implementation or teacher attitude in the presentation of materials, it is clear from the statistical results that only one of the classrooms showed significant change and positive attitude towards the intervention and that was the classroom with the most highly engaged teacher.

The results obtained from the statistical model showed that while there was an overall change in mindset, it was not the result of this intervention program, but due to the mindset prior

to the intervention and gender. However, one classroom was approaching significance. Therefore, by removing some barriers to the implementation of the intervention (e.g., time of school year, length of time for the intervention) it is possible that *Brainology* could facilitate a change in mindset. Implications for future research should examine areas for improved implementation.

Implications for the field of School Psychology

School psychologists are often tasked with being experts in the best practice of academic and behavioral interventions. However, school psychologists are increasingly called upon to be leaders in the area of social-emotional development as well. There has been an increase in demand to address the social-emotional needs of students in an ever-changing world. School pscyhologists are also tasked with supporting children who experience difficulty and seek to foster resilience in students who are faced with an ever increasing amount of adverse childhood expereinces.

School systems often work within the confines of a multi-tiered system of support or MTSS when delivering interventions to students. This tiered support system is set in place to ensure that all students will have their academic, behavioral, and mental health needs met by their school district. Assigning students to different tiers, and then utilizing intervention best fit for their needs has allowed schools to move away from a *one size fits all* mentality and towards a system for delivering intervention that targets a student's individual needs. (Noltemeyer, 2014)

In the first tier, or universal/primary support tier, the needs of the entire student body are taken into account when developing a program. A common example of a universal MTSS program would be a building wide Positive Behavioral Intervention System or PBIS. In a PBIS prgram, students are encouraged to follow school rules in order to obtain points that lead to a

large choice of rewards. This program would be avialble to the entire student population. In tier two, or the strategic support tier, the goal is to support children who need the extra guidance or instruction through early interventions. Finally, the third tier, is an intensive, individualized program to meet student needs.

Based on the outcomes of this study, the *Brainology* program appears best suited as a tier two intervention. This study was presented to almost the entire population of third grade students and resulted in a non-significant change in mindset for the total group. However, a subset of students did show a signigicant change and they were female students. Therefore, one might assume that targeting female students with a program such as this one may result in an increase in mindse. Dweck and her colleagues have continued to create programs to address this need and to help cultivate a growth mindset in students from kindergarten through college age (Mindset Works, 2011; Panuesku, 2013; Coates, 2016). This research adds to the body of literature concerning research-based interventions and their appropriateness for elementary-age children.

Future Research

Despite this study's mixed results regarding the *Brainology* program, future research should consider using the *Brainology* program to teach the concepts of growth mindset to elementary-age students. While this program was not a significant predictor for change in mindset for the overall sample, one classroom approached a significant change in mindset. Additionally, based on the limitations of pre-selected groups, future researchers should consider using a true experimental model. Random assignment of participants to the experimental and comparison groups might address these concerns and prevent teacher mindset to impact the intervention and the results of the study.

Additional factors that should be considered are both gender and teacher mindset. Gender was a significant factor in change in mindset in this study. Therefore, when considering the aforementioned limitations of the study, the *Brainology* program deserves further consideration as a possible intervention for elementary-age children. Previous research has also examined teacher mindset, and while this study did not examine these particular teachers' mindsets, further research should consider examining this variable as well, especially with elementary teachers.

In regard to the study design itself, many of the breakout sessions were not utilized due to time restraints. Previous research has either used none of the sessions or all of the sessions, culminating in mixed results. Should another researcher wish to examine the effects of the *Brainology* program with elementary-age students, it is suggested that the program should be delivered in its entirety to students. If students are being exposed to the concepts of growth mindset for the first time, this may give the students a deeper understanding of the topics presented. Future studies should also include increased in-person contact with the researcher and the teachers administering the program. This would also allow for a measure of treatment fidelity. One barrier for implementation was the distance between the school and the home of the researcher. Being closer to the school may have improved the intervention in Classroom B, and the researcher would have witnessed the differences between classrooms that resulted in conflicting results.

Summary

Research has shown that when students are introduced to the concepts of growth mindset, they are able to change their own view of intelligence. The adoption of a growth mindset has been shown to improve academic achievement, goal setting, and self-regulation (Burnette et al.,

2013; Corpus & Lepper, 2007; Dweck, 1986; Diener & Dweck, 1978, 1980). Until recently, the majority of research-based intervention programs for growth mindset have focused solely on their implementation with adolescents. It is possible that fostering a growth mindset could be a long-term process, and elementary school children would benefit from being taught these concepts sooner (Phillips-Martines, 2017).

Results of the multiple regression analysis indicated that there were some statistically significant changes in mindset by third grade children at the end of this intervention. The results also indicated that the variables of gender and pretest scores were significant predictors of change in mindset after the intervention was administered. Participation in the *Brainology* program was not a statistically significant predictor of mindset change. Classroom A and B were the experimental classrooms. Further analyses assessed that Classroom A was approaching significance when controlled for in the regression model. While this study did not examine teacher mindsets, it is possible that the differences in Classrooms A and B could be in part contributed to teacher minds. Further research should consider examining this variable as well, especially with elementary teachers.

This study was able to contribute to the developing field of growth mindset. This analysis in particular sought to examine the *Brainology* program with elementary students, a first known study in the field to do so. Future research should consider using this program to solidify the concepts of growth mindset through the use of the *Brainology* intervention for elementary-age students. As discussed previously, possible threats to the validity should be noted when future research is being considered.

Growth mindset has exploded in popularity within the halls of schools all over the United States. Social-media, parenting magazines, and YouTube videos are all created with the purpose

of introducing these concepts to children and their families. While this study did not show *Brainology* participation as a statistically significant predictor of change in mindset, one classroom approached a statistically significant change. Therefore, it is suggested that this study be replicated with a more diverse sample of students, and over a longer period of time. Additionally, the MAP should be examined to determine whether it is a valid measure of growth and fixed mindset, based on Dweck's' earlier version of the scales.

In conclusion, research in this area should be continued with this specific population. Elementary-aged children can benefit from the messages and principles of a growth mindset and the *Brainology* program. This current study contributed to the current field of study and hopes to expand and encourage the use of growth mindset concepts and interventions with elementary-age children. With an increase in the academic demands that we are placing on our students, a more mature social world, as well as helping them to develop socially and emotionally, further research is imperative.

References

Academic Motivation Research | About PERTS. (2016) Retrieved April 12, 2017, from https://www.perts.net/about

Ahmavaara, A., & Houston, D. M. (2007). The effects of selective schooling and self-concept on adolescents' academic aspiration: An examination of Dweck's self-theory. *British Journal Of Educational Psychology, 77*(3), 613-632. doi:10.1348/000709906X120132

Alfonso, V. C., Flannagan, D. P., & Radwan, S. (2005). The Impact of the Cattell-Horn-Carroll Theory on Test Development and Interpretation of Cognitive and Academic Abilities. In. D.P. Flanagan, P. L. Harrison, D.P. Flanagan, P. L. Harrison, (Eds.), *Contemporary Intellectual Assessment: Theories, Tests, and Issues* (pp. 185-202). New York, NY; US: Guilford Press.

Baldridge, M. C. (2011). The effects of a growth mindset intervention on the beliefs about. intelligence, effort beliefs, achievement goal orientations, and academic self-efficacy of LD students with reading difficulties. *Dissertation Abstracts International Section A*, *72*, 1168

Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit Theories of Intelligence Predict Achievement Across an Adolescent Transition: A Longitudinal Study and an Intervention. *Child Development*, *78*(1), 246-263.doi:10.1111/j.1467-8624.2007.00995.x

Blackwell, L. S., Rodriguez, S., Guerra-Carrillo, B. (2015). In S. Goldstein, D. Princiotta, & J. A. Naglieri (Eds.), *Handbook of Intelligence: Evolutionary Theory, Historical Perspective, and Current Concepts* (pp. 209-227). New York, NY: Springer.

Bradway, K. P., & Thompson, C. W. (1962). Intelligence at adulthood: A twenty-five year follow-up. *Journal of Educational Psychology, 53*(1), 1-14. doi:10.1037/h0045764

Burnette, J. L., O'Boyle, E. H., VanEpps, E. M., Pollack, J. M., & Finkel, E. J. (2013). Mind-sets matter: A meta-analytic review of implicit theories and self-regulation. *Psychological Bulletin, 139*(3), 655-701. doi:10.1037/a0029531

Carroll, J. B. (1993). Human cognitive abilities: A survey of factor-analytic studies. New York: Cambridge University Press.

Cattell, R. B. (1943). The measurement of adult intelligence testing. *Psychological Bulletin, 2,* 153-193.

Cattell, R. B. (1963). Theory of fluid and crystalized intelligence: A critical experiment. *Journal of Educational Psychology. 54*(1), 1-22.

Coates, K. (In publication). *Growing Early Mindsets (GEM™).* Mindset Works Inc.

Coates, K. (2016) *An evaluation of Growing Early Mindsets (GEM™)* (Unpublished doctoral dissertation). University of Oregon.

Corpus, J. H., & Lepper, M. R. (2007). The effects of person versus performance praise on children's motivation: Gender and age as moderating factors. *Educational Psychology, 27*(4), 487-508.doi:10.1080/01443410601159852

Credé, M., Tynan, M. C., & Harms, P. D. (2017). Much ado about grit: A meta-analytic synthesis of the grit literature. *Journal of Personality and Social Psychology, 113*(3), 492-511. doi:10.1037/pspp0000102

Davis, J. L., Burnette, J. L., Allison, S. T., & Stone, H. (2011). Against the odds" Academic underdogs benefit from incremental theories. *Social Psychology of Education, 14*(3), 331-346. doi:10.1007/s11218-010-9147-6

Diener, C. I., & Dweck, C. S. (1978). An analysis of learned helplessness: Continuous changes in performance, strategy, and achievement cognitions following failure. *Journal of Personality and Social Psychology*, 36(5), 451-462. doi:10.1037/0022-3514.36.5.451

Diener, C. I., & Dweck, C. S. (1980). An analysis of learned helplessness: II. The processing of success. *Journal of Personality and Social Psychology*, 39(5), 940-952. doi:10.1037/0022-3514.39.5.940

Droege, K. L., & Stipek, D. J. (1993). Children's use of dispositions to predict classmates' behavior. *Developmental Psychology*, *29*(4), 646-654. doi:10.1037/0012-1649.29.4.646

Dweck, C. S. (1986). Motivational processes affecting learning. *American Psychologist, 41*(10), 1040-1048. doi:10.1037//0003-066x.41.10.1040

Dweck, C. S. (2000). *Self-Theories: Their Role in Motivation, Personality, and Development. Essays in Social Psychology.* Psychology Press.

Dweck, C. S. (2006). *Mindset: The new psychology of success*. Random House.

Dweck, C. S. (2010). Even geniuses work hard. *Educational Leadership*, *68*(1), 16-20.

Donohoe, C., Topping, K., & Hannah, E. (2012). The impact of an online intervention (Brainology) on the mindset and resiliency of secondary school pupils: A preliminary mixed methods study. *Educational Psychology*, *32*(5), 641-655. doi:10.1080/01443410.2012.675646

Duckworth, A. L., Peterson, C., Matthews, M. D., & Kelly, D. R. (2007). Grit: Perseverance and passion for long-term goals. *Journal of Personality and Social Psychology, 92*(6), 1087-1101. doi:10.1037/0022-3514.92.6.1087

Duckworth, A. L., & Quinn, P. D. (2009). Development and validation of the Short Grit Scale (GRIT–S). *Journal of Personality Assessment, 91*(2), 166-174. doi:10.1080/00223890802634290

Elliott, E. S., & Dweck, C. S. (1988). Goals: An approach to motivation and achievement. *Journal of Personality and Social Psychology*, *54*(1), 5-12. doi:10.1037/0022-3514.54.1.5

Farrington, C.A., Roderick, M., Allensworth, E., Nagaoka, J., Keyes, T.S., Johnson, D.W., & Beechum, N.O., (2012). *Teaching adolescents to become learners. The role of noncognitive factors in shaping school performance: A critical literature review.* Chicago University of Chicago Consotrium on Chicago School Research.

Fisher, E. M. (1998, May). A cross case survey of research based on Howard Gardner's Theory of Multiple Intelligences. *Dissertation Abstracts International Section A*, 58, 4171.

Furlong, N. E., Lovelace, E. A., & Lovelace, K. L. (2000). *Research methods and statistics: an integrated approach*. Fort Worth, TX: Harcourt College Publishers.

Furnham, A. (2014). Increasing your intelligence: Entity and incremental beliefs about the multiple 'intelligences'. *Learning and Individual Differences, 32*, 163-167. doi:10.1016/j.lindif.2014.03.001

Gardner, H. (2003, April 21). Multiple Intelligences after twenty years [Conference Paper]. American Educational Research Association, Chicago, Illinois.

Gardner, H. (2013, October 16). Howard Gardner: 'Multiple intelligences' are not 'learning styles'. *The Washington Post*. Retrieved September 11, 2018, from http://courses.educ.ubc.ca/socials/Articles/Howard Gardner: ‘Multiple intelligences’ are not ‘learning styles’ | The Answer Sheet.pdf

Gardner, H., & Hatch, T. (1989). Multiple Intelligences Go to School: Educational Implications of the Theory of Multiple Intelligences. *Educational Researcher*, 18(8), 4. doi:10.2307/1176460

Good, C., Aronson, J., & Inzlict, M. (2003). Improving adolescent’s standardized test performance: An intervention to reduce the effects of stereotype threat. *Journal of Applied Developmental Psychology, 24* (6). 645-662. doi:10.1016/j.appdev.2003.09.002

Gottfried, A. W., Gottfried, A. E., & Guerin, D. W. (2006). The Fullerton longitudinal study: A long-term investigation of intellectual and motivational giftedness. *Journal for The Education of The Gifted, 29*(4), 430-450.

Gottfried, A. W., Gottfried, A. E., & Guerin, D. W. (2009). Issues in early prediction and identification of intellectual giftedness. In F. D. Horowitz, R. F. Subotnik, & D. J. Matthews (Eds.), *The development of giftedness and talent across the life span* (pp. 43-56). Washington, DC, US: American Psychological Association. http://dx.doi.org/10.1037/11867-0033

Howe, Adele. Ceiling and Floor Effects. Retrieved from https://www.cs.colostate.edu/~howe/EMAI/ch3/node7.html on January 01, 2020.

Kamphaus, R. W. (2001). Clinical assessment of child and adolescent intelligence. Boston, MA: Allyn and Bacon.

Kurtz-Coates B., McCall, R. J., Kinlaw, C. R., Wiesen, C. A., & Joyner, M. H. (2005). What does it mean to be smart? The development of children's beliefs about intelligence in Germany and the United States. *Journal of Applied Developmental Psychology, 26* (2), 217-233. doi:10.1016/j.appdev.2004.12.005

Laursen, E. K. (2015). The power of grit, perseverance, and tenacity. *Reclaiming Children and Youth, 23*(4), 19-24. Retrieved from http://ezproxy.alfred.edu:2048/login?url=http://search.proquest.com/docview/1655359246?accountid=8263

Levy, S. R., Stroessner, S. J., & Dweck, C. S. (1998). Stereotype formation and endorsement: The role of implicit theories. Journal of Personality and Social Psychology, 74(6), 1421-1436. doi:10.1037/0022-3514.74.6.1421

Licht, B. G., & Dweck, C. S. (1984). Determinants of academic achievement: The interaction of children's achievement orientations with skill area. *Developmental Psychology, 20*(4), 628-636.

Kangas, J., & Bradway, K. (1971). Intelligence at middle age: A thirty-eight year follow-up. *Developmental Psychology, 5*(2), 333-337. doi:10.1037/h0031471

Keith, T. Z., & Reynolds, M. R., (2010). Cattel-Horn-Carroll abilities and cognitive tests: What we've learned from 20 years of research. *Psychology in The Schools, 47*(7), 635-650.

Menanix, S. E. (2016). Teaching for a growth mindset: How contexts and professional identity shift decision-making. *Dissertation Abstracts International Section A*, 77,

McCutchen, K. L., Jones, M. H., Carbonneau, K. J., & Mueller, C. E. (2016). Mindset and standardized testing over time. *Learning and Individual Differences, 45*208-213. doi:10.1016/j.lindif.2015.11.027

Mindset Works, Inc. (2002-2011). *The Brainology Curriculum Implementation Guide.*

Moss, H. A., & Kagan, J. (1964). Report on personality consistency and change from the Fels Longitudinal Study. *Vita Humana, 7*(2), 127-139.

Naglieri, J. A., Das, J. P., & Jarman, R. F. (1990). Planning, attention, simultaneous, and successive cognitive processes as a model for assessment. *School Psychology Review, 19*(4), 423-442.

Neisser, U., Boodoo, G., Bouchard, T., Boykin, A., Brody, N., Ceci, S. J., Halpern, D. F., Loehlin, J. C., Perloff, R., Sternberg, R. J., Urbina, S. (1998). Intelligence: Knowns and unknowns. In M. E. Hertzig, E. A. Farber, M. E. Hertzig, E. A. Farber (Eds.), *Annual progress in child psychiatry and child development: 1997* (pp. 95-133). Philadelphia, PA, US: Brunner/Mazel

Nicholls, J.G. (1978). The development of the concepts of effort and ability, perception of academic attainment, and the understanding that difficult tasks require more ability. *Child Development, 49*(3). 800-814. Doi”10.2307/1128250

Noltemeyer, A. L. (2014). Best Practice in Fostering Student Resilience . In *Best Practices in School Psychology: Student Level Services* (Vol. 4, pp. 225–237). Bethesda, MA: NASP Publications.

Ortiz, S. O. (2015). CHC Theory of Intelligence. In S. Goldstein, D. Princiotta, & J. A. Naglieri (Eds.), *Handbook of Intelligence: Evolutionary Theory, Historical Perspective, and Current Concepts* (pp. 209-227). New York, NY: Springer.

Paunesku, D., Walton, G. M., Cohen, G., & Dweck, C. S. (2013). Scaled-up social psychology: intervening wisely and broadly in education (Unpublished doctoral dissertation).

Paunesku, D., Walton, G. M., Romero, C., Smith, E. N., Yeager, D. S., & Dweck, C. S. (2015). Mind-set interventions are a scalable treatment for academic underachievement. *Psychological Science*, *26*(6), 784-793. doi:10.1177/0956797615571017

Ricci, M. C. (2017). *Mindsets in the classroom: Building a culture of success and student achievement in schools.* Waco, TX: Prufrock Press.

Salkind, N. J. (2010). *Encyclopedia of research design* Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781412961288

Sameroff, A. J., Seifer, R., Baldwin, A., & Baldwin, C. (1993). Stability of intelligence from preschool to adolescence: The influence of social and family risk factors. *Child Development, 64*(1), 80-97. doi:10.2307/1131438

Sattler, J. M. (2018). Assessment of children: cognitive foundations and applications. La Mesa, CA: Jerome M. Sattler, Publisher, Inc.

Schneider, W., Niklas, F., & Schmiedeler, S. (2014). Intellectual development from early childhood to early adulthood: The impact of early IQ differences on stability and change over time. *Learning and Individual Differences, 32*156-162. doi:10.1016/j.lindif.2014.02.001

Sisk, V. F., Burgoyne, A. P., Sun, J., Butler, J. L., & Macnamara, B. N. (2018). To What Extent and Under Which Circumstances Are Growth Mind-Sets Important to Academic Achievement? Two Meta-Analyses. *Psychological Science*, *29*(4), 549–571. https://doi.org/10.1177/0956797617739704

Stangor, C. (2015). *Research methods for the behavioral sciences*. Australia: Cengage Learning.

Steele, C. M., & Aronson, J. (1995) Stereotype threat and the intellectual test performance of African Americans. *Journal of Personality and Social Psychology, 69*(5), 797-811. doi:10. 1037/0022-3514.69.5.797

Steele, C. M., Spencer, S. J., & Aronson, J. (2002). Contending with group image: The psychology of stereotype and social identity threat. In M. P. Zanna, M. P. Zanna (Eds.), Advances in experimental social psychology, Vol. 34 (pp. 379-440). San Diego, CA, US: Academic Press. doi:10.1016/S0065-2601(02)80009-0

Sternberg, R. J. (2003). Contemporary theories of intelligence. In W. M. Reynolds, G. E. Miller, I. B., Weiner, (Eds.), *Handbook of psychology: Educational psychology* (pp. 23-44). Hoboken, NJ, US: John Wiley & Sons Inc.

US Census Bureau. (2019, October 9). Data. Retrieved from https://www.census.gov/data.html.

Verniers, C., & Martinot, D. (2015). Perception of students' intelligence malleability and potential for future success: Unfavourable beliefs towards girls. British Journal of Educational Psychology, 85(3), 289-299. doi:10.1111/bjep.12073

Yeager, D. S., & Dweck, C. S. (2012). Mindsets that promote resilience: When students believe that personal characteristics can be developed. Educational Psychologist, 47(4), 302-314.

Watkins, M. W., & Smith, L. G. (2013). Long-term stability of the Wechsler Intelligence Scale for Children—Fourth Edition. *Psychological Assessment, 25*(2), 477-483. doi:10.1037/a0031653

Wieland, L. R. (2012). Brainology and math achievement. Dissertation Abstracts International Section A, 72, 3183.

Wilkins, P. B. (2014). Efficacy of a growth mindset intervention to increase student achievement. Dissertation Abstracts International Section A, 76

Appendix A

MINDSET ASSESSMENT PROFILE TOOL

For the Teacher: Using the Mindset Assessment Profile

This is a tool to get a quick assessment of your students' mindsets—their beliefs about the malleability of intelligence, the relative importance of learning and perfect performance, and their attitudes toward effort and mistakes.

It's important that students not feel labeled by this tool. The MAP categories just represent the way they are thinking and feeling about these questions at the present time. They can change these beliefs, and they may feel differently on different days.

You can use this assessment tool in a number of ways. For example, you can use it as an:

1. 1) Individual assessment, scored by the teacher (with the result not shared with the student)
2. 2) Individual assessment, scored by the teacher (with the result shared with the student)
3. 3) Individual assessment, scored by the student
4. 4) Individual assessment, scored by a peer

Once students have completed the assessment, you can follow up with discussions or activities to explore the issues raised. For example, you can:

- Identify students who scored in the fixed mindset range and discuss 1:1
- Ask students to select the statement where they had a Profile number of 1-3 (the "fixed mindset" range) and write or talk about it.
- Ask students to respond to question 4 about whether they feel the MAP description fits them.
- Have pairs of students exchange their profiles and discuss their beliefs.
- Present the overall percentage of students in each Profile category to the class.

Here are some questions that you might explore in any of the above formats:

- Are there some subjects where you don't feel confident that you can learn and do well?
- How do you think it feels to get a bad grade if you believe that you can't do any better?

- Can you think of a time when you learned to do something really hard? How did you learn it?
- What would you be willing to work hard to achieve if you knew it was possible?

- If you knew that you could develop your intelligence through effort, what goals would you set for yourself?

Mindset Assessment Profile Tool

Description: Survey for getting a quick assessment of your students' mindsets Objective: Students will complete survey and (optional) reflection
Timeline: 10-30 minutes

Instructions:

- Explain to the students that they are about to take a survey. A survey is a tool to gather information—in this case, your opinions about intelligence, performance, learning, effort, and challenges. It may look like a test or quiz, but in fact it is not! Answer honestly and say what you believe. There will be no grade attached to the survey and the "score" you receive is not a percentage correct. Afterwards, we will discuss the questions and the different ways that people think about them.
- Have students answer the survey questions. This can be done anonymously if desired.
- You may opt to have students self-score, or not.
- You may choose to engage students in reflection through writing or discussion.

After the survey

Make sure that you emphasize that the survey is a gauge (like taking a temperature with a thermometer) of their thinking right now. As we learn new things, our thinking changes. The survey is not intended to be a way to label students, but rather to get to the core of their thinking so that new learning can occur.

Optional Reflection/Discussion

Debrief with your class after they complete the survey. Ask:

- Were there any questions that surprised you?
- Which questions were difficult to answer? Why?
- Are there any questions that you were glad to have been asked?
- Are you excited to learn more about this topic? Why/Why not?

MINDSET ASSESSMENT PROFILE

Name: _____

This is NOT a test! It is an opinion survey about beliefs and goals regarding ability and performance. It is very important that you give your honest opinion, not what you believe someone else would think best. Read each statement, decide how much you agree or disagree with the statement, and circle your answer.

Do you Agree or Disagree?	Disagree A Lot	Disagree	Disagree A Little	Agree A Little	Agree	Agree a lot	Profile Number
1. No matter how much intelligence you have, you can always change it a good amount.	A	B	C	D	E	F	
2. You can learn new things, but you cannot really change your basic amount of intelligence.	A	B	C	D	E	F	
3. I like schoolwork best when it makes me think hard.	A	B	C	D	E	F	
4. I like schoolwork best when I can do it really well without too much trouble.	A	B	C	D	E	F	
5. I like schoolwork that I'll learn from even if I make a lot of mistakes.	A	B	C	D	E	F	
6. I like schoolwork best when I can do it perfectly without any mistakes.	A	B	C	D	E	F	
7. When something is hard, it just makes me want to work more on it, not less.	A	B	C	D	E	F	
8. To tell the truth, when I work hard at my schoolwork, it makes me feel like I am not very smart.	A	B	C	D	E	F	
Mindset Assessment Profile TOTAL							

First, determine your Profile Number for each question.

a. For questions with odd numbers (1, 3, 5, 7), write the number of your answer into the boxes in the right column.
b. For questions with even numbers (2, 4, 6, 8), use the table below to fill in the gray boxes in the right column.

If you chose this answer:	Then write this number in the gray box on the right (Profile Number
Disagree A Lot (1)	6
Disagree (2)	5
Disagree A Little (3)	4
Agree A Little (4)	3
Agree (5)	2
Agree A Lot (6)	1

2. Now, add up all your Profile numbers.
   a. Add up all the numbers in the Profile column on the right, and write the total in the last box in the bottom right corner.
3. What does your Mindset Profile Number mean?
   a. Find the group that includes your number in the chart below and circle it.
   b. Now, read what it says about your MAP group.

If your profile number falls into this range:	Then Your MAP group is:	People in this Map Group usually believe the following things:
8-12	F5	You strongly believe that your intelligence is fixed—it doesn't change much. If you can't perform perfectly you would rather not do something. You think smart people don't have to work hard.
13-16	F4	
17-20	F3	You lean toward thinking that your intelligence doesn't change much. You prefer not to make mistakes if you can help it and you also don't really like to put in a lot of work. You may think that learning should be easy.
21-24	F2	
25-28	F1	You are unsure about whether you can change your intelligence. You care about your performance and you also want to learn, but you don't really want to have to work too hard for it.
29-32	G1	
33-36	G2	You believe that your intelligence is something that you can increase. You care about learning and you're willing to work hard. You do want to do well, but you think it's more important to learn than to always perform well.
37-40	G3	
41-44	G4	You really feel sure that you can increase your intelligence by learning and you like a challenge. You believe that the best way to learn is to work hard, and you don't mind making mistakes while you do it
45-48	G5	

4. Do you think the description under your MAP group matches the way you think and feel about your schoolwork? Which parts are true for you and which are not?

Appendix B

BRAINOLOGY®

April 10, 2019

Brainology Program at XXXX

My name is Jaclyn Wolferd and I am a school psychology doctoral student with Alfred University. I have worked closely with XXXX School for the past few years and we have decided to partner together to offer your child a chance to join in an exciting new curriculum called Brainology! Your child's classroom has been selected to participate in a research study and I ask that you read this form for some important information about this study, returning the signed form of consent to your teacher.

Background Information
The goal of the Brainology curriculum is to help children develop a growth mindset. Children with a growth mindset think of their intelligence as something that they can change through learning and studying. Having a growth mindset can help increase a child's motivation to learn and improve their grades.

This program can help children develop a growth mindset by teaching them how the brain works and how it changes physically when we exercise it through practice. It can also provide a set of skills for facing academic challenges by showing them how to apply this knowledge to their schoolwork.

Procedures
This online curriculum will be taught to your child over a six-week period from May 13, 2019 through June 21, 2019. All of the lessons will be taught in school, and there are no in-home requirements. If you would like more information on this program and the topic of growth mindset please do not hesitate to reach out to myself or your child's teacher.

Risks and Benefits of Being in the Study
This program will be provided to your child at no additional cost to you or the district. This computer-based curriculum will initially be taught to Mrs. XX and Mrs. XXX homeroom students. While unlikely, some students may feel discomfort while considering some of the growth mindset topics. You are free to discontinue and remove your child from participation in this study at any time. In the unlikely event that this occurs please do not hesitate to reach out, I may be reached at jw10@alfred.edu or (607) 699-XXXX.

Confidentiality
The records of this study will be kept private. The data from this study will be used in the completion of my dissertation. All identifying information will be kept private when published, and no information will be included that would make it possible to identify any participants. Records will be kept in a locked file; only the researcher will have access to the records. Records will be kept for at least three years after the end of the study.

Voluntary Nature of the Study
Your decision whether or not to allow your child to participate will not affect his or her standing with XXXX School, their teacher, or their grades. If you decide to participate you are free to withdraw at any time without penalty.

Contact and Questions

I am so excited for the opportunity to partner once again with your amazing kids and teachers. If you have any questions regarding Brainology, I would love to speak with you further! I may be reached at jw10@alfred.edu or (607) 699-XXXX. If you have any questions in regard to the design of this study or concerns about participating in research, please reach out to Dr. Danielle Gagne, Chair of the Alfred University Human Subjects Committee, at (607) 871-2213 or electronically at HSRC@alfred.edu

Statement of Consent

I have read the above information.

- ☐ I consent for my child to participate in this study
- ☐ I do not want my child to participate in this study

_____ _____

Parent Signature **Child's Name**

_____ _____

Printed Name (Parent) **Date**

Child's Teacher:

- ☐ **Mrs. XX**
- ☐ **Mrs. XXX**

Appendix C

BRAINOLOGY INTERVENTION LOGS:

Teacher:
Week of:

Date of Instruction:

The Lesson taught was….	Was the Lesson completed?	What needs to be finished?	When will this be completed?	What students were absent?

COMMENTS/QUESTIONS:

_____

_____

Date of Instruction:

The Lesson taught was….	Was the Lesson completed?	What needs to be finished?	When will this be completed?	What students were absent?

COMMENTS/QUESTIONS:

_____

_____

Table 1
Pre and Post Test Mean Scores on the MAP for each Classroom

	Pre-Test			Post-Test		
Experimental Group	*n*	*M*	*SD*	*n*	*M*	*SD*
Classroom A	*18*	*33.83*	*6.25*	*18*	*36.72*	*5.53*
Classroom B	*16*	*31.81*	*6.30*	*16*	*31.31.*	*7.98*
Total	*34*	*33.26*	*6.13*	*34*	*34.18.*	*7.23*
Comparison Group	*n*	*M*	*SD*	*n*	*M*	*SD*
Classroom C	*20*	*32.95*	*5.34*	*20*	*32.230*	*6.38*
Classroom D	*19*	*33.58*	*7.00*	*19*	*34.21*	*6.76*
Total	*39*	*32.89*	*6.27*	*39*	*33.18*	*6.56*

Table 2
Independent Samples t-test comparing Mindset change within groups

	Post-Test					
	N	*M*	*SD*	*t*	*df*	*sig (2-tailed)*
Experimental Group	34	1.29	6.81.	.950	71.	.345
Comparison Group	39	-0.77	5.52			

Table 3
Multiple Regression Analysis between Experimental Group and Comparison Group

	Mindset Change		
Variable	*B*	*t*	*sig (2-tailed)*
Constant	11.417	3.069	.003
Group	1.115	.846	.401
PreTotal	-.384	-3.574	.001**
Gender	2.654	2.017	.048*
R^2	.202		
F	5.085		

*Note. $N = 73$, * $p < .05$, ** $p < .01$

Biographical Statement

Dr. Jaclyn Wolferd is a practicing school psychologist in Long Island, NY. In addition to her work as a school psychologist, she belongs to a private practice group specializing in the treatment of anxiety and phobias. Dr. Wolferd graduated with her Bachelor of Arts degree in Psychology from Dowling College and received a Master of Science from Long Island University CW Post in Mental Health Counseling. After working as a clinician for many years with children and families she decided to pursue her Doctorate in School Psychology from Alfred University. Her research interests include the relationship between perseverance, trauma, and academic achievement, which lead to her interest in growth mindset. She may be contacted via email at jw10@alfred.edu.