TUTORING AND VISION: EXAMINING TWO INTERVENTIONS TO IMPROVE SECONDARY STUDENT LITERACY

by

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Abstract

Literacy, one of the most foundational skills supporting learning progress, grows in importance as students enter adolescence, with secondary school courses and materials increasing in complexity. However, literacy skills are informed by many factors that predate student arrival in the middle school classroom, including disparities in access to quality instruction and socioeconomic factors including physical environments, psychosocial health, and physical health. These multidimensional determinants of learning require interventions targeting different factors in order to move the needle of student learning.

Given the importance of program evaluation for continuous improvement of evidencebased interventions, this dissertation examines the impact of two different interventions intended to improve student reading. In the first two sets of research questions, this dissertation explores the impact of a reading tutoring program on middle school student reading achievement, as well as the reading self-efficacy perceptions of striving readers after participation in the program. While the impact on reading achievement was inconclusive, students in the program reported strong reading self-efficacy perceptions, comparable to average readers. In the final set of research questions, the impact of a school-based vision program providing eyeglasses to students is considered, exploring the impact on eyeglasses use and the relationship between treatment, eyeglasses use, and reading achievement. While no significant impact on eyeglasses use was found, evidence of the impact of eyeglasses use on reading achievement was noted in an exploratory analysis.

This dissertation points to the importance of program evaluation of real-world interventions, allowing for continuous improvement to better ensure effective and replicable support for student reading skills.

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Chapter 1: Introduction

The ability to read fluently and with comprehension is crucial to success as students enter secondary school, when the materials they encounter in class become more complex, the topics more technical, and the demands of assignments more advanced. Mathematics, science, social studies and health courses are all either introduced for the first time as distinct specialized courses or gain greater complexity during these grades, while education increasingly focuses on performance outcomes and grades (Midgley et al., 1995; Schielack & Seeley, 2010). Students who reach the middle grades reading below grade level are likely to fall further behind academically each year (Lewkowicz, 2000; Lyon, et al., 2001), as they fail to move from the early stages of "learning to read" to later educational focus on "reading to learn" (Carroll, 1997; McGillis, 1997).

This struggle with reading in the middle grades may negatively impact student engagement and motivation with schooling and creating a self-perpetuating crisis where poor performance may lead to disengagement which leads to poorer performance (Kempe et al., 2011; Stanovich, 2009). Lower literacy skills at the middle school level predict increasing likelihood of disengagement, poor academic self-efficacy, and dropping out of school (Biancarosa & Snow, 2006; Kamil, 2003; Snow & Biancarosa, 2003). Low literacy skills may be further exacerbated by non-instructional determinants of learning , including physical and mental well-being (Sanderson et al., 2021), which can inhibit students' ability to access or engage with learning. Student perceptions of their academic self-efficacy, for instance, may impact their motivation to engage in learning or overcome academic challenges. Likewise, students suffering from poor vision and without the ability to access needed eyecare cannot access or participate fully in everyday class activities and reading materials.

Many secondary students struggle with reading. According to the most recent pre-COVID data from the National Assessment of Educational Progress (NAEP), 66% of 8th grade students have not reached the proficient mark in reading (National Center for Education Statistics, 2020). The percentage of Maryland eighth grade students proficient in reading in 2019 was just 36%, while almost three quarters of students had only basic literacy skills (NCES, 2020), while in Baltimore City Public Schools, just 15% of eighth grade students were found to be proficient readers (NCES, 2020). These scores have been relatively consistent for decades, showing that, despite widespread policy and practice changes and interventions in the intervening years, average secondary student reading levels have not increased on the whole.

This issue has gained greater urgency and demand as a result of widespread COVID-19 related disruptions to the education system. U.S. and global society changed dramatically in early 2020 with the outbreak of the novel coronavirus (COVID-19), which has resulted in massive public upheaval, illness, and death. "Unprecedented challenges in education" (d'Orville, 2020) led to widespread school closures and disruptions of vital academic and non-academic services students and their families rely on schools to provide (Di Pietro et al., 2020; Storey & Slavin, 2020), including health and vision screening services. Both predictions and calculations of "COVID learning loss" based on pandemic-era data collection indicate that serious loss of reading learning and literacy skills for students of all ages and backgrounds has taken place. There have been greater deleterious effects for students from schools, particularly older students, with largely minority and low SES background populations (Betthäuser et al., 2023; Bielinski et al., 2020; Hammerstein et al., 2021; Kuhfeld et al., 2020; Lewis & Kuhfeld, 2021; Storey & Zhang, 2021). During the pandemic, Black, Hispanic, and low-SES students reported substantially greater challenges accessing the classroom and receiving direct contact with

teachers than the average student (Basch et al., 2021; Dorn et al., 2021; Herold, 2020), and demonstrated greater learning loss than their peers (Storey & Zhang, 2021).

By the middle of the 2020-2021 school year, Black kindergarten and first grade students were two times more likely to be at risk of not learning to read, and Hispanic students showed similar increases in the percentage of students at risk (Amplify, 2021). Based on data from Fall 2021, K-5 students nationally were found to have learned 87% of the reading skills that they are expected to demonstrate, while students in schools predominantly serving students of color were found to have only learned 77% of what would typically be expected (Dorn et al, 2021). This impact on elementary students will likely have lasting effects as those students enter middle school.

By 2022, the NAEP reading assessment found that both fourth and eighth graders had lost three points compared to 2019, the lowest score for fourth graders since 2005 and since 1998 for eighth graders (The Nation's Report Card, 2022). In Maryland, fourth grade scores in reading fell 8 points from 2019 to 2022 (The Nation's Report Card, 2022) and eighth grade students dropped five points, while in Baltimore City, fourth grade scores dropped 8 points (eighth grade scores remained stable).

Because of the aforementioned disparities in access to learning during COVID, these results are mostly likely under-reporting pandemic-caused learning challenges. These deep and wide-ranging consequences, as well as the further disruptions to education progress likely caused by mutations of coronavirus, point to the ongoing need for additional and ongoing school-based supports for the large number of students striving to learn to read.

Students considered to be "struggling readers" or "striving readers" are often found to be from minority or minoritized groups (Biancarosa & Snow, 2006), creating a gap in learning

opportunities. In early elementary grades, differences in performance form the basis for what is often termed an "achievement gap" (Assari et al., 2021; Hanushek et al., 2019; Renzulli, 2013), which can continue through students' education careers. Though blame and responsibility for poor academic performance is often placed students' shoulders, these early differences in performance are often due to socioeconomic and non-academic factors outside children's control (Darling-Hammond et al., 2014; Mountford-Zimdars et al., 2015), such as regular access to reading materials prior to entering school (Baeg et al., 2012; Neuman & Celano, 2011; Weinberger, 1996), access to high quality literacy instruction (Stanovich, 2009) and consistently safe spaces for learning and recreation (Simons et al., 2010; Wang & Degol, 2015), teacher retention and stability (Rodriguez, 2009; Young, 2018), and reliable food and health services through schools (Frisvold, 2015; Ruffini, 2021; Schwartz & Rothbart, 2019), including vision care. These factors contribute to what is seen as an "achievement gap," often measured through grades, graduation rates, course taking decisions, and educational attainment (Banks & Dohy, 2018; Engle & Tinto, 2008), but could more accurately understood and addressed as an opportunity gap. These differences in learning and achievement, as well as educational opportunities, are often connected to systemic racial and gender inequalities in the education system (Hatfield et al., 2015; Walters, 2020) and should be addressed both at the policy level as well as the individual level to improve learning skills.

Addressing the learning needs of secondary students experiencing the greatest need for support is an urgent responsibility for the school system, education practitioners and policymakers. A core pillar of the support systems students will need will be intensive targeted teaching, such as tutoring. Tutoring programs have repeatedly proven to be one of the most powerful interventions to support students to increase learning, particularly students from low

SES backgrounds (Dietrichson et al., 2017; Baye et al., 2019). Tutoring programs offer those students who most need additional supports the means to make progress and close gaps with other students. They do so by providing increased attention and opportunities for learning through individualized and adaptable instruction, small group cooperative learning, and focused time for learning (Slavin et al., 2011). Evidence-based tutoring programs were regularly proposed as an important means of recovering learning lost due to the COVID-19 pandemic school disruptions (Slavin and Madden, 2021).

Common educational interventions to improve reading include whole school or whole classroom reforms to change practices, professional development for teachers to improve teacher pedagogy and teaching methods, cooperative learning programs that emphasize students working together and teaching one another, and computer-assisted instruction, which incorporates learning software into the classroom (Slavin et al., 2011; Neitzel et al., 2021). However, reviews and meta-analyses of these interventions for primary and secondary students indicate those focused on professional development (ES = +0.07; Dietrichson et al., 2017), cooperative learning (ES ranging from 0.10 to 0.22; Dietrichson et al., 2017; Baye et al., 2019), whole school or whole classroom reforms (ES ranging from 0.06 to 0.27; Neitzel et al., 2021; Baye et al., 2019), and computer-assisted instruction (ES = 0.11; Dietrichson et al., 2017) all have minimal positive effects on reading learning. In contrast, elementary school level one-to-one and small group tutoring reading programs have reliably demonstrated stronger effects than these alternative options, with effect sizes between +0.14 and 0.31 for small group tutoring and +0.27 to 0.41 for one-to-one tutoring (Neitzel et al., 2021; Slavin et al., 2011). Meta-analyses focused on secondary students' literacy programs have also highlighted the effectiveness of tutoring programs, finding effects between +0.24 and 0.36 (Baye et al., 2019; Dietrichson et al., 2017).

Despite these positive signs, tutoring research at the secondary level, particularly in the United States context, is limited. Only five tutoring studies (all based in the United Kingdom) qualified for Baye's review (2019)—no studies took place in the United States. Nickow and colleagues (2020), finding a positive effect from reading tutoring interventions for students in grades 6-11 (ES = 0.12), argues that expanding secondary school level tutoring would be "potentially transformative" (p. 55). This points to a gap in the research and a need for better understanding of the efficacy of reading tutoring programs at the secondary level in the United States. Chapter 3 of this dissertation will examine the impact of one specific secondary school level tutoring program, Tutoring with ThemeReads, over the course of a semester of implementation.

The vast majority of efforts to improve student performance focus on schools (Neitzel et al., 2020), but non-academic factors can strongly influence success. Interventions may also consider non-academic factors, such as youth motivation, self-efficacy perceptions, and social determinants of learning, such as access to health services, as a means of supporting learning. Self-efficacy refers to the perceptions individuals hold about their capability to complete a task or action (Bandura, 1977), shown to positively predict and be associated with important outcomes for students and youth including academic achievement (Bandura, 1986; Chapman & Tunmer, 1997; Melnick et al., 2009; Pajares, 2005; Tobing, 2013), career choices (Lent, Brown & Larkin 1986), course selection (Durik et al., 2006), and athletic performance (Bandura, 1977). In academic settings, self-efficacy perceptions can be positively influenced through a number of easy to implement practices, such as individualized attention, regular feedback, and encouragement from teachers, peer collaboration and behavior modeling with fellow students, and regular practice. However, students who struggle academically often have negative or low self-efficacy perceptions (Margolis & McCabe, 2001), leading to students feeling stressed in

academic settings and avoidance of those tasks that cause them stress, such as reading aloud in class, which in turn leads to greater learning loss. This can cause a recursive loop, exacerbating achievement gaps and learning difficulties. The relationship between learning and non-academic, mental health-related conditions, such as self-efficacy, suggests the need for interventions targeting both student reading skills and self-efficacy perceptions and using measures of both to evaluate program success. Chapter 4 of this dissertation will examine the association between student participation in the Tutoring with ThemeReads program and their perceptions of reading self-efficacy at the end of participation.

Uncorrected vision problems have been identified as a potentially serious hindrance to student reading. While about one quarter of school-aged children and youth need eyeglasses (Ferebee, 2004), those from disadvantaged or minority backgrounds are far less likely to have access to or use their eyeglasses (Heslin et al., 2006; Qiu et al., 2014; Ruderman, 2016; Zhang, Cotch, et al., 2012). School-based interventions to provide equitable eyecare, including vision screenings, examinations, and eyeglasses at no cost to families, could be key to removing a barrier to learning for many students. Chapter 5 of this dissertation will examine the effect of the Vision for Chicago (V4C) program, a school-based intervention providing eyecare and eyeglasses to students in grades K-8, while also seeking to improve school and home culture of eyeglasses wear and care. The chapter will examine the effect of the program on eyeglasses compliance (use of eyeglasses when prescribed) and in an exploratory assessment, consider whether eyeglasses compliance mediates the effect of receipt of treatment on reading achievement.

Summary of Dissertation

In this dissertation, the included studies will examine multiple means of supporting the literacy development of struggling or striving readers. These studies were selected for their thematic coherence and relevance due to their focus on improving reading outcomes for secondary students and adolescents. The first two of the three studies described here are part of a larger initiative called Tutoring with ThemeReads, a school-based tutoring program for secondary students aimed at improving student literacy for striving readers through high dosage, small group tutoring supported by a teaching assistant. This program was pre-piloted in schools in Spring 2022.

The first set of research questions analyze the impact of the ThemeReads tutoring program on student literacy achievement. It was expected that students participating in the tutoring program would demonstrate stronger learning gains than counterparts not participating in the program.

The second set of research questions and analyses examines students' perceptions of themselves as readers, their reading self-efficacy (RSE), after involvement in the ThemeReads program. It was expected that students participating in the ThemeReads program would display RSE beliefs that were comparable to or higher than the beliefs of other striving readers who have participated in other literacy support interventions.

The third study in this dissertation focuses on the Vision for Chicago (V4C) program. This school-based vision program (SBVP) program was an initiative based in Chicago Public Schools (CPS) to provide access to quality eye care for Chicago students in elementary, middle, and high schools, as well as interventions designed to create a culture of eyeglasses use in CPS schools. V4C provided vision screenings and eye exams to students who returned signed consent forms, and focused on students who failed vision screenings, were entering kindergarten grade,

were newly arrived in the district, had individualized education programs, and those students for whom teachers believe there may be a vision problem. CPS partnered with Johns Hopkins University to study the effectiveness of the program in increasing reading achievement by increasing use of prescribed eyeglasses. Provision of eyeglasses was expected to improve students' ability to access and engage in learning in the classroom through improved ability to read and see the board (Neitzel et al, 2021). Importantly, the mere provision of eyeglasses is known to not always be sufficient to ensure impact on reading achievement. As glasses are frequently lost or broken, students may not understand or appreciate the benefits of wearing glasses in contrast to social pressures not to wear eyeglasses (Aldebasi, 2013; Kodjebacheva et al., 2015). The V4C program attempted to address this issue through the assessment of eyeglasses usage, provision of eyeglass clinics to repair or replace broken eyeglasses, presentations to teachers, parents, and children on vision care, and use of social media to share these messages. In doing so, the V4C hoped to provide a useful illustration of a means of complimenting other academic interventions to improve student reading.

The impact of the V4C program will be explored in the third set of research questions. First, the chapter examines the impact of eyeglasses provision on eyeglasses compliance, and whether compliance is a mediator of treatment impact on reading performance. It was expected that treatment would improve eyeglasses compliance, and that eyeglasses compliance would mediate or positively enhance the effect of treatment on reading achievement.

In the following dissertation, an overview of the dissertation research is presented. In Chapter 2, a general literature review and overviews of the ThemeReads and Vision for Chicago programs are described. In the following Chapters 3-5, the data and analytic plans for each of the different studies and their respective research questions are described. These are presented as

three independent, but thematically-related, papers. Chapter 6 summarizes learnings across all three studies and provides conclusions.

Chapter 2: Background Information

Introduction

As discussed in Chapter 1, there is a long-standing yet urgent need for interventions supporting adolescent readers, both directly through educational interventions and through nonacademic school-based interventions targeting out of school factors that may indirectly impact reading skills and achievement. This set of studies examines the effectiveness of two specific models for addressing the needs of struggling or striving readers. Before describing the specific methods and findings of each study in Chapters 3-5, this chapter reviews the relevant background literature concerning striving readers, literacy theory, and academic and nonacademic factors underlying learning. This chapter also describes in detail the two interventions forming the basis for these research studies, Tutoring with ThemeReads and Vision for Chicago (V4C).

Adolescent Striving Readers

Many adolescent students entering middle school lack foundational reading skills. These students are sometimes termed "at-risk, struggling readers, or striving readers" (Phelps, 2005, p. 16); a label often applied to diverse and distinct groups of students, including those diagnosed with reading disabilities, English learners (ELs), students seen as "underachieving, unmotivated, disenchanted, or generally unsuccessful in school literacy tasks" (Alvermann, 2002, p. 195). These students all face different challenges and require different supports in order to become proficient readers yet are often lumped together. While there is no ideal term that is not in some way stigmatizing or cumbersome, for the purposes of this study and simplicity, we use the term "striving readers" to include students in grades six through eight who are reading at the second-grade level or above, yet below their own grade. The term "struggling readers" carries with it

negative connotations due to an unstated assumption that readers struggle due to some personal failing or lack of effort. In reality, student failure to perform at grade level is often related to education systems failing students. A variety of socioeconomic and non-academic reasons which often predate their arrival in middle school (Caggiano, 2007) and continue throughout their secondary school experience lead to student educational struggles, including inadequate or inconsistent instruction in the early grades (Stanovich, 2009), minimal secondary school teacher preparation to teach reading, misunderstandings of their role in teaching reading, disparate school and classroom resources and opportunities, and systemic structural disparities in education (Leko et al., 2019; Moreau, 2014; Rubie-Davies et al., 2006). Some of these factors are closely related to the "social determinants of learning" framework (Sanderson et al., 2021), which identifies non-academic factors that impact the opportunities and ability of students to engage in learning. While larger-scale interventions to address teacher training and professional development should be pursued, current secondary school students require additional support for reading learning. As a result of these conditions, the term "striving readers" is preferred and used throughout this dissertation.

Literacy Theory

One of the common misconceptions about reading, which informs the instruction that adolescents in middle school receive, is that the process of learning to read is basically complete by the time students finish elementary school. Literacy is usually considered the key focus of early elementary instruction, replaced by content areas in middle and high school grades (Torgesen, 2017). Easy unconscious reading is taken for granted as the norm by adulthood. However, given that 66% of eighth graders do not read proficiently (NCES, 2020), this approach is not resulting in youth reaching the desired end point of fluent literacy.

Literacy is often considered a set of concrete subskills making up the ability of individuals to comprehend and draw meaning from texts, but in reality, is part of a larger sociocultural context related to different purposes for learning (Lague, 2021; Moje, 2002). Torgesen (2017) identifies six essential skill areas for reading: reading fluency, vocabulary knowledge, content knowledge, higher-level reasoning and thinking skills, cognitive strategies for reading comprehension, and motivation and engagement. Unsurprisingly, acquiring these different skills is a lengthy process, lasting throughout one's education career. Chall & Jacobs (1983) laid out what is considered the traditional sequence of reading stages as beginning before entering school (Stage 0) when children begin to gain familiarity with letters, move through the steps (Stages 1 and 2) of learning and practicing the foundational reading skills of decoding and vocabulary, among others, before increasing in complexity as they read for learning new information (Stage 3), read multiple points of view (Stage 4), and become capable of constructing and reconstructing meaning (Stage 5) (Chall & Jacobs, 1983).

Later, Shanahan & Shanahan (2008) developed a simplified framework for literacy with three levels: basic, intermediate, and disciplinary literacy. The first category includes the basic literacy skills of decoding, oral reading fluency, and other skills typically taught and expected to be learned during elementary school, while intermediate literacy refers to the "generic comprehension strategies, common word meanings, and basic fluency" skills that are more intellectually demanding, completed during middle schools (Faggella-Luby et al., 2012, p. 71). Disciplinary literacy equates to Chall's Stages 4 and 5, thought to be learned through middle and into high school (Faggella-Luby et al., 2012; Shanahan & Shanahan, 2008). In Chall's framework, the basic stages should all be completed by about fourth grade (Chall & Jacobs, 1983), setting the stage for students to encounter and understand more complex texts and

concepts as they progress through secondary school, creating a simple division between "learning to read" and "reading to learn" (Chall & Jacobs, 1983; Torgesen, 2017).

The reality is more complex than this, however, and these stages or levels say little about learning and development for those who do not follow the normative literacy learning process or face systematic differences in learning opportunities and resources. Students' readiness to read or learn to read upon entering school depends greatly on a variety of factors outside of their control, such as their exposure to literary environments as young children (Jacobs, 2008), which provide a foundation for teachers to build on through direct instruction and practice of basic reading skills. These foundational skills should provide the building blocks for students to read quickly and fluently and draw meaning from what they read. However, they are just one portion of literacy, which must be addressed through effective academic instruction.

Adolescent Literacy

Students struggling with reading or striving to read as they enter middle and high school have typically missed out on years of reading practice and time as proficient readers (Anderson et al., 1988; Cunningham & Stanovich, 2001; Torgesen, 2017). As they progress into the middle school grades, the demands on their literacy skills increase dramatically, with students exposed to more technical and discipline-specific courses and texts. Students must be able to read and draw meaning from texts of different types, both narrative as well as informative, and across genres (Snow & Biancarosa, 2003). However, literacy is not just the ability to read or write but is dependent and reliant on a number of more complex "non-cognitive" factors. Some of these necessary capacities include reading and learning motivation, metacognitive skills such as the ability to gauge one's own progress and understanding while reading (Snow & Biancarosa, 2003), and positive feelings of self-efficacy (Bandura, 1977). These differing and more advanced

academic needs point to other elements that must be incorporated into adolescent or secondary school level reading instruction and interventions.

Biancarosa & Snow (2006) laid out 15 elements of effective adolescent literacy programs, including direct explicit reading comprehension instruction, motivation and selfdirected learning, text-based collaborative learning, strategic tutoring, diverse texts, ongoing formative and summative assessments of students, and extended time for literacy. However, these elements are not consistently taught in secondary schools, nor are schools always capable of providing striving readers with the support they need to master these elements.

The very structure of secondary school, with its more discipline-based structure (Fuchs et al., 2010; Kamil et al., 2008; Leko et al., 2019), does not lend itself to supporting striving readers. Literacy difficulties are exacerbated by a general lack of support from secondary school teachers; middle and high school educators are more likely to be predominantly trained in instruction in their content area (Leko et al., 2019), with little to no training in teaching reading skills (Moreau, 2014). These teachers are more likely to feel that teaching reading is outside of their job responsibility and expect students to already be competent and fluent readers (Alvermann, 2002; Edmonds et al., 2009) or to feel they lack the capacity to teach or support reading skills development (Cantrell et al., 2013; Greenleaf et al., 2001). Students from different backgrounds also face different expectations from teachers and schools, and students from minority or lower SES backgrounds are typically faced with lower expectations in the classroom (Rubie-Davies et al., 2006), regardless of their actual learning ability. In addition, an insufficient number of reading specialists placed in secondary schools (Carlson, 2013) means students must rely on outside supports and programs to provide them the instruction they need, but do not always have access to, limiting opportunities for growth and academic success. Finally,

information about supporting adolescent students struggling with literacy skills remains limited, particularly within the United States (Baye et al., 2019). Along with systemic differences in physical resources and school services, these conditions further impede student literacy learning and opportunities for success in secondary school and beyond, and require a framework to guide the design and implementation of effective interventions and instruction to support student learning at the adolescent level.

Factors Underlying Effective Instruction

While Chall and Shanahan & Shanahan seek to model the stages through which students progress to become proficient readers, their models do not speak directly to the actual processes or effective methods needed to support students from different backgrounds and reading abilities move from beginning literacy to proficient readers of different disciplines, and the elements necessary to instruct students to read. Based on Carroll's model of school learning (1963), Slavin (1984) introduced a framework guiding effective instruction and interventions focused on the "alterable elements" of learning and instruction. These four elements; Quality of instruction, Appropriate levels of instruction, Incentive, and Time (QAIT), are all identified as elements teachers and schools have control over and can change (Slavin, 1994). Quality of instruction refers in the framework to how well information is presented to students so they may easily learn them, informed by the curriculum and lesson presentation. Appropriate levels of instruction is defined by how appropriate a new lesson is to the students learning it, and whether students have the requisite skillset and knowledge for the lesson. The Incentive element focuses on whether teachers ensure students are motivated to focus on educational tasks and learn what is being taught. Finally, Time requires that students have enough time in order to learn the material.

However, Slavin (1994) cautions that these four elements cannot be addressed in isolation; instruction must be strong in all four elements simultaneously for it to be effective; and that alterations to one element may require a tradeoff with another (Cheung & Slavin, 2012). Thus, a teacher or tutor prioritizing time for learning must also consider whether there is sufficient learning material at the students' reading level to ensure quality of instruction and appropriate level of instruction and to ensure that instruction is aligned and effective. Without doing so, the extra time will not have the desired effect and may in fact reduce student incentive to learn. This framework provides the foundation for the design of the ThemeReads adolescent tutoring program, which seeks to improve literacy skills through effective instruction methods, moving students into position to ascend through the levels and stages outlined by Chall & Jacobs, Shanahan & Shanahan, and Torgesen.

Other Determinants of Learning

While the majority of research on improving student reading focus on academic or instruction-based interventions, increasing research and interventions have focused on addressing other determinants of learning. In one framework, these are termed "social determinants of learning," which are "socially imposed forces that are causative factors that have implications for or influence one's life" (Sanderson et al., 2021, 207), that can impact students' learning and ability to engage in learning (Neitzel et al., 2020). The framework includes core components of physical health, psychosocial health, economic stability, self-motivation, social environment, and physical environment. Continued exposure to negative elements, including poor health and negative environmental conditions, significantly impacts student ability to engage in learning, yet are often concentrated amongst students living in poverty (Berliner, 2009) or part of other minoritized populations (Neitzel et al., 2020).

The concept of self-motivation describes a motivation to learn and participate in learning, and Sanderson and colleagues call for faculty to encourage active participation and growth mindsets in order to improve learning. Reading self-efficacy (RSE) perceptions, both positive and negative, can have a formative and long-lasting effect on student motivation to learn (Melnick et al., 2009; Pajares, 2005) and actual learning (Alvermann, 2002; Chapman et al., 2018; Conway, 2017; Lent, Brown & Larkin, 1984; 1986; Schunk, 1989; Zimmerman, 2000). RSE has been associated with better use of self-regulated learning strategies (Hong & Park, 2012), ESL proficiency (Templin, 2011), and is correlated positively with such outcomes as reading achievement and specific reading skills (Barkley, 2005; Burrows 2012; Carrol & Fox, 2017; Tobing, 2013; Waleff. 2010).

Addressing student health needs through school-based service programs serves as an interesting contrast to improve learning access and academic achievement compared to instructional support methods. Uncorrected vision problems, particularly refractive errors, remain a common health problem for children and youth (Ethan & Basch, 2008), which can in turn have a major impact on student ability to learn and engage in school activities. When child vision problems are not addressed, children may experience a wide range of personal and academic repercussions, including depression, tiredness and headaches, greater or permanent vision loss, slowed development and learning, struggles with paying attention to schoolwork, and lower reading speed (Killeen & Lee, 2022; Kodjebacheva et al., 2015; Ruderman, 2016).

Effective school-based health services, such as eyecare, can play a role in overcoming barriers to learning and even impact student learning and achievement in positive ways. Disproportionate discrepancies persist in access to and use of eyeglasses for low-income children and their families (Ethan & Basch, 2008). While about one quarter of school-aged children and

youth require eyeglasses to address refractive errors (Ferebee, 2004), those from disadvantaged or minority backgrounds are much less likely than those from the middle class or white ethnic backgrounds to have and use needed eyeglasses (Ganz et al., 2007; Heslin et al., 2006; Qiu et al., 2014; Ruderman, 2016; Zhang, Cotch, et al., 2012; Zhang, Elliott, et al., 2012). These roadblocks to receiving vision care include access to transportation and health insurance, linguistic hurdles, and education (Solomon et al., 2022). Equity-centered programs that provide eyecare to students of all backgrounds at no extra cost to students or their families may be able to help bridge opportunity gaps in academics and in life. These programs, such as those organized by Vision to Learn (VTL), typically organize interventions such that students do not need to have health insurance, services are provided in multiple languages based on student and parental needs, and services are brought to schools where children spend most of their time. These qualities help to address the hurdles to care, and enable all children and youth to benefit from possession and use of eyeglasses. These programs may not always be successful due to a number of other challenges (such as compliance rates, discussed in Chapter 5), but they do provide a strong foundation to support the non-academic social determinants of learning.

Overview of Tutoring with ThemeReads

Tutoring with ThemeReads is a program intended to provide effective small-group literacy tutoring for striving readers and uses cooperative learning and computer-assisted instruction to target striving readers in grades six through eight reading at third grade level and above. Students, identified and assigned to the program by their respective schools (based on prior performance and achievement, scheduling, and school pod structure, among other factors), participating in the ThemeReads program received tutoring up to five days a week during normal school hours. Students worked in pairs, sharing a computer, and alternated roles as "reader" and

"coach," while tutors conducted regular progress assessments, identified and filled in student skill gaps, and motivated students through goal setting, progress monitoring, and celebration of student progress (see Figure 1 for an example of the ThemeReads "Celebration Station," offering options for students to view fun videos when achieving certain goals and completed levels). The role of student or peer coach was not a passive role, instead requiring active thinking and critical engagement in the reading process, just as when students were acting as readers.

Figure 1.



Screenshot of Sample ThemeReads Celebration Station Page

The Tutoring with ThemeReads program was developed to increase vocabulary, fluency, comprehension, and background knowledge of students through brief, content-rich passages centering on the thematic areas of community, social studies, and science. These passages (an example shown in Figure 2) should be read quickly and with understanding, enabling students to practice both reading and acquisition of specialized vocabulary and content area knowledge.

Passages focus on a variety of content area themes, including human senses, travel, the Stone Age, or realistic fiction (see Figure 3 for a sample table of contents in the ThemeReads program), with multiple texts on each topic, providing more opportunity to practice reading content area words and synthesizing across texts to develop deeper knowledge in each topic. Reading passages are grouped into units of five readings on the same topic, using similar words and high-value vocabulary. This helps students to develop automaticity and fluency.

Figure 2.

Screenshot of Sample ThemeReads Reading Passage





Figure 3.

ThemeReads Sample Table of Contents for Level A3



The program was designed to address all of the elements in the QAIT model for effective instruction and reading instruction methods in a tutoring setting to maximize rapid growth and improve adolescent literacy, as described below and depicted in Figure 4.

• **Quality of instruction** was ensured through well-trained and supervised tutors, familiar with the learning model, program goals, and instructional methodology. Instruction was

also supported through the use of a carefully designed computer interface, which guided learning progress. As has been noted elsewhere, paraprofessional tutors have been shown to produce strong reading gains for striving readers, as has well-developed and integrated computer-assisted instruction (Baye et al., 2019; Gersten et al., 2020; Neitzel et al., 2021; Wanzek et al., 2016).

• The program's tutors and computer program also ensured adequate **appropriateness of instruction**, as tutors worked with smaller numbers of students, allowing more individualized attention, and the adaptive computer interface assessed students' needs and monitored their progress, and then provided reading materials appropriate to any given student's reading level. In addition, the cooperative learning approach encouraged students to assist one another when their partners encountered difficulties, which has been shown to impact learning (Baye et al., 2019; Herrera et al., 2016; Neitzel et al., 2021). This functioned as a sort of scaffolding approach, in which students worked together to achieve each new reading skillset and reading level.

Figure 4.

Tutoring with ThemeReads Program Logic Model



• Tutoring with ThemeReads was designed to improve student incentive to learn through regular encouragement from tutors and student reading partners. Tutors supported incentive building through progress monitoring, celebration of student progress, and regular goal setting activities with students. These goals were monitored by the ThemeReads computer interface. Students took turns playing two roles, reader and coach. As reader, they attempted new and interesting texts while working towards the goals they set with their partner and tutor, such as vocabulary learning. As coach, they acted as a partner who listens, assists, and encourages their reading partner. This contributed to both the ThemeReads program and the act of reading remaining interesting and engaging. Both roles were designed to keep students engaged and incentivized to participate and

learn, and required cognitive thinking and active participation in the program, modeling and supporting one another.

The QAIT model's concept of time was dependent on the amount of time allocated for learning, and the amount of "engaged time" during which students were actively engaged in learning tasks (Slavin, 1994). This engaged time was dependent on "quality of instruction, student motivation, and allocated time" (Slavin, 1994, p. 148). Tutoring in general, and ThemeReads in particular, by its very nature and existence, allocates additional time for learning to read, which is usually unavailable to middle schoolers. This also ensured that the majority of tutoring time was spent engaged in learning to read. The program's cooperative learning approach, along with tutor and technological monitoring, contributed to ensure that time was used effectively for learning.

Before engaging with the passages, students worked together to complete a set of vocabulary activities. Each student then took turns reading each passage aloud and acting as peer coach, then listened to the computer interface read the passage aloud while following along. The students then took turns reading again, while being timed and assessed by the computer. Passages at the lowest reading level were about 150 words in length, with passages increasing in both length and complexity as students moved through the reading levels, reinforcing vocabulary and automaticity through the use of similar words in new forms. As automaticity increased, students improved their overall fluency skills and could concentrate on learning new vocabulary and overall comprehension, rather than focusing also on the act of reading.

Comprehension question activities (Figure 5) followed each set of passages, to be completed together by the student pair groups. These comprehension questions led into a final set of questions connecting the ideas and concepts from the reading passages to student lives and
the world. Each unit ended with a review by tutors. During this stage, students again read the passage aloud while being observed by the tutor, and tutors discussed student progress and performance with students.

Figure 5.

Screenshots of Sample ThemeReads Vocabulary and Reading Comprehension Activities

	DE	FINITION	SENTENCE
cartoons	funny o	drawings in	I laughed at the funny rabbit
comic strips	newspaper	rs or animated	in the cartoons.
funnies)	nows	
animation			
studios	J		
released			
graphic novels			
captions]		
leaves	seasons	flowers	tilted
mountains	snowdrops	tadpoles	
mountains	snowdrops	tadpoles	
mountains	snowdrops	tadpoles	
mountains	snowdrops	tell me s	pring is coming.
mountains	snowdrops	tadpoles	pring is coming.



Student progress was supported by consistent instructional and supportive guidance from tutors. ThemeReads tutors were teaching assistants with college degrees and had experience working with children, employed full-time by Success for All Foundation (SFA). One full-time tutor was assigned to each school, providing up to nine 30-minute tutoring sessions daily to four students at a time, forming two partnerships, which were largely consistent throughout the semester. Tutors were trained and supported by experienced Success for All coaches throughout the semester. SFA coaches typically had full-time positions with SFA and had supported previous tutoring efforts, such as Tutoring with Lightning Squad or other SFA initiatives. Tutors received two days of initial training, followed by regular coaching visits and observations from lead tutors. As students completed tutoring sessions, tutors received feedback from the ThemeReads program software on student performance and progress, which were used to guide instruction and support student areas of difficulty. They were also able to create versions of the reports that were appropriate and understandable for students to understand, describing measures such as words correct per minute. In one-on-one check-in meetings and goal setting sessions with each reading partner group, tutors reviewed these reports in a supportive manner and helped students to target different skills areas, such as vocabulary development, for students to focus on in upcoming tutoring sessions, and provided direct instruction in challenge areas. Tutors were instrumental in identifying student areas for growth, and for helping students recognize when they were making progress and becoming stronger readers.

Each week, student partner groups engaged in goal setting, in which they agreed together on skills or activities to focus on and target, such as completing three passages during a week or focusing on vocabulary learning. Students also completed one-on-one check-ins with tutors to receive direct support and guidance.

Tutoring with ThemeReads: Research Study

In order to understand the impact of ThemeReads, researchers at Johns Hopkins University conducted a rigorous program evaluation to assess the impact of the tutoring on reading achievement. This evaluation followed a quasi-experimental design, with Baltimore City

Public Schools assisting in the recruitment of middle schools for the study. Students were identified by their school to participate in ThemeReads tutoring program based on prior reading performance. Using within-school student-level matching, each participating student was matched prospectively to a similar comparison student in their school based on pre-existing characteristics. Matching data, including prior reading achievement on the i-Ready Reading Assessment (Curriculum Associates, 2015) and demographic information, were provided by Baltimore City Public Schools.

In January 2022, participating Baltimore City Public Schools identified students in need of tutoring. All Baltimore City Public School students completed the i-Ready Reading Assessment in fall, winter, and spring of the 2021-2022 school year, while only participating ThemeReads students (those for whom active consent was received) completed the reading selfefficacy measure in May-June 2022 at the end of the academic year. Matching took place using pre-intervention data. Student groups were assessed for baseline equivalence, using sex, ethnicity, and prior academic performance, among other characteristics. The reading selfefficacy measure is described in more detail in Chapter 4.

Overview of Vision for Chicago program

The Vision for Chicago (V4C) program was a collaborative initiative between Johns Hopkins University (JHU) Wilmer Eye Institute and School of Education and Chicago Public Schools (CPS). The program, started in 2017, sought to improve the implementation of the Chicago Vision Exam Program (CVEP), provided access to quality eye care to students, and promoted compliance with eyeglasses wear through educational and communication interventions. As a partnership between CPS, Chicago Department of Public Health (CDPH), and Chicago Mayor's Office, CVEP coordinated with optometric providers to ensure eye exams

and eyeglasses to students at no out-of-pocket costs to them or their families. Eye screenings and exams took place at school or off-site locations organized by the program. These services were made available to all students who return a signed parental consent form, regardless of background or status. Vision screenings organized by CVEP follow state regulations and procedures. Students failing screenings twice were referred for examinations.

The V4C program was designed to improve student examination rates following referral and to promote student, family, and staff awareness of eye health and the importance of eyeglasses use. V4C worked to improve communication between families, school staff, and providers, and develop teacher monitoring and eyeglasses encouragement systems. V4C School Vision Advocates (SVAs) regularly visited CPS schools to educational initiatives to raise awareness of the importance of eyeglasses wear and maintenance, support schools in vision screening and eye exam processes, support eye exam consent form collection, coordinate with educators to develop plans to monitor eyeglasses use and reward students for usage of eyeglasses, support program-school communications and engagement, and support the development of a culture of eyeglasses wear and care in CPS schools.

Vision for Chicago: Research Study

The Vision for Chicago (V4C) research study was developed to evaluate the impact of an enhanced school-based vision support program on academic performance using a cluster randomized design. In partnership with CPS, 80 schools were recruited to participate in the study. The schools were then randomized into two groups of 40 schools making up the intervention and control schools, following a matched pairs methodology. Principal components analysis was used to develop scores using school demographic and achievement characteristic data. These scores were then used to rank schools in 20 pairs, which were then used in the

random assignment, with one school in each pair assigned to treatment and the other to control. Researchers determined that the randomization was successful and the two groups were sufficiently similar prior to intervention (Neitzel et al., 2021).

The V4C program also intended to increase access to care and use of eyeglasses for students across grades, though this study focuses on students in grades six through eight. In order to examine progress in eyeglasses use, V4C SVAs and researchers conducted a series of classroom observations. Observations took place in both treatment and control schools at the beginning and end of each school year from 2017-2019, with the first observations predating eyeglasses screenings or distribution, serving as a baseline. In Fall 2017 at baseline, two sets of observations were conducted, with inter-rater reliability checks taking place to ensure all observers were conducting observations uniformly. Observers coordinated with schools prior to arrival for observations, but classrooms and teachers did not receive advance notice of visits. Observations were conducted to determine the number of children wearing glasses in academic classes. All counts were conducted in the morning, prior to the start of the lunch period, in order to find as many students in academic class lessons as possible. Observers visited each class, counting both the number of students wearing glasses and the number of students present. These counts were not limited to students who had been identified as needing or receiving eyeglasses through the V4C program. In addition, eyeglasses screenings, examinations, and distribution took place throughout the school year, with timing of observations not tied to these activities.

Chicago Public Schools (CPS) also provided researchers with student academic and demographic data from 2017-18 and 2018-19 school years to be used in assessing the impact of the V4C program on student reading achievement. Academic data included the Northwest Evaluation Association's Measures of Academic Progress (MAP) (collected fall, winter, and

spring from 2017-2019 school years), the Partnership for Assessment of Readiness for College and Careers test (PARCC) (collected in spring 2017 and spring 2018), and the Illinois Assessment of Readiness (IAR) (replacing the PARCC, collected in spring 2019). Demographic data provided by CPS for both treatment and control school students included race/ethnicity, bilingual language status, special education status, and free or reduced lunch (FRL) status.

Summary

The research in this dissertation examines the development of strong adolescent readers through the following lenses: instructional support, student self-perception, and the availability of vision care. This set of studies fill a gap in the research on programs addressing striving middle school readers, as the majority of research on such interventions focuses instead on elementary school reading interventions and in non-U.S. contexts. The first two studies are designed to provide evidence of the impact of middle school tutoring on academic achievement, but while also contributing to the literature concerning the relation between such interventions and students' reading self-efficacy perceptions. Studying the impact of reading tutoring on students' reading self-efficacy alongside the impact on academic achievement is important because of the close reciprocal interrelationship between the two outcomes. Improving student recognition of their progress and greater reading ability may be as important to supporting lasting reading engagement and skills growth as the actual growth itself. The third and final study examines how the provision of eyeglasses and efforts to create a culture of eyeglasses use in schools contribute to students' eyeglasses use and their reading achievement.

Chapter 3: The Impact of Tutoring with ThemeReads Program on Secondary Student Literacy Skills

Introduction

For students entering the middle school grades, it is a time of great upheaval and change, both personally and academically. In addition to the biological changes their bodies are undergoing, their academic roles and responsibilities are changing as well. More is asked of students mentally as their courses all introduce more complex subject matter and require more advanced understanding and skills from students to succeed. For some readers, these learning materials may reach a level of readability too intense and intimidating (Mastropieri et al., 2003), or may in fact be above grade level (Berendes et al., 2018). Literacy of both informative and narrative texts is required in middle school (Perry, 2006), as well as career settings and higher education. Though a great deal of research exists concerning elementary reading interventions and beginning reading theory, less high-quality research has been conducted for secondary students struggling in reading, suggesting a need for more evidence concerning effective interventions, particularly tutoring programs, targeting this group.

Background and Literature Review

Recognizing the importance of literacy support highlighted by the NAEP, international assessments (including the Programme for International Student Assessment or PISA), and reports from organizations including the International Reading Association (IRA) and RAND Corporation (Biancarosa & Snow, 2006; Jacobs, 2008), United States federal and state legislation have provided substantial funding for literacy programs over the past twenty years. The No Child Left Behind Act (NCLB: 2002) emphasized the importance of early grade reading development through state proficiency level testing (Zimmer et al., 2010), while the Every

Student Succeeds Act (ESSA: 2015) directed states to develop challenging academic reading standards and set aside funds to support struggling schools. While the majority of this funding and attention was directed to elementary and primary education, the Striving Readers Comprehensive Literacy Program and the Investing in Innovation Fund have supported research and interventions for striving readers in low-income secondary schools (Baye et al., 2019; Herrera et al., 2016; Jacobs, 2008). The Common Core State Standards include guidance for K-12 schools and educators about expectations for English Language Arts for each grade, outlining a "pathway to proficiency for all students, including those who struggle with literacy" (Haager & Vaughn, 2013, p. 5). However, not all states have implemented the Common Core standards, and the CCSS remain controversial (Lee, 2021; Ridler, 2022), potentially limiting the initiative's effectiveness and reach.

ESSA also emphasized the need for evidence-based programming, defining four tiers of evidence to guide understanding of programmatic effectiveness (Regional Educational Laboratory at American Institutes for Research, 2019). Table 1 depicts the four tiers of evidence. Tier I programs with strong evidence have been evaluated by at least one well-designed and implemented experimental study, preferably using randomization. Programs with moderate evidence (Tier II) have been studied as part of a strong quasi-experimental study, while Tier III programs have been studied through a correlational study, controlling for selection bias. Finally, promising or emerging evidence (Tier IV) refers to programs based on evidence or research, but have not yet been studied. The emphasis of recent legislation has been on standards and the development and funding of research to gather evidence related to educational programs. The present study aims to contribute to research in Tier II of the ESSA standards.

Table 1.

ESSA	Tiers	of Evidence	
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Category	Definition	Example
Tier I	Strongest evidence base through at least one well-designed and implemented experimental study meeting What Works Clearinghouse (WWC) standards and at least 350 participants in more than one district or school	Randomized control trial
Tier II	Second strongest basis, with at least one strong quasi-experimental study meeting WWC standards with reservations and at least 350 participants in more than one district or school	Quasi-experimental study
Tier III	Program studied with at least one correlational study with statistical controls for selection bias	Correlational study
Tier IV	Program based on evidence or research, but without focused research study of the program to date	Program with evidence- informed logic model

Research on Reading Programs for Secondary Students

While there are a wide variety of elementary school level programs meeting all four tiers of evidence, comparably less attention has been paid to secondary literacy support in the research literature. Most existing research has focused on interventions at the elementary school level, where meta-analyses have pointed to the strength of one-to-one and small group tutoring, programs focused on decoding and phonics, and cooperative learning (Baye et al., 2019; Edmonds et al., 2009; Gersten et al., 2020; Neitzel et al., 2021; Slavin et al., 2009; Slavin et al., 2011). In contrast, educational technology and computer-assisted instruction (CAI), wholeschool programs, and revisions to content and curriculum have shown only minimal or inconsistent positive effects for student reading skills (Baye et al., 2019; Cheung & Slavin, 2012; Dietrichson et al., 2017; Herrera et al., 2016; Neitzel et al., 2021). As noted in Chapter 2, the relative lack of research focused on secondary student reading interventions and tutoring in the United States points to a need for additional US-based tutoring program research meeting ESSA standards of evidence.

Theoretical Basis for Effective Tutoring

When successful, literacy tutoring programs, such as ThemeReads, can address each of the elements of the QAIT model (quality of instruction, appropriate level of instruction, incentive, and time) to ensure effective instruction (Slavin, 1994), which can lead to improved reading skills (Baye et al., 2019), attendance (Fryer & Howard-Noveck, 2020), and positive self-efficacy (Schunk & Rice, 1992). Tutoring programs provide quality instruction through a variety of means, including well-designed evidence-based materials and curricula and effective pedagogical methods. While it was assumed for many years that teachers made the best tutors, recent research has indicated that the difference in effectiveness between one-to-one tutoring and small group tutoring of three to four students led by trained paraprofessionals may be minimal (Baye et al., 2019; Neitzel et al., 2021; Robinson et al., 2021). The strongest tutoring programs are those that ensure quality instruction through regular support and training for tutors (Kraft & Falken, 2021; Nickow et al., 2020; Wasik & Slavin, 1993), such as tutoring session visits and guidance from coaches.

Effective tutoring programs ensure an appropriate level of instruction through personalization and collaboration. The small, intimate setting of a tutoring session, where students work directly with a tutor or in small group with peers without distractions from other students at different performance abilities, allows tutors to provide more individualized attention and adapt direct instruction to meet students' needs (Jun et al., 2011; Nickow et al., 2020). The small group setting also allows tutors to provide consistent student progress monitoring and

feedback (Jacob et al, 2016; Kraft & Falken, 2021). This individualized and adaptive instruction is more easily achieved in a tutoring program than in a large classroom with more students at various skill levels.

The small and individualized setting of tutoring programs also enables these programs to effectively improve student incentive to learn. The regular feedback students receive from tutors and peers encourages students to engage with the lessons and recognize their learning progress and improved reading skills. By prioritizing cooperation and collaboration between students, tutoring programs encourage the development of strong personal relationships between students and tutors (Baye et al., 2019), as well as peer relationships in which students support one another. Some research in elementary grades has suggested that students may demonstrate greater learning gains in programs in which they have stronger personal connections with tutors (even just over 3 months) (Cabezas et al., 2021), and these connections may have effects beyond academic outcomes (Nickow et al., 2020), including social-emotional and behavioral outcomes that could have lasting impacts on students' lives. In addition to paraprofessional tutors, some effective tutoring programs focus on the use of peer models or cross-age tutors, where older tutor students instruct younger students. Cross-age tutoring programs have also shown some amount of effectiveness for secondary students serving as tutors (Jacobson et al., 2001; Jun et al., 2011), but these initiatives may be less effective when the struggling student is an adolescent. Modeling positive behaviors and learning strategies, such as reading skills, especially when the model shares similar traits with the learner, has been shown as an effective means of improving learning as well as engagement with learning and positive self-efficacy perceptions (Schunk & Hanson, 1985). While all four of the QAIT elements must be adequately addressed for a program to be effective, increasing student incentive to learn through relationships that provide feedback and

encouragement may be one of the most important and far-reaching opportunities in tutoring programs.

By providing a dedicated time period in which students may focus on learning, tutoring programs clearly address the time element of the QAIT model. The most effective tutoring programs are typically those termed "high-dosage" programs, which may be defined in minutes per week, i.e., "225 minutes per week" (Fryer & Howard-Noveck, 2020), or number of sessions per week, i.e., "three or more sessions per week" (Robinson et al., 2021). Most tutoring programs last between a semester (Dietrichson et al., 2017) and a full school year, suggesting that substantial and meaningful improvement can be seen in a short time period if students are engaged properly in learning, and in fact, longer tutoring programs may be negatively associated with learning (Dietrichson et al., 2017; Wanzek et al., 2013; Wanzek et al., 2016). This points again to the necessity of tutoring programs to prioritize engaged time for learning.

Literacy tutoring research demonstrates that tutoring in reading for secondary students is an effective approach to supporting the literacy development of students, but that more research is necessary to support such programs in the United States. As discussed in Chapter 2, the ThemeReads program, based on the QAIT model for effective instruction, emphasizes tutorstudent interactions and cooperative learning between student pairs, and is designed to fulfill these theoretical bases for effective instruction. This project proposes to fill this gap in the research by examining the effectiveness of the ThemeReads program model in improving the reading skills of struggling Baltimore public school students.

Methods

Purpose Statement

The purpose of this quasi-experimental study is to examine the effectiveness of the ThemeReads tutoring program to improve participating sixth through eighth grade students' literacy abilities. This purpose led to the following research questions.

Research Questions

Research Question 1: How does participation in ThemeReads impact student reading achievement compared to similar comparison students who engage in business-as-usual learning activities?

Given the theoretical underpinnings of the ThemeReads program and the research supporting the strong impact of tutoring programs on student literacy, it was expected that the students participating in literacy tutoring through ThemeReads would have higher reading scores than similar students not participating in the program. Therefore, it was hypothesized that there would be an association between participation in the ThemeReads program and increased reading skills for participating students.

Research Question 2: How do the effects of ThemeReads differ by student demographic characteristics and baseline reading achievement?

Certain background characteristics have been found to be correlated with educational outcomes, as described earlier in this dissertation. It was therefore hypothesized that student reading gains may differ by characteristics such as gender, race and ethnicity, or baseline reading achievement.

Research Question 3: In the context of ThemeReads, how do different levels of participation in ThemeReads and the pace with which students move through the program differ from partial participation or those who make slower progress?

Typically, receiving more tutoring support is expected to have a greater impact on student learning (Fryer & Howard-Noveck, 2020; Robinson et al., 2021). It was hypothesized that there would be an association between student attendance in the tutoring program and reading achievement as measured in standardized reading assessments. It was also hypothesized that there would be an association between student progression at a faster pace or rate through ThemeReads reading levels and reading skills as measured in standardized reading assessments.

Sample

Participants in the study were drawn from two public schools serving students in grades 6-8 that agreed to participate in the ThemeReads tutoring program in Baltimore. Participating schools were recruited for the program with support from Baltimore City Public Schools, based on interest in participation in the program. These schools were subsequently approached to participate in a pre-pilot study of the ThemeReads program, with two schools agreeing to allow research to take place on their campuses. A third school dropped out during the first month due to personnel issues before students were assigned to the treatment group.

Each school was responsible for identifying 24-36 students to participate in the tutoring program, based on whatever information was available to them, including characteristics such as prior academic performance and student class schedules. Newcomer English learners and students with individualized education plans indicating cognitive deficits disabilities were generally excluded from consideration as they receive alternative school supports.

Students were assigned to tutoring based on school pod structure and academic schedule, by school personnel. Baltimore City Public School students were administered the i-Ready Diagnostic for Reading assessment (Curriculum Associates, 2015) in Fall 2021, Winter 2022, and Spring 2022. These tests serve as individual pretests and outcome measures. The same students were followed from January through June.

Active consent was sought from the parents or caregivers of all students identified and participating in ThemeReads tutoring, while passive consent was sought from parents or caregivers of students within the same schools and grades as participating ThemeReads students. An incentive was provided for ThemeReads students to return the form (regardless of decision), consisting of an item such as a toy or snack costing \$3 or less. The non-participating students from the same schools and grades formed the pool for the comparison sample. Any ThemeReads students for whom parental consent was not received or comparison students for whom a negative parental consent was returned, were removed from the potential pool of matching students and from the final sample. Obtaining signed active consent forms, regardless of parental response, proved challenging, and resulted in a smaller sample size than originally intended. This would have an impact on the possible balance that could be achieved between treatment and control groups, as will be discussed in the pages that follow.

Research Methodology

This study examined the impact of the ThemeReads program on sixth grade student reading assessment performance gains of sixth grade students tutored over the course of a semester, comparing participating student performance to a comparison group on similar students who did not receive ThemeReads tutoring support. Participating sixth grade students

received tutoring services 30 minutes per day, four or five days a week, between January 2022 and May 2022.

Data Collection

Data for this study were collected from Baltimore City Schools and the ThemeReads program. The Tutoring with ThemeReads software program automatically collected student performance data in the tutoring program. Baltimore City Schools provided background and academic data for treatment and comparison group students. Measures were obtained from both sources.

Outcome measure.

Student reading achievement measure: The i-Ready Diagnostic for Reading, created by Curriculum Associates (Curriculum Associates, 2015), was administered in Fall 2021 and Winter and Spring 2022 by Baltimore City Schools. The Spring 2022 i-Ready scores served as an outcome measure.

The web-based i-Ready assessment was created to be administered in a uniform way across schools (Curriculum Associates, 2015), lasting around 45-50 minutes. The assessment was designed to be aligned with the Common Core State Standards (CCSS) (Aguilar, 2019) and established standards related to college- and career-readiness, as a means of providing instructional guidance for teachers and help direct resources for targeted instruction for struggling students (Swain et al., 2020). The i-Ready Assessment is intended for multiple purposes, including as an assessment, a means of assessing student knowledge or growth in knowledge, and providing guidance for instruction and student placement decision-making (Aguilar, 2019; Curriculum Associates, 2015), and is intended for students in Kindergarten to eighth grade. While early grade forms of the assessment include phonological awareness and

phonics subtests, the i-Ready assessment for students in grades 6-8 includes vocabulary and reading comprehension subtests (Aguilar, 2019).

The i-Ready assessment has been tested extensively for validity and reliability, allowing researchers to draw conclusions about student knowledge and capabilities or proficiency within content areas (Aguilar, 2019; Curriculum Associates, 2015). Scores on the i-Ready have been found to correlate with scores on other established reading assessments, including the Partnership for Assessment of Readiness for College and Careers (PARCC) and 23 U.S. states' standardized measures of learning, including New York, Illinois, and Pennsylvania (Aguilar, 2019; Curriculum Associates, 2015).

Scores range from around 300-800, with students reading at lower reading levels or in lower grades receiving lower scores than older students or those reading at higher reading levels (Neitzel et al., 2021). This value reflects the total score students receive on the i-Ready end of year reading assessment. It is calculated through summing the scores across each sub-scale (phonological awareness, phonics, high-frequency words, vocabulary, and comprehension). In the analytic sample, scores ranged from 423 to 627 (mean = 518.7)

Covariates.

i-Ready Reading Prior Achievement: As noted above, the i-Ready assessment is administered by Baltimore City Schools in fall, winter, and spring of each academic year. The Fall 2021 i-Ready overall score served as a baseline measure.

Student demographic data: Student demographic data was provided by Baltimore City Public Schools. This includes data including student age, grade, race and ethnicity, English language learner status, direct certification status, school, and gender. Direct certification acts as a poverty indicator (and will be referred to as such in tables and figures in this study) refers to students

eligible for participation in programs such as Temporary Assistance for Needy Families (TANF), SNAP (Food Stamps), Foster Care, or have the status as a homeless student. Eligibility for FARMS is based on family income. It should be noted that direct certification status does not necessarily reflect all students who qualify or receive free or reduced lunches through schools, but is an approximate category used given Baltimore City FRL policy impacts how these characteristics may be measured.

School: A dummy variable for each school was created and included in the model as a fixed effect. This was intended to allow the analysis to differentiate and draw conclusions about differences in implementation between participating schools.

Dosage: ThemeReads tutors kept daily attendance records in Google Sheets. These records were used to calculate an attendance rate variable dividing each students' number of days present by the total number of potential tutoring days.

Pace: The ThemeReads tutoring software automatically tracks and records student progress through the ThemeReads material whenever students log into a program session. Each level of ThemeReads has a grade level equivalent representing the reading level that student are achieving. When assessing differences in learning gain by pace, a continuous variable representing pace was included. This variable reflects a count of the number of grade levels students completed during the course of their participation in the ThemeReads program.

Propensity Score Matching

Baltimore City Schools provided student academic and background data and deidentifying data for all potential comparison group students. Due to challenges in gathering consent forms and approval for implementation in schools, the sample pool of both treatment and

comparison students was limited to those from two schools and largely from grade six. This would have an impact on the potential balance of the two comparable groups.

Listwise deletion was used to address missing data for those students who did not complete the baseline or outcome reading assessments. As a result, only one treatment student was left in the sample from School 2, so the analysis was limited to School 1 students, allowing greater consistency of analysis. In addition, based on examination of variable distribution, those students whose pre-test i-Ready scores were equal to or lower than 400 were deemed to be outliers, and these students were excluded as well. Following these processes, the analytic sample included 22 treatment students and 110 potential comparison students.

After finalization of the dataset, the study used within-school one-to-one propensity score matching (PSM) to approximate an experimental design, and minimize selection bias. PSM, developed by Rosenbaum & Rubin (1983), is noted for reduction and removal of selection bias through the estimation of the probability of receiving treatment for matched individuals (Hudson et al., 2014). The use of matching is intended to strengthen inferential validity and account for background characteristics that would be controlled for automatically through random assignment. PSM has been shown to effectively produce estimates similar to those that could be produced through a randomized control trial or experimental research design (Babalola & Kincaid, 2009). PSM has been found effective for small sample sizes, including with samples of no more than 40 subjects (Pirracchio et al., 2012). Given the potential differences in groups prior to analysis, use of inverse probability of treatment weights (IPTW) was considered as a means of accounting for differences. However, the alternative method did not contribute to the understanding of the outcomes of interest or study goals, likely due to the small sample size. As a result, propensity score matching was used.

In the first stage of PSM, a logit model was used to estimate the propensity score, or the likelihood for each individual for receiving the treatment (Morgan et al., 2010). Variables used in estimating the propensity score were used to ensure that the model accounted for variables related to selection or assignment into the treatment intervention and outcomes. As race or ethnicity, direct certification, and age were not related to schools' decision-making processes in identifying students, these variables have been left out of the matching equation. In contrast, prior reading achievement and IEP status were factors in selecting or deselecting students for the treatment, and are known to be predictive of academic achievement, so these variables were considered important parts of the propensity score equation. These variables, as well as student sex, were included in the logit model. While some PS logit models include more variables, the decisions here were theoretically driven as well as informed by the uniformity of the existing sample of treatment and comparison students from the same schools, which was entirely Black (100%), all within one grade (sixth), from School 1, and had direct certification (80.56%). Chosen variables were based also on available data provided by the school district. These decisions follow established guidance from education and medical research (Brookhart et al., 2006; Harris & Horst, 2016; Steiner et al., 2010, Stuart, 2010).

Table 2.

Category		Overall	Control	Treatment	p-value
Number of Students	-	36	18	18	-
Sex (%)	М	21 (58.3%)	10 (55.6%)	11 (61.1%)	1.00
	F	15 (41.67%)	8 (44.4%)	7 (38.9%)	1.00
Age (mean (SD))		12.81 (0.62)	12.78 (0.65)	12.83 (0.62)	0.79

Baseline Equivalency of Analytic Sample Following Propensity Score Matching

Category	Overall	Control Treatment		p-value
Poverty Indicator % (mean (SD))	80.56% (0.40)	89% (0.32)	72% (0.46)	0.22
IEP Status (mean(SD))	13.89% (0.35)	22% (0.43)	6% (0.24)	0.16
Fall 2021 i-Ready Score (mean(SD))	483.56 (38.64)	489.83 (49.93)	477.28 (22.28)	0.34
Black (mean (SD))	100% (0.00)	100% (0.00)	100% (0.00)	1.00

The calculation of propensity scores and matching was done using the MatchIt R package (Ho et al., 2011). Once propensity scores had been calculated for each student using the logit model, a new data frame of 44 sixth grade students was created, split evenly between treatment and comparison students. In this way, the sample was restricted to pairs of observations with very similar propensity scores, but differ only in their treatment status. As can be seen in Table 2, which describes the baseline equivalency of the treatment and control groups, were statistically similar in all available criteria used for matching. There were, however, still substantial differences between the two groups at pretest.

A power analysis was conducted to estimate the minimum detectable effect size for this study. Based on these analyses, the minimum detectable effect size for the study is 0.31.

Data Analysis

Research question 1: Reading achievement compared to Business as Usual. To assess the impact of ThemeReads tutoring on students' achievement in reading, several analyses were used. First, an impact analysis was conducted to estimate the effect size of the treatment on student growth.

Next, student-level linear modeling was used. This analysis follows an intent-to-treat (ITT) approach, so that students are analyzed in accordance with the group to which they are

originally assigned (McCoy, 2017). This allows for the treatment-control difference in spring achievement for students in treatment and control schools after one semester of implementation in treatment schools to be calculated. The analysis controls for students' baseline achievement as indicated by the pretest measure, sex, IEP status, age, and poverty (indicated by direct certification). As there was no variation in race, EL status, or grade, these variables were not included as covariates. This step employs the following regression model:

Reading Achievement

 $= \beta_0 + \beta_1 Treatment + \beta_2 Baseline Reading Performance + \beta_3 Sex$ $+ \beta_4 IEP Status + \beta_5 Age + \beta_6 Poverty Indicator + e$

In this model, participation in ThemeReads predicted endline reading performance levels, holding all else equal. A dummy-coded treatment indicator (Treatment, where 1 = ThemeReads participation and 0 = not a part of ThemeReads tutoring) was used to make this prediction. In addition, the model included dummy variables used to adjust for variables identifying where values have been imputed. Effect sizes were calculated to estimate the overall impact of participation in the ThemeReads program.

Research question 2: Reading achievement difference by covariates. To assess the differential effects of ThemeReads tutoring participation for students based on demographic characteristics and prior achievement, interaction terms between a treatment indicator and student-level covariates of interest were added to the analysis. This provided an opportunity to determine whether students with specific characteristics receiving ThemeReads services performed better than similar comparison group students. This step employed the following regression model:

 $= \beta_{0} + \beta_{1}Treatment + \beta_{2}Baseline Reading Performance + \beta_{3}Sex$ $+ \beta_{4}IEP Status + \beta_{5}Age + \beta_{6}Poverty Indicator$ $+ \beta_{7}(Treatment * Baseline Reading Performance)$ $+ \beta_{8}(Treatment * Sex) + \beta_{9}(Treatment * IEP Status) + \beta_{10}(Treatment * Age) + \beta_{11}(Treatment * Poverty Indicator) + e$

The analysis for this research question used the initial equation as a base, with the addition of interaction variables. In this model, participation in ThemeReads once more predicted the endline reading performance levels, but the inclusion of interaction terms allowed conclusions to be drawn regarding the differential effects participation in the program had for certain subgroups.

Research question 3: Reading achievement differences related to dosage and pace of progress

To assess the relation between student performance and their participation and progress through the ThemeReads program, a correlational regression approach was used.

In the first model, the dichotomous treatment indicator was replaced by a continuous variable, attendance. This variable describes the attendance rate of each treatment student.

Reading Achievement

 $= \beta_0 + \beta_1 Attendace + \beta_2 Baseline Reading Performance + \beta_3 Sex$ $+ \beta_4 IEP Status + \beta_5 Age + \beta_6 Poverty Indicator + e$

In this model, the level of participation (dosage) in ThemeReads predicted the endline reading performance levels, allowing conclusions to be drawn regarding the association between increased participation in the tutoring program and student reading skills, holding all else equal. Once more, dummy variables indicating imputation of values have also been included, but are not reported here.

To examine the association between the rate or pace of learning progress on student gains, the following model was used:

Reading Achievement

 $= \beta_0 + \beta_1 Pace + \beta_2 Baseline Reading Performance + \beta_3 Sex$ $+ \beta_4 IEP Status + \beta_5 Age + \beta_6 Poverty Indicator + e$

In this model, the pace of progress through ThemeReads (measured through number of grade levels completed) is predicting the endline reading performance levels, allowing conclusions to be drawn regarding the association between faster rates of progress through the tutoring program curriculum and student reading skills, holding all else equal. As in other models in this analysis, dummy variables indicating imputation of values have also been included, but are not reported here.

Results

Research Question 1: Impact of ThemeReads on reading achievement

To examine the effect of the ThemeReads program on students' reading achievement, linear regression analysis was conducted, using spring reading achievement as the dependent variable and receipt of treatment as the independent variable, with student demographic characteristics as covariates and controlling for pre-test reading achievement.

The mean pre-test from fall 2021 and the adjusted post-test outcomes from spring 2022 are summarized in Table 3. In this table, the primary outcome indicator used is the effect size (Hedge's g), describing the difference between treatment and control groups of students. The unit of measure for the effect size is standard deviations. On the i-Ready outcome, students in the

treatment group performed higher than comparison group students, indicating a positive impact of ThemeReads at the end of the semester, with an effect size of +0.17. However, this impact was not statistically significant (p = 0.40).

Table 3.

Impacts	on Achievem	ent for Sixth	Grade Students

Outcome	n	Pretest Fall 2021 (SD)	Adjusted Post Test Spring 2022 (SD)	Impact SE	Effect Size	p- Value
Treatment	18	477.28 (22.28)	519.78 (35.24)	6.63	0.17	0.40
Control	18	489.83 (49.93)	511.60 (56.11)	6.33	0.17	0.40

The full results of the regression analysis are described in Table 4, providing coefficients and significance for all included covariates.

Table 4.

Impact of Treatment on Spring 2022 i-Ready Reading Score

Category	Estimate	SE	t-value	p-value
Intercept	511.60	6.69	76.51	<0.001***
Treatment	8.18	9.59	0.85	0.40
Fall i-Ready Achievement	0.72	0.16	4.39	<0.001***
Sex	4.83	9.96	0.49	0.63
Age	-34.23	12.75	-2.68	0.01*
Poverty Indicator	5.92	7.89	0.75	0.46
IEP Status	10.45	13.79	0.76	0.45

Note. **p* < .05. ***p* < .01. ****p* < .001

Based on the results of this analysis, it is impossible to reject the null hypothesis of no change in spring reading achievement due to receipt of treatment. Reasons for this will be discussed below. However, the results do suggest a significant positive impact of prior reading scores on later reading achievement. This is in line with common trends seen in reading research. The results also suggest that age was a significant negative predictor of reading performance, suggesting that older students performed worse than younger students. As the analysis was limited to students in sixth grade, students varied in age from 12 to 14 years of age and the average student across groups was 12.81 years old. While the result was statistically significant, given the small sample size and range, it is probably likely that this was not a meaningful difference.

Research Question 2: Differential impacts on reading achievement

Previous research studies have identified certain covariates as likely to have a particular influence on student performance. This analysis included the interaction covariates student sex, baseline reading achievement, age, and IEP status. The results are described in Table 5.

Table 5.

Category	Estimate	SE	t-value	p-value
Intercept	519.81	6.60	78.81	<0.001***
Treatment	-1.12	9.30	-0.12	0.90
Fall i-Ready Achievement	0.60	0.20	3.04	0.01*
Sex	34.47	13.71	2.51	0.02*
IEP Status	-59.21	24.92	-2.38	0.03*
Age	-11.33	10.82	-1.05	0.31
Poverty Indicator	-34.87	24.95	-1.40	0.18
Treatment*Sex	-47.34	19.94	-2.37	0.03*
Treatment*Fall i-Ready	-0.18	0.38	-0.46	0.65
Treatment*Age	27.65	18.45	1.50	0.15
Treatment*IEP Status	-5.06	31.77	-0.16	0.87
Treatment*Poverty Indicator	50.37	30.17	1.67	0.11

Differential Regression Results Based on Student Characteristics

Note. p < .05. p < .01. p < .001

In this analysis, the interaction variable between treatment and sex was significant (β = -47.34, p = 0.03). This suggests that boys in the treatment group benefited more from the treatment than girls on the spring i-Ready assessment.

Research Question 3: Reading achievement differences related to dosage and pace of progress

As part of an exploratory research question and in the pursuit of greater understanding of the impact of the program on student reading skills, the impact of student attendance in ThemeReads sessions (dosage) and the pace of their progress through the program reading levels (growth) on student post-test reading achievement were examined. To accomplish these analyses, the binary treatment variable was replaced in the linear regression model by the dosage and growth variables, respectively. In Table 6, the impact of dosage on spring reading achievement is considered.

Table 6.

Category	Estimate	SE	t-value	p-value
Intercept	533.72	42.81	1247	<0.001***
Attendance	-32.26	93.32	-0.35	0.74
Fall i-Ready Achievement	0.47	0.57	0.83	0.43
Sex	-24.21	23.61	-1.03	0.33
Age	12.12	20.00	0.61	0.56
Poverty Indicator	14.42	24.47	0.59	0.57
IEP Status	-64.14	45.34	-1.42	0.19

Impact of Dosage on Spring 2022 i-Ready Reading Achievement

Note. **p* < .05. ***p* < .01. ****p* < .001

In this analysis, we are again unable to reject the null hypothesis, and cannot determine whether attendance rate impacted student reading achievement. To account for any deficiencies in the analysis due to low power, the analysis was run again using attendance rate converted to a categorical variable. However, no significant differences in the results were found.

Finally, in Table 7, the effect of student pace of progress through the ThemeReads program reading levels on spring reading achievement is examined.

Table 7.

Impact of Pace of Progress in ThemeReads on Spring 2022 i-Ready Reading Achievement

Category	Estimate	SE	t-value	p-value
Intercept	537.03	15.15	35.44	<0.001***
Pace of Progress	-20.35	14.67	-1.39	0.20
Fall i-Ready Achievement	-0.06	0.55	-0.10	0.92
Sex	-11.51	17.28	-0.67	0.52
Age	18.09	17.46	1.04	0.32
Poverty Indicator	14.92	19.42	0.77	0.46
IEP Status	-99.35	34.69	-2.86	0.02*

Note. **p* < .05. ***p* < .01. ****p* < .001

Once more, we are unable to reject the null hypothesis, that there is no effect of the covariates and that each covariate is equal to zero. We cannot rule out the possibility that the predictor variables had no relationship with spring reading achievement. In addition, in this analysis, students in special education or with individual education plans (IEP) performed significantly lower on the spring i-Ready reading assessment than other students.

Discussion

This study aimed to contribute to the existing literature on effective tutoring, providing Tier II evidence concerning the Tutoring with ThemeReads secondary school reading tutoring program, based on matched samples. ThemeReads was designed to support the reading development of students still not reading at grade level by the time they reach the middle school grades through engaged and individualized tutor support, quality materials aimed at the reading levels students at which students perform at assessment, rewarding videos and games upon completion of levels, recognition of student progress, and additional time to learn to read.

These students and their literacy learning needs have often been overlooked in both research and practice, with greater attention paid to elementary students first learning to read. Instead, ThemeReads recognizes that students still reading below grade level in middle school have been treated as struggling for years and will benefit from additional effective support. The results from this pre-pilot study provide an opportunity to gauge the success of the program for a small sample of sixth graders in one school in Baltimore City Public Schools, as well as point towards areas for further development of the program to improve learning gains.

While the effect of participating in the tutoring program was not statistically significant, the effect size (+0.17) is comparable to trends seen in effective educational interventions for secondary students. Effect sizes of educational interventions are typically smaller than in other fields, such as medicine, with reading interventions averaging +0.09 SDs and tutoring averaging +0.36 SDs (Dietrichson et al., 2017). One-on-one tutoring interventions specifically for secondary students have had an average effect of +0.28 SDs while small group tutoring had an average impact of +0.14 SDs (Baye et al., 2019). In contrast, effective whole school and cooperative learning interventions had effects lower than +0.10 (Baye et al., 2019). These results highlight the strong potential benefits of tutoring interventions, such as the ThemeReads program, on reading of students in the secondary level.

Effects of educational interventions for older students are typically smaller than those for elementary school students. A study of elementary school reading interventions (Neitzel et al., 2021) found one-on-one tutoring had an average effect of +0.41 SD (compared to +0.28 reported above), for instance. Lipsey and colleagues estimated that a gain of 0.20 to 0.40 SDs was

representative of just 13-26% of the average yearly gains for K-1 students, but 83-167% of the gains typically seen for students in Grades 8-9 (Dietrichson et al., 2019). Should the +0.17 effect seen in this study of ThemeReads prove to hold up in future research, the program targeting secondary school students has the potential to have a meaningful impact on learning for striving readers. Given this context, the positive effect of ThemeReads on student reading is therefore promising and suggests the benefits of future research to explore these effects in more detail.

The achievement gap between high and low SES students has been estimated as being as high as 0.74 SD for students at Grade 4 and 0.66 SD by Grade 8 (Lipsey et al., 2012), while the gap between white and minority students has been estimated at 0.25 SD (Slavin et al., 2008). None of these interventions have been able to close the gap entirely, but have indicated that it is possible to make that gap smaller and improve outcomes for low SES and minority students. This is particularly true for secondary school aged students.

Tutoring programs, particularly small group tutoring interventions like ThemeReads, with one tutor supporting multiple students in each session, are noteworthy not just for their potential positive effect on reading skills, but also for their potential for scale up both within schools and at the city or district level. ThemeReads relies on trained paraprofessional staff to serve as tutors, which has been shown to be nearly as effective in improving learning as teacher tutors (Slavin et al., 2011), and is more cost effective due to the lower salaries required for paraprofessionals versus certified teachers. This supports scale up by opening the possibility of hiring a greater number of tutors using paraprofessionals than teachers, and reaching a larger number of students through small groups rather than one-on-one tutoring sessions.

In contrast, more complicated interventions, such as whole school interventions and multi-tiered systems of support (MTSS), may be more difficult for scale up due to higher

operational expense, complicated intervention activities, and need for cooperation with multiple stakeholders. While no real world interventions are truly simple to implement, impacted as they are by different stakeholders' needs and engagement, school scheduling disruptions, and logistical challenges, tutoring programs have the benefit of being fairly straightforward in both conception and implementation, easy to comprehend and earn support, and following a regular schedule.

Recommendations for Future Research

There are several directions that future research and program evaluations may consider when examining the effect of high-dosage tutoring programs in general and the Tutoring with ThemeReads program in particular. School districts would do well to consider the results of such research in their policy decisions, as the ThemeReads program is built on strong theoretical framework and designed to be adaptable and reasonably cost-effective, through the use of adaptive computer learning systems and para-professional tutors. Tutoring programs that have been proven effective based on strong research, have been shown repeatedly to improve student learning and help struggling students make meaningful progress (Baye et al., 2019; Fryer & Howard-Noveck, 2020; Neitzel et al., 2021; Nickow et al., 2020; Pellegrini et al., 2021). In order to further the specific effectiveness of the ThemeReads program, additional research seems warranted given the promise shown in the current study.

The impact of the current study may have been weakened by both the short period of implementation and a small sample size. A longer intervention, lasting at least a whole school year, may be advisable given the potential for students to gain more familiarity with tutoring procedures and gain competencies. While some tutoring programs have seen effects after just one semester (Dietrichson et al., 2017), a year in length is a common approach for tutoring

interventions. A longer duration intervention is also more likely to be able to show an impact on standardized assessments such as the i-Ready reading assessment. While ThemeReads students showed positive growth in programmatic measures, sometimes raising several reading levels, it may take more time for students who have been labeled as striving readers to gain enough confidence and persistence as readers to demonstrate that improvement consistently on longer assessments.

In addition, future research studies should include recruitment of a larger sample of participating schools and students than were possible during this pre-pilot. In addition to providing a larger sample size, allowing for enhanced statistical power, this would also enable researchers to utilize between school matching instead of within school matching. A randomized trial comparing students in schools with tutoring to those in schools without the tutoring program would be preferable from a research perspective. To address school district objections to students missing out on a potential benefit, researchers could randomly assign schools to cohorts, allowing all students to receive the tutoring intervention and learning benefits over time, but also enabling researchers to have a valid counterfactual. Should that be non-permissible, propensity score matching between schools electing to implement the tutoring program and other similar schools that did not opt into the program would also be a beneficial way to create a stronger matched comparison group.

Limitations

This research is drawn from a pre-pilot study, with a limited sample of treatment students matched with comparable students from the same schools. As a result, the generalizability of this study is limited. Because the pre-pilot was conducted over for the course of a single semester, and reliant on a small sample of treatment students predominantly from just one school, matched

to other similar students within the same schools, the results from this study should be considered as applying specifically to this context of students and intended as an indicator of potential for future research to examine the impact of the program in more depth. The homogeneity of the sample also limited the variables that could or should have been used in the propensity score estimation and matching process, as well as in the data analysis. Drawing from a larger sample over a wider variety of schools would allow for matching across a longer list of variables and individuals.

Achieving balance between the treatment and comparison groups proved challenging, due to variance in student consent form return rates and inherent differences between students identified by their schools to participate in the program and those deemed to be strong enough readers to not need tutoring. These reductions in the total sample prior to matching impacted the possible matches available and the equivalency of the two groups, even when matching with replacement.

As a real world implementation, this intervention faced a number of issues common to programs taking place outside of a laboratory or controlled setting. While schools had reopened to in-person education during the 2021-2022 school year, policies were still in place related to COVID-19 outbreaks, and as such, there were several disruptions to tutoring due to school closures during the course of the semester. In addition, tutoring sessions were often interrupted or superseded by other events, including class presentations and activities, field trips, district or state testing, and snow days. While these disruptions were largely out of the tutors' and researchers' control, this may have limited the potential total impact of the tutoring program. Future studies should consider procedures to limit disruptions to tutoring sessions to allow for the maximum potential effect of the intervention.

Chapter 4: Student Reading Self-Efficacy Development through the Tutoring with ThemeReads Program

Introduction and Literature Review

The increased attention on student learning and literacy has corresponded with greater interest in understanding and supporting students' "non-cognitive" skills and factors. This construct is useful in categorizing the "behaviors, skills, attitudes, and strategies" vital to academic success but not measured directly through cognitive academic assessments (Farrington et al., 2012, p. 2), including motivations, persistence, self-control, organization, and self-efficacy (Aro et al., 2018; Lazowski & Hulleman, 2016). Self-efficacy is an important construct associated with outcomes in a variety of fields, including academics, career choices (Lent, Brown & Larkin 1986), and athletic performance (Bandura, 1977). In academic contexts, selfefficacy has been connected most often to achievement (Bandura, 1986; Chapman & Tunmer, 1997; Melnick et al., 2009; Pajares, 2005; Tobing, 2013) and course selection (Durik et al., 2006). These perceptions inform how students respond to academic tasks and situations and student perceptions of academic task difficulty or ease (Melnick et al., 2009; Pajares, 2005). This in turn influences attitudes and motivation towards school and learning, for good or ill.

Developing positive self-efficacy perceptions in the academic sphere is important from an early stage, as student self-perceptions can play a foundational role in guiding student academic engagement and success throughout their lives, as well as contributing to their overall mental health. Students with lower self-efficacy have repeatedly demonstrated lower levels of achievement (Alvermann, 2002; Chapman et al., 2018; Conway, 2017; Lent, Brown & Larkin, 1984; 1986; Strahan, 2008) and reduced persistence with difficult subjects or tasks (Schunk, 1989; Zimmerman, 2000). Those entering middle school after years of struggling in school have

learned through experience that they lack the skills necessary to read or comprehend the meaning of a text, leading to weak self-efficacy perceptions (Margolis, 2005). As a result, those with low self-efficacy or motivation are more likely to fall further behind due to reduced effort (Spear-Swerling & Stemberg, 1994) as they grow older and enter secondary school, where they will encounter more complicated and challenging materials and academic tasks. These perceptions are informed by teacher behaviors, such as regular encouragement inspiring positive self-efficacy amongst students (Schöber et al., 2018). Addressing student self-efficacy and encouraging students to have positive perceptions of learning and themselves as learners is therefore important both from an early age and throughout students' academic careers. Ensuring student positive self-efficacy is all the more important because of the long time period, during school closures related to COVID-19, in which students went without regular substantive contact with teachers and peers (Dorn et al., 2021), preventing them from experiencing teacher support for self-efficacy that students benefit from to build strong and positive self-efficacy perceptions. Given the importance of self-efficacy perceptions in academics, this study will examine the connection between self-efficacy and student learning in the domain of literacy.

Self-Efficacy Theory

The concept of self-efficacy is rooted in Bandura's (1977) work in social cognitive theory, which argued that human psychological functioning is informed by a combination of internal and external forces, both personal and vicarious. While earlier constructs, such as "selfconcept" or "locus of control," focused on general or global perceptions of the self, self-efficacy refers to the judgments an individual makes about their ability to perform a particular task or goal (Bandura, 1986; Schunk, 1991). Since Bandura's seminal works on the topic, others have expanded and clarified components of the construct. Tobing (2013), for instance, noted that self-
efficacy beliefs may not reflect a person's actual abilities, merely their perceptions of what they are capable of accomplishing. Bandura (as cited in Pajares, 2005) seemingly foreshadowed this, writing:

There are two kinds of self-confidence, one a trait of personality and another that comes from knowledge of a subject. It is no particular credit to the educator to help build the first without building the second. The objective of education is not the production of selfconfident fools. (p. 344).

Supporting this point, a study of sixth graders identified as striving readers noted that at baseline, despite all demonstrating relatively homogenous reading abilities, members of the study displayed a wide variety of self-efficacy perceptions (Chapman et al., 2018). While students may not necessarily have an accurate view of their own capabilities, improving student self-efficacy perceptions may have an impact on their academic performance or level of effort or engagement with academics. The inverse may be true as well, as increased academic performance should lead to more positive self-efficacy perceptions. This suggests that it may be beneficial to incorporate efforts to address both student academic knowledge and skills, as well as self-efficacy perceptions, into academic interventions and pedagogy.

This dual focus on both academic skill and self-efficacy growth stems from the reciprocal nature of the relationship between self-efficacy and achievement. This reciprocity has been described by a number of self-efficacy and education researchers (Kurtz-Costes & Schneider, 1994; Pajares, 2005; Shell et al., 1995). Those who perform well in school are more likely to have developed positive self-efficacy beliefs (Melnick et al., 2009). In addition, positive self-efficacy beliefs are an important contributor to adolescents becoming stronger readers (Alvermann, 2002; Schöber et al., 2018; Strahan, 2008). Achievement and early reading

performances have been found to predict later self-efficacy perceptions (Guthrie et al., 2013), and students with higher self-efficacy perceptions were found to persist longer and reach higher academic achievement levels in technical or science fields (Lent, Brown & Larkin 1984). This close and reciprocal relationship further cements the hypothesis that interventions that engage in practices addressing the sources of self-efficacy are likely to result in improved learning outcomes.

Sources of Self-Efficacy

Bandura and colleagues theorized that an individual's sense of self-efficacy stems from four key pillars: mastery experience, vicarious experience, social persuasion, and emotional or physiological arousal (Usher & Pajares, 2006). Each of these sources contributes to feelings of self-efficacy, but it is likely that individual students, either consciously or unconsciously, may place more importance on one source over the others (Henk & Melnick 1995), such as the inputs and responses they receive from peers in relation to their reading. The ThemeReads tutoring approach and structures, as described in Chapter 2, address each of these pillars suggesting that ThemeReads may improve student self-efficacy perceptions.

Mastery experiences are often considered the most impactful source of self-efficacy (Bandura, 1995; Pajares, 2005), encompassing the hands on, practical experiences that individuals go through where they learn a skill and overcome a challenge directly, learning they are capable of mastering difficult tasks or skills. In the ThemeReads program, students work in pairs to read increasingly complex passages on a variety of important topics and fields. Successfully reading a passage or set of passages and progressing to the next reading level are tangible experiences students accomplish through the course of the program, with weekly

progress check-ins with tutors and goal setting meetings with their partners serving to help students realize when they have achieved mastery over certain skills.

The term "vicarious experiences" refers to the process of observing other people, such as teachers, peers, or similar individuals successfully completing an objective (Bandura, 1977; 1995). Given the highly social nature of youth at this age and the importance of relationships with peers and non-caregiver adults (Munsch & Blyth, 1993), this component may be of even more importance for adolescents. Seeing someone similar to them succeed can improve a student's confidence and feel that they too are capable of completing the task (Schunk, 1989). The ThemeReads cooperative learning structure serves as the central feature of student peer interactions, with students working in pairs, alternating roles as coach and reader, while tutors oversee progress and provide feedback. This gives students the opportunity to observe a peer with similar traits to them performing and receiving feedback from the tutor. This vicarious learning experience, coupled with direct instruction, provides a useful model for students to learn form and encourages students to see themselves as capable of learning and mastering the same skills.

Social persuasion describes the influence of verbal or written feedback a student receives in the classroom, typically from a teacher (Bandura, 1977; Schunk, 1989). Encouragement from a respected teacher or peer can help students realize they are making progress and, as a result, can increase their feeling of self-efficacy, while discouragement can cause feelings of low selfefficacy to drop further. Social persuasion is utilized in ThemeReads to improve student incentive to learn. Tutors circulate throughout each tutoring session, providing ongoing feedback and recognizing student progress. This fosters positive self-efficacy perceptions for students who may not have received much positive recognition from teachers previously, as they begin to

recognize that they are making progress and improving in their reading skills. Students in the ThemeReads program also receive positive encouragement from peers in the program when engaging in cooperative learning as they take turns as reader or coach and when achieving goals with their partners by improving certain skills or completing passages.

Finally, emotional and physiological arousal refers to the well-being or stress one feels when taking part in a task. This is not just the physical reaction or emotional response one has to a task (feeling stressed that you are taking a test), but also how one reacts to that response (Bandura, 1977). For instance, feelings of stress when presented with an academic task, such as being asked to read aloud in class, constitutes negative arousal. This stress reaction sticks with youth, who remember how bad they felt while performing the stressful task. This may inhibit development of feelings of positive self-efficacy and lead to attempts to avoid the stressful situation in the future. Academic tasks are of course intended to improve student learning, so avoiding these tasks inhibits that very purpose. In contrast, students with higher or more positive self-efficacy feelings may approach the same situation with a feeling of excitement to overcome a challenge, which is likely to reinforce their positive self-efficacy (Pajares, 2005).

The ThemeReads program is structured in such a way that stressful arousal is reduced. Repeated opportunities to practice reading in a comfortable setting and the use of reading materials selected by tutors to be at the appropriate reading level to support learning, are intended to minimize stressful feelings. The partnerships students form are designed to be mutually supportive and encouraging, and reading materials are selected to scaffold reading skills instead of forcing students to read material they struggle with in a setting they associate with failure. In this way, ThemeReads students' initial stressful reaction to having to read may grow smaller with time, and students may eventually begin to have positive reactions to reading

opportunities, and more positive feelings of self-efficacy. The practices and structures at the core of the ThemeReads model (described in Chapter 2) support the hypothesis that the program will encourage participating students to improve not just their literacy skills, but also their selfefficacy perceptions of themselves as readers. While this impact may not be easily measured, this improvement may result in long-term increases in student mental health and stability.

Need for Specific Measures and Interventions: Academic and Reading Self-Efficacy

Because self-concept is generally seen as a global construct, assessments of student selfconcept typically follow the same framework. The opposite is true in the case of measures of self-efficacy. Bandura was critical of these global measures due to their inability to accurately measure and predict particular behaviors and outcomes (Bandura, 2006; Marsh et al., 1991). Indeed, studies that have relied on global self-concept or self-evaluations to predict or measure the impact on specific academic outcomes have often failed to find much evidence (Marsh & Craven, 2006; Valentine & DuBois, 2005). Instead, Bandura and others have argued in favor of domain-specific measures of self-efficacy being developed and implemented in settings directly related to the domain being assessed (Bandura, 2006; Klassen, 2007; Marsh et al., 1991). One such domain-specific adaptation of self-efficacy theory has been "academic self-efficacy" (ASE). ASE refers to the self-efficacy beliefs that one holds about their own academic capabilities in academic contexts or at a given level of performance (Bong & Skaalvik, 2002; Schunk, 1991), as opposed to self-efficacy related to social, emotional, or athletic domains, for instance. Analyses related to ASE have shown to be more capable of predicting academic outcomes, including for longer-term effects in higher education, than global self-efficacy or selfconcept measures (Gore, 2006; Mercer et al., 2011; Zajacova et al., 2005). Understanding these

long-term relationships is important in supporting the learning needs for middle school grade and secondary students.

At the even more domain-specific level, reading self-efficacy (RSE) describes the beliefs individuals hold about their reading ability, in general and on specific reading tasks, as well as their ability to learn to read (Chapman & Tunmer, 1997; Guthrie et al., 2009; Henk & Melnick, 1995). As with general self-efficacy, RSE has been considered a component of reading motivation (Carrol & Fox, 2017), requiring measures and interventions that take the reciprocal relationships between RSE and reading achievement into account. Students' conceptions of themselves as readers begin to develop from an early age, with reading experiences in the first years of schooling shown to be associated with RSE in later grades (Chapman & Tunmer, 1997). Unlike more general constructs such as self-concept, RSE has been found to vary based on a given task, such as in word recognition exercises as opposed to longer passages reading tasks with comprehension questions (Piercey, 2013). This sensitivity suggests that reading interventions incorporating activities or practices thought to improve student RSE, such as providing feedback or encouragement to students, may be able to move the needle and support increased positive feelings of reading self-efficacy for students.

Reading self-efficacy perceptions, both positive and negative, can have a formative and long-lasting effect, but also sensitive enough to change based on new experiences and information inputs for students, as Bandura theorized. RSE level in fourth grade predicted course selection in Grade 10 (Guthrie et al., 2013). RSE has also been associated with later use of self-regulated learning strategies (Hong & Park, 2012) and ESL proficiency (Templin, 2011), and has been found to be positively correlated with reading achievement and specific reading skills, including grade-level reading (Waleff, 2010), word reading (Carrol & Fox, 2017), reading

comprehension (Barkley, 2005; Burrows, 2012; Tobing, 2013). Reading comprehension interventions, particularly those that target sources of self-efficacy (Anderson, 2016; Aro et al., 2018; Bailey, 2009; Wilfong, 2008) and reading strategies (Burrows, 2012; Nelson & Manset-Williamson, 2006; Schunk & Rice, 1992) have led to improved reading self-efficacy for students, sometimes in as little as 12 weeks (Aro et al., 2018). As with self-efficacy as an overall concept, RSE has also demonstrated the expected reciprocal relationship with reading comprehension and performance (Kurtz-Costes & Schneider, 1994; Shell et al., 1995), contributing to construct validity of the RSE construct. The long-term potential impact of higher positive self-efficacy, paired with the sensitivity to intervention, points again to the importance of addressing RSE through the practices and structures of reading interventions. Following a precise and context-specific understanding of reading self-efficacy also requires a contextspecific measure of self-efficacy.

Though Bandura (2006) and others called for the use of domain-specific measures to examine self-efficacy perceptions of students, it was not until recently that some valid and reliable measures were developed and disseminated (Henk & Melnick, 1995; Melnick et al., 2009). The Reader Self-Perception Scale (RSPS; 1992), developed by Henk & Melnick, follows the Elementary Reading Attitude Survey (ERAS) in focusing on elementary students' attitudes and beliefs about reading and their skills (Melnick et al., 2009). Henk, Melnick, and others later built on their successful RSPS with the RSPS-2, targeting students in grades 7-10. These measures have the benefit of following Bandura's social cognitive theory and his recommendations for measuring self-efficacy. Measures of self-efficacy are beneficial as they are sensitive to small or nuanced changes to students' contexts (Zimmerman, 2000). In this light,

we find that the more context-specific an intervention or desired outcomes are, the more contextspecific the measure should be to ensure researchers are able to observe an effect.

Summary

As described in the logic model in Chapter 2, ThemeReads was designed to improve student reading through effective adaptable elements, which have much in common with a number of practices and inputs that address the sources of self-efficacy, resulting in improved student reading achievement as well as reading self-efficacy perceptions simultaneously. ThemeReads includes activities and practices identified as effective in addressing each of the pillars of self-efficacy, described by Usher & Pajares (2006). Working in pairs while progressing through distinct reading units of increasingly complex reading passages on a variety of engaging topics, coupled with weekly progress check-in meetings with their tutors create observable tangible mastery experiences. ThemeReads provides students with positive vicarious experiences through cooperative learning interactions, in which students alternate acting as reader and coach, providing each other with models for successful reading and receipt of feedback. Social persuasion is supported through the ongoing feedback and recognition of progress tutors provide, as well as the peer encouragement students receive from their reading partner as they move through the ThemeReads reading levels together and act as reader and coach. Finally, ThemeReads minimizes stressful emotional and physiological arousal while supporting positive feelings through providing a regular opportunity to practice reading in a comfortable setting and through engaging reading materials on various topics of interest and relevance to students, which are targeted to students actual reading level. The program's use of vicarious experiences and peer modeling activities are in particular considered to be important sources of self-efficacy (Bandura, 1997; Pajares, 2005; Usher & Pajares, 2006), indicated in several studies using the RSPS and

RSPS-2 to be among the most influential factors in contributing to student RSE and predicting reading achievement (Hedges & Gable, 2016). Through the program, as students experience academic gains, it is expected they may also develop stronger perceptions of their own reading self-efficacy, leading to increased engagement, which may lead to further growth. ThemeReads also required tutors to check in regularly with students on their progress (as described in Chapter 2), using electronic progress measures to provide feedback and guidance on student reading. Frequent feedback, encouragement, and progress sharing supports students to recognize their learning progress (Aro et al., 2018) and assists students in understanding that their efforts and hard work contribute to their progress. This forms the basis for the following study and research questions.

Methods

Purpose Statement

The purpose of this non-causal correlational study is to examine the reading self-efficacy perceptions of sixth grade students after participating in the ThemeReads tutoring program. This purpose led to the following research questions.

Research Questions

Research Question 1: What are struggling students' perceptions of their reading self-efficacy following participation in the ThemeReads tutoring program?

ThemeReads was designed and implemented with practices and structures including cooperative learning and vicarious experiences that are known to contribute to student reading self-efficacy. Students participating in the tutoring program were thought to develop positive reading self-efficacy through their time in the program. **Research Question 2:** Is there a significant positive correlation between struggling students' RSE and their reading progress or participation in the ThemeReads program?

It is expected that there may be variation in the degree of participation in the program and the rate at which different students progress through the different reading levels. It is hypothesized that greater reading self-efficacy will be associated with greater attendance in the program, reading progress, and greater reading achievement. While some research has pointed to differential gains in learning based on student background and socioeconomic characteristics (Guthrie et al., 2009), the population of this sample was deemed too limited in size and homogeneity (see Table 1 for demographic data) for correlation analysis to reveal any useful findings in this regard.

Research Design

Since randomization was not possible, this study followed a descriptive and correlational research design. Data were collected from a sample of 27 students participating in the tutoring program in May 2022, though results from two students were excluded from the analytic sample as will be described below. The tutoring group received 21 weeks of reading tutoring intervention.

Sample

Participants in the study were drawn from two public middle schools participating in a tutoring program in Baltimore city (ThemeReads, described in Chapter 2). Participating schools were recruited with support from Baltimore City Public Schools, based on interest in participation in the program. Each school was responsible for identifying between 24-36 students for participation in the tutoring program based on student and class characteristics that were available to them, including prior academic achievement.

Table 8.

	Sex		Sex Grade Race					į-					
	М	F	6	7	В	W	Direct Certification	EL	SWD	Ready Fall Score	Fall GLE	Attendance Rate	Total Sessions
School 1	62.5%	37.5%	100%		100%		100%	0%	8.3%	469.83	3.25	46.95%	46.33
School 2	33.3%	66.67%	33.33%	66.67%	66.67%	33.33%	100%	0%	0%	569.67	2.53	40.63%	42.67
Overall	62.96%	37.03%	92.59%	7.41%	96.3%	3.70%	100%	0%	7.41%	481.35	3.19	46.12%	44.04

Tutoring with ThemeReads Student Demographic Data

Note. Overall average was calculated with weighted means.

After tutoring program rosters were set by each school, active consent was sought from the parents or caregivers of all students identified and participating in ThemeReads tutoring. An incentive was provided for students to return the form (regardless of decision), consisting of an item such as a toy or snack costing \$3 or less. Students were more positively responsive in returning consent forms when offered spicy chips or snacks as a prize, regardless of whether consent was given or not.

Of the 42 students at School 1 and 18 students in School 2 tutoring cohorts in January 2022, 27 positive consent forms were received, resulting in a maximum sample of 27 students, an overall response rate of 45%. Demographic data for the 27 participating students is presented in Table 8. The majority of students in both participating schools was Black or African-American, in sixth grade, and male. No participants were English Learners (EL students were not selected for the tutoring program as they received separate interventional support), and only two students were categorized as having disabilities. Students scored an average i-Ready scale score of 481.35 in the fall and read at the equivalent of grade 3.19 prior to intervention.

Consent form response patterns are presented in Table 9.

Table 9.

	Consent Forms Sent	Consent Forms Received	Consent Given	Consent Refused	Survey Completed
School 2	18	3	3	0	3
School 1	42	24	24	0	22
Total	60	27	27	0	25

Patterns of Consent Form Return and Response

Consent forms were initially sent home with students by their tutors, who subsequently followed up with students. Parents were also contacted directly by phone and email to encourage signing and returning of consent forms. While the direct causes for the differences in response rate between schools, some reasons for the poor return rate at Vanguard may include disruptions to school scheduling due to COVID-19 or other non-tutoring school activities. In addition, students were responsible for carrying consent forms home to have their parents sign them, and then return the forms to school and remember to hand them over to their tutor. This places a great deal of responsibility on students, and requires considerable follow-up on tutors to remind students of the need to return forms. Finally, the initial incentives offered may not have been sufficient to elicit students to complete the consent form return process.

Measures

Reader self-efficacy measure: Reader self-efficacy were assessed using the Reader Self-Perception Scale 2 (RSPS-2) (Henk et al., 2012) (included as an appendix), created specifically to assess adolescents' (Grades 7-10) reading self-efficacy perceptions. Designed following Bandura's theory of self-efficacy (Bandura, 1977) and his guidelines about assessing selfefficacy (Bandura, 2006), this measure builds on the researchers' Reader Self-Perception Scale 1, which was developed to measure a similar construct for elementary students in grades 4-6 (Henk & Melnick, 1995). Both assessments were designed for multiple uses, including

assessment, instruction support and guidance, research, and individual and group reading evaluations for adolescents (Henk et al., 2012). While previous research indicates that students in a business-as-usual setting are unlikely to demonstrate significant increases in reading selfefficacy (Rhew et al., 2018), student self-perceptions of their reading efficacy has been shown to change as a result of intervention (Slinger, 2017).

The scale of 46 items uses a 5-point Likert scale to gauge respondents' level of agreement with statements concerning their "internal beliefs regarding overall reading ability, word recognition, word analysis, fluency, and comprehension" (Hedges & Gable, 2016; Melnick et al., 2009). The measure was designed to be divided into four scales: Progress, Observational Comparison, Social Feedback, and Physiological States (Melnick et al., 2009). Items in the Progress scale (16 items) ask that students compare and contrast their past and current reading performance (for example: "I read better now than I could before" or "I understand what I read better than I could before"), while Observational Comparison items (9 items) require students to consider their performance in relation to their class mates ("My reading comprehension level is higher than other students" or "I read better than other students in my class"); Social Feedback items (9 items) gauge student beliefs about the messages and response from teachers, parents, and peers about their reading ("I can tell my teachers like to listen to me read" and "My classmates like to listen to the way I read"), and Physiological State items (12 items) require students to assess how they feel internally when reading ("Deep down, I like to read" and "I feel good inside when I read") (Henk et al., 2012; Melnick et al., 2009).

The Reading Self-Perception Scale 2 (RSPS-2) has been validated and used for populations similar to Baltimore City public school students (Henk et al., 2012; Melnick et al., 2009; Urban, 2022). In addition to basing the study on Bandura's self-efficacy theory and

measurement guidance, Melnick et al. (2009) validated and piloted the study with over 3,000 secondary students (N = 3,031) from various rural, suburban, and urban backgrounds and conducted principal components analysis of the factor structure to establish construct validity (Melnick et al., 2009). In their pilot study, the authors reported alpha reliabilities for each dimensions' data as ranging from 0.88 to 0.95 (Melnick et al., 2009). In Hedges and Gable's study (2016) using the RSPS-2, alpha reliabilities ranged from 0.84 to .92 for grades 5-8 and .85 to .94 and .84 to .90 for grades 5-6 and grades 7-8, respectively.

In January 2022, RSPS-2 (Henk et al., 2012) was adapted to Qualtrics (see appendix). The RSPS-2 was administered to several ThemeReads students early in spring 2022 semester as a trial to work through any logistical issues. The survey was administered to all participating students for whom parental consent had been received in late May 2022 near the end of the semester and participation in the tutoring program. Completion of the RSPS-2 took approximately 20-25 minutes per student (Henk et al., 2012) and was supervised by tutors during a regularly scheduled tutoring session. Conducting the assessment during tutoring sessions was intended to improve student completion rate of the survey. The RSPS-2 was completed in May 2022 near the end of the spring semester and the end of student participation in the tutoring program.

Other variables

Dosage: ThemeReads tutors recorded student attendance at each tutoring session, recorded in Google Sheets. Correlation analysis was conducted using a dosage variable indicating the attendance rate of each student.

Overall attendance rates were calculated based on students' attendance (including days of full participation, days when doing solo reading activities, and days focused on tutor checks of

student progress) divided by total tutoring days offered. Attendance rates ranged from 31.25% to 60%, with a mean rate of 46.19% (SD = 0.1199).

Growth: The ThemeReads software automatically tracked and recorded student progress through the ThemeReads material whenever students logged into a program session. This variable counted the number of levels students completed during their participation in the ThemeReads program. Growth ranged from 0.4 levels to 3.2 levels, with an average growth of 1.188 reading levels (SD = 0.9212).

Student reading achievement: The i-Ready Diagnostic for Reading, created by Curriculum Associates (Curriculum Associates, 2015), was administered in Fall 2021 and Winter and Spring 2022 by Baltimore City Schools to all students. The Fall 2021 i-Ready scores serve as a baseline measure, while the Spring 2022 scores serve as a variable in the correlation analysis.

Data Analysis

Research question 1: Reading self-efficacy. To answer this question, trends in student RSE were examined, focusing both on their overall RSE and each subscale included in the RSPS-2. Means and standard deviations for each of the four scales included in the survey measure will be calculated and examined. In addition, results were compared to normed student data (Henk et al., 2012) using the RSPS-2, as well as similar studies that used the same survey measure. To do so, Hedges' *g* effect sizes were calculated between each subscale mean of this and other studies using RSPS-2 and the subscale means and standard deviations found in the norming study. Hedges' *g* was preferable in this situation due to the small sample size of this study. The equation used for this is as follows:

Hedges'
$$g = \frac{M_1 - M_2}{SD^* pooled}$$

Three students at Vanguard completed the survey twice, initially on paper and subsequently through the electronic interface. Their latter survey results were accepted as they most closely aligned with the end of the semester and the timing of other students' survey results. Two students at School 1 did not complete the electronic survey. These results were dropped from the analytic sample.

Research question 2: Correlation analysis. To answer this question, correlations using Spearman's rank correlation were conducted between students' reading self-efficacy scores and attendance, growth and reading variables. Initially, to allow the use of Pearson's *r*, non-normal variables were transformed using log, square root, and cube root transformation methods. However, the distribution of all variables remained non-normal following these transformations, likely due to the small analysis sample size. Given the non-normal distributions of a number of variables, due to the small sample size of the analysis, Spearman's rank correlation was preferable to Pearson's *r*. Spearman's rank correlation is desirable in this situation as it is considered to have greater validity when assumptions related to parametric distribution are violated (Bishara & Hittner, 2012). Based on the research by Bishara & Hittner (2012), Spearman's rank correlation is preferable over Pearson's *r* because it may minimize Type I error rates.

Results

Research Question 1: Reading self-efficacy

Descriptive Statistics of Reader Self-efficacy perception

Students' mean responses, minimum and maximum scores, and standard deviations are presented in Table 10.

Table 10.

	Ν	Mean	Percentile	Minimum	Maximum	Standard Deviation
Total RSE	25	165		125	204	20.39
Observational Comparison (OC)	25	31.21	50	21	42	5.60
Social Feedback (SF)	25	32.04	70	20	40	4.68
Progress (PR)	25	59.54	32	49	73	6.33
Physiological Status (PS)	25	42.21	55	25	51	8.39

Descriptive Statistics for Student Reader Self-efficacy (RSPS-2)

Note: RSE = Reading Self-efficacy; Total possible score for RSPS-2 = 230; Total possible sub-scores: PR = 80; OC = 45; SF = 45; PS = 60

As shown in Table 10, students' mean overall score was 165 (out of a total possible 230 points). The RSPS-2 includes four subscales, observational comparison, social feedback, progress, and physiological status. For each subscale, Henk and colleagues developed a percentile equivalent (Henk et al., 2012). Students scored an average of 31.21 for the observational comparison subscale (out of a total possible 45 points, which corresponds with the 50th percentile. Students scored an average of 32.04 for the social feedback subscale (out of a total possible 45 points), which corresponds with the 70th percentile. Students scored an average of 59.54 for the progress subscale (out of a total possible 80 points), which corresponds with the 32nd percentile. Students scored an average of 42.21 for the physiological status subscale (out of a total possible 60 points), which corresponds with the 55th percentile. Students in the sample demonstrated notably high social feedback perceptions (70th percentile), and lower than expected progress perceptions (32nd percentile).

Table 11.

	Observational Comparison	Social Feedback	Progress	Physiological Status	Overall
Storey 2022	31.21	32.04	59.54	42.21	165
(n = 27)	(5.60)	(4.68)	(6.33)	(8.39)	(20.39)
Henk et al 2012	31.0	29.7	61.2	39.7	161.6
(n=3,030)	(7.4)	(5.9)	(12.5)	(11.3)	
Rhew et al 2018	27.07	27.07	44.43	36.32	134.89
(n=68)	(1.96)	(2.37)	(4.19)	(5.93)	
Urban 2022	26.65	27.32	59.43	39.49	151.47
(n = 102)	(4.95)	(3.66)	(7.38)	(8.86)	(24.78)

Average Scores and Standard Deviations in Relation to Similar Studies Using RSPS-2

Note: Rhew et al., 2018 and Urban, 2022 reflect post-intervention survey results.

Without a pre-intervention survey point of reference, these results can only provide an idea of how students view their reading abilities after taking part in the ThemeReads tutoring program. It may be helpful, therefore, to examine the results of this survey in contrast to the initial norming study, as well as other studies that have used the RSPS-2 survey measure. Table 11 depicts the reading self-efficacy perceptions from the control or comparison groups of studies of similar student populations. Figure 6 depicts this relationship visually. Henk and colleagues (2012) developed and normed the RSPS-2 survey in a study with a sample of 3,030 students in grades seven through ten from various backgrounds and skill levels. The survey was intended for diagnostic purposes, rather than overall normative comparisons (Melnick, personal communication, February 1, 2023), so an overall mean and standard deviation were not calculated as they were deemed to be less important and informative than understanding student perceptions across the four distinct subscales.

Figure 6.



Comparison of RSPS-2 Average Responses Across Similar Studies

Rhew and colleagues (2018) used the RSPS-2 prior to and post-intervention in their quasi-experimental study of The Brainology program, an intervention for six-eighth graders in an urban school district in western Connecticut. Results reported in Table 11 reflect the postintervention results. The Brainology program, focused on improving growth mindset for students, included students taking 15-minute computer lab sessions five days per week for eight weeks. At a semester in length, this pre-pilot of ThemeReads and the Brainology intervention both provided similar dosage levels to students.

Urban (2022) used the RSPS-2 in an evaluation of 10th grade students' reading skills development through a culturally relevant reading intervention in central New Jersey. Urban's study examined the impact of an 18-week intervention, which also roughly matches the semester-long intervention in this study, measuring student RSE following the intervention. As seen in Table 11 and more clearly in Figure 6, students in the ThemeReads sample from this study reported similar or even higher levels of reading self-efficacy as did students in other studies utilizing the RSPS-2. Students in the ThemeReads program sample reported higher overall RSE perceptions than students in the norming study (Henk et al., 2012), higher scores in Social Feedback (0.40 SDs) and Physiological Status subscales (0.22 SDs), and nearly identical scores in the Observational Comparison subscale (0.03 SDs). However, ThemeReads students reported slightly lower Progress subscale levels compared to the norm study (0.13 SDs).

Students in this study reported higher reading self-efficacy across all subscales compared to control group students at endline in Rhew and colleagues' study. ThemeReads students reported overall RSE scores 30.11 points higher than the Rhew students, and an average of 7.53 points higher in each subscale. In particular, students in this study reported higher levels of Progress perceptions than students not in an intervention. Students in this study reported scores on average in the 51.75th percentile, compared to an average of the 23.25th percentile.

ThemeReads students reported more similar reading self-efficacy perceptions to the Urban study comparison group compared to Rhew's study, most closely in the case of the Progress subscale. However, their perceptions were higher overall and in the Observational Comparison, Social Feedback, and Physiological Status subscales. Urban's comparison group students averaged in the 33rd percentile, and about 3.03 points lower than students in this study. **Figure 7.**

Differences between RSPS-2 Survey Post-Intervention Findings



Using effect sizes, it is possible to compare intervention studies using the RSPS-2 survey at post-test to the study in which the survey was normed (Henk et al., 2012). This is described in Figure 7. Effect sizes were calculated for each subscale of the RSPS-2 survey—observational comparison, social feedback, progress, and physiological status. These results indicate that the students in this study displayed higher RSE scores in three out of the four subscales in comparison to Henk and colleagues. In particular, the effect size for social feedback was +0.40 and +0.22 for physiological status greater than students in the norming study, a medium and small effect, respectively. This indicates that in social feedback, the ThemeReads students differ from the Henk sample by 0.44 standard deviations, and by 0.22 standard deviations in physiological status. In contrast to this study, students in Rhew et al (2018) and Urban (2022), both of which focused on interventions for struggling adolescent students, found effects lower than the norming study in all subscales. While we cannot conclusively state that the Tutoring with ThemeReads study had a positive impact on student RSE, or that ThemeReads was more effective in improving RSE compared to the interventions assessed by Rhew and colleagues or

Urban, these results further point to the possibility that the positive impact on student RSE perceptions took place due to participation in ThemeReads.

Research Question 2: Correlation Analysis

Though the studied population was small and fairly uniform in certain demographic variables, it was deemed useful to examine the association between student reading self-efficacy perceptions and their progress and participation in the program.

Table 12.

Correlation Analysis Between Student RSE Perceptions and Student ThemeReads and i-Ready

Data

	Attendance Rate	Growth	i-Ready Spring Score
RSE Overall Score	-0.07	-0.30	0.26
	(0.73)	(0.14)	(0.23)
OC Score	-0.24	-0.30	0.34
	(0.25)	(0.14)	(0.10)
SF Score	0.07	-0.09	-0.02
	(0.73)	(0.68)	(0.93)
PS Score	-0.04	-0.38	0.01
	(0.83)	(0.06)	(0.97)
PR Score	0.02	-0.07	0.21
	(0.93)	(0.74)	(0.33)

Note: $\overrightarrow{RSE} = \operatorname{Reading Self-Efficacy}$; OC = Observational Comparison; SF = Social Feedback; PR = Progress. *p < .05. **p < .01. ***p < .001

Correlation analysis using Spearman's rank correlation was conducted between each subscale of the RSPS-2 and post-intervention student dosage, growth, and reading achievement variables, described in Table 12. Overall, the results were inconclusive. Most correlations were statistically non-significant, while Physiological Status perceptions and ThemeReads growth were weakly correlated and marginally significant (r = -0.38, p = 0.06). This could be interpreted as indicating that as students' Physiological Status perception scores increase, they completed fewer ThemeReads levels. However, Observational Comparison perceptions were marginally positively correlated with student i-Ready spring scores (r = 0.34, p = 0.10). This suggests that as students' Observational Comparison perception scores increase, their i-Ready spring scores increase. The results of this analysis, while mostly statistically non-significant or weakly correlated, go against expected hypotheses, and point to challenges in finding correlational relationships due to the small sample size and longer time required to cause improvement to reading skills and self-efficacy perceptions.

Discussion

The results are noteworthy for suggesting that after their time in the ThemeReads program, students who had been identified for the program due to reading below grade level reported positive perceptions of themselves as readers, felt others viewed their reading positively, and felt good when reading, as opposed to stressed and uncomfortable, which can negatively impact engagement and learning. These perceptions were in fact on par with the perceptions of average readers and were equal to or higher than other striving readers of the same age group following their participation in reading interventions. This is most striking because, though we lack self-perception data from before they were assigned to the ThemeReads program, these students started the school year (and the intervention) reading below grade level. Some students identified by their school for the program were reading at just a first grade reading level at the beginning of the program in January 2022. These same students were, by the end of the year, reporting that they enjoyed reading and felt good when doing it.

While only a few other studies used the RSPS-2 in relation to a reading intervention for striving readers, the comparison here is useful in pointing to potential positive effects that the ThemeReads program may have on student RSE due to its structure and methodologies. In contrast to the other studies referenced above, which focused on a computer-based program designed to teach a growth mindset in students over six weeks (Rhew et al., 2018) and culturally relevant curriculum materials over six months (Urban, 2022), respectively, the ThemeReads program provided daily tutoring sessions to small groups of students working collaboratively with focused support from a consistent in-person tutor over the course of one semester. Based on these findings, we may be able to hypothesize that the cooperative learning partnerships that students form in the ThemeReads program or the more focused support they receive from tutors in the program may contribute to development of positive student self-perceptions of their reading ability.

ThemeReads also relies on a series of reading units on various topics outside of standard school-based curricula felt to be relevant to student interests and learning, which may support student engagement in learning and reading. That these students had such positive perceptions of others and of their own experience as readers could suggest that the gains these students experienced may support continued engagement in reading and learning as students continue in school. Lacking causal evidence or pre-assignment perception data, it is these points of comparison highlight the potential benefits of the ThemeReads program and suggest the need for further research examining what components of the program may inform development of positive student reading self-efficacy perceptions.

Recommendations For Future Research and Practice

These findings suggest high-dosage tutoring incorporating cooperative learning as implemented in the Tutoring with ThemeReads program may support student positive reading self-efficacy perceptions, but more research is needed to allow for a causal claim. In particular, future researchers should consider use of a pre-test assessment of student reading self-efficacy and develop a randomized or quasi-experimental methodology allowing student RSE perceptions to be compared to students not receiving the treatment. A larger-scale evaluation of the program that meets What Works Clearinghouse (WWC) thresholds for study significance using the RSPS-2 would serve to provide a causal link between programmatic practices and student reading selfefficacy perceptions. Incorporating mixed methods research could also provide greater understanding of the specific components of the ThemeReads program that are more or less successful in achieving the goals of improving student reading and RSE.

Reading self-efficacy is a concept sensitive to intervention and changes in selfperception, unlike broader self-analyses (Zimmerman, 2000). A semester or year-long intervention, such as the Tutoring with ThemeReads program, has the potential to support improved reading self-efficacy perceptions within that time period, but a longer intervention may be necessary for these students who have a long history of struggling academically to demonstrate stronger academic outcomes. These improved self-evaluations may lay the foundation for future sustainable reading progress and academic success (Barkley, 2005; Burrows 2012; Tobing, 2013).

Given the potential benefits to student self-perceptions, the addition of a reading selfefficacy measure (such as the RSPS or RSPS-2) in future reading intervention evaluations has the potential to add depth to our understanding of the impact of such interventions beyond academic achievement measured by program-specific or standardized assessments.

Understanding the impact of reading interventions on students' reading self-efficacy perceptions may provide useful insights into intervention priorities and areas for closer engagement, providing information about the impact of reading growth on student self-perceptions, the role and impact of tutors, and cooperative learning.

Future research and interventions should also consider the impact of student attendance and engagement in reading programs. Reviewing the attendance records for students during the intervention, it became clear that the majority of missed tutoring sessions were not due to student absences, but due to disruptions in the academic calendar outside of their control. Of 1,146 total absences for all students in the sample, only 230 of those absences were due to students' actions (including behavioral issues or repercussions, such as suspension from school). All other absences were attributable to causes outside of student control, including teacher professional development days, fire drills, field trips and class activities, testing, and COVID quarantines. These disruptions impact both program implementation and potential impact of the intervention, as well as research protocol and fidelity.

The creators of the RSPS-2 (Henk et al., 2012) note that student self-efficacy ideas are closely connected to the social context in which they are learning to read and that instructors can use the results from the survey to adapt the learning environment to better support student literacy development. Recognizing this, future research might explore the possibility that ThemeReads tutors could more overtly call attention to student reading progress during tutor checks and one-on-one planning meetings with students using an explicit process.

Study Limitations

The data used in this study came from a single data collection time point at the end of the intervention, lacking comparison data from prior to sampling or intervention start. As a small

pre-pilot program, the sample size of the program was small and not necessarily representative of each school, or students in need of reading support. As a result, the generalizability of this study is limited to students in the ThemeReads program who completed the RSPS-2 survey.

The challenges with study implementation, as well as program implementation issues (as seen in the measures of student- vs. externally-caused absences from tutoring), highlight the challenges related to conducting research during the COVID-19 pandemic. Though schools in the Baltimore City Schools district had returned to full-time in-person instruction during the Spring 2022 semester, COVID protocols remained in place, with tutors and students required to undertake quarantine protocols when found to have contracted the virus. These disruptions to the tutoring schedule could have interfered both with the amount of support students received in the tutoring program, and opportunities for change in reading self-efficacy perceptions. Disruptions also likely impacted the implementation of research protocols, including distribution and collection of consent forms and surveys. These experiences may inform future research concerning reading tutoring interventions in real world school settings.

Chapter 5: A Randomized Clinical Trial Evaluating Eyeglasses Compliance in Grades 6-8 Introduction and Literature Review

Refractive errors remain a common issue for children and youth. An estimated 21.5% of children between the ages of 6-11 have vision problems, while 24% of 12-17 year old youth experience vision problems, indicating that the rate increases as children age (Ferebee, 2004). When these vision problems are not addressed, children may experience depression, disease, tiredness and headaches, slowed development and learning, struggles with paying attention to schoolwork, lower reading speed, and greater or permanent vision loss (Killeen & Lee, 2022; Kodjebacheva et al., 2015; Ruderman, 2016). Despite the serious consequences of uncorrected vision issues, the vast majority of these problems can be addressed through the use of eyeglasses (Ferebee, 2004; Ruderman, 2016). Eyeglasses could support roughly 160 million cases of visual impairment and blindness across the world (Burton et al., 2021; Killeen & Lee, 2022)

Broadening access to eyecare and a culture supportive of eyeglasses use is an important goal as there are disproportionate discrepancies in access to and use of eyeglasses for lowincome children and their families (Ethan & Basch, 2008). Pediatric eyecare is, in fact, considered an essential health benefit under the Affordable Care Act (Killeen & Lee, 2022), but many children lack the resources or opportunities to obtain eyeglasses (Qiu et al., 2014), particularly those from poor or underrepresented backgrounds (Basch, 2011; Kemper et al., 2006). Mexican American and non-Hispanic Black youth are significantly more likely to have inadequately corrected refractive error, and Hispanic students in Michigan were less likely to have had previous eye exams or worn glasses (Killeen & Lee, 2022; Killeen et al., 2022; Qiu et al., 2014). These differences in access to eyecare and use of eyeglasses may have been exacerbated by the COVID-19 pandemic (Killeen & Lee, 2022), due to disruptions in

transportation, school-based health services, and parental employment, among other pandemicrelated impacts.

A number of hurdles stand in the way of access to eyecare. Social determinants of health, including access to transportation and health insurance, linguistic hurdles, and education have all been identified as barriers to receipt of eyecare (Solomon et al., 2022). A child may fail a screening organized by the state or district, but parents may not follow through on recommendations of comprehensive vision assessments due to the cost of eye exams or eyeglasses, lack of insurance covering vision care, or lack of knowledge about how to access free vision testing (Kemper et al., 2006; Kimel, 2006; Slavin et al., 2018).

Those with poorer eyesight may have more trouble reading or engaging in learning. Sanderson and colleagues (2021) highlight the role that issues of equity and inclusion play in the distribution and presence of these social determinants of learning. There is ample evidence that access to proper eyecare is disproportionately distributed amongst those from white or economically privileged backgrounds (Ethan & Basch, 2008).

The culture of supporting the use of eyeglasses that students are exposed to at home and within schools may also vary by socioeconomic and racial/ethnic backgrounds. In some countries or for those from some cultural backgrounds, there may be quite different experiences and expectations about eyeglasses use. Parents may sometimes be less likely to pursue eyecare for their child or encourage the use of eyeglasses due to disbelief that young children and adolescents can need eyeglasses (Kemper et al., 2006). Some parents disapprove of children wearing eyeglasses (Aldebasi, 2013). And even if parents do move forward with vision testing and are able to purchase eyeglasses, children neglect to wear the spectacles, break them, or lose

them. Retesting and replacing eyeglasses is difficult, and disadvantaged parents may not be able to afford these added expenses and time expenditures (Slavin et al., 2018).

In adolescence, students' friends and peers likely play one of the largest roles in influencing their perceptions of how to dress, act, and indeed, whether to wear one's eyeglasses. While in some cases, eyeglasses have been seen as positive fashion accessories by older students (Inns, 2018), both elementary age students and their older peers have reported facing bullying or other negative social interactions due to their use of eyeglasses. After interviewing parents, school nurses, and principals, Kodjebacheva and colleagues (2015) noted that societal issues, including peer bullying and name calling, as well as perceptions that eyeglasses are unattractive, was a particular issue among African American and Latino populations. In a qualitative study in India, researchers found that adolescents were particularly concerned with feeling discriminated against or being different from their peers due to wearing eyeglasses (Narayanan et al., 2017). In the Baltimore BREDS study, a predecessor to the Baltimore Vision program, Vision for Baltimore (V4B), 20% of respondents reported being on the receiving end of bullying due to their glasses (Huang et al., 2019).

Given the pervasive nature of eyeglasses needs, discrepancies in access to eyecare, and common societal barriers to eyewear use, schools have been identified as an ideal central location to support eyecare and the use of prescribed glasses.

School-Based Eyecare

School-based eyecare has evolved over the past decades to include comprehensive programs incorporating vision screenings, examinations, and eyeglasses provision. Almost all states and school districts require school-based vision screening, usually at the elementary school level, but often with follow up screenings at middle school and high school levels (Basch, 2011).

At least 20 states have schools or school districts with larger-scale, comprehensive school-based vision programs (SBVPs) (Collins et al., 2022). Comprehensive eye care programs differ from screening programs, with the inclusion of examinations and treatment (Killeen & Lee, 2022) when students fail vision screenings. They may also include student and family education initiatives, which are typically missing from vision screening programs. Students in need of eyeglasses are those students found through screenings and examinations to have poor vision due to refractive error, whether they be farsighted (hyperopia, the difficulty seeing close up things) or nearsighted (myopia, the difficulty seeing things far away), or have been diagnosed with astigmatism, an issue with eye shape causes vision to defocus (Slavin et al., 2018). In addition to hyperopia and myopia refractive errors (found in about 15% of children), school vision screenings generally focus on detecting amblyopia and strabismus, found in between 2-5% of children (Ferebee, 2004).

School-based vision care programs have been identified as superior support systems for student vision needs due to providing a service that is otherwise confusing, difficult, and expensive for parents to obtain, and challenging to maintain. Children are at school five days per week, making it theoretically easier to provide students with examination where they are most likely to be, as well as ensure they continue to wear the eyeglasses or get replacements as needed (Slavin et al., 2018).

School-based vision programs, such as the Eagles Eye Mobile in Philadelphia, which serves over 3,000 children per year (Alvi et al., 2015), have shown positive impacts on student academic outcomes, including reading and mathematics. While much of this research centers on elementary school aged children, programs providing eyeglasses in rural China have shown to improve student test scores in reading by up to 0.34 standard deviations (Glewwe et al., 2016)

and mathematics by 0.26 standard deviations (Hannum & Zhang, 2012). Other research has pointed to significant impacts for students in rural Western China public schools compared to students in private migrant schools (Ma et al., 2014; 2018; 2021), finding gains in math and reading of up to 0.25 standard deviations. United States-based studies have found positive learning impacts in reading and mathematics, particularly for female students, those in special education, and those performing in the lowest quartile at baseline (Neitzel et al., 2021). Anecdotally, parents and teachers also have observed these improvements in reading fluency and engagement in schoolwork, with students better able to see the board, participate in class activities and discussion, and complete their schoolwork (Kretz et al., 2022).

Challenges Facing School-Based Vision Programs

While these school-based eyecare programs stand to support significant positive gains for students, the programs are not always easy to implement. They can be costly and complex, requiring partnerships with local vision care organizations and eyeglasses frames and lens manufacturers, as well as relationships between city or district education and health departments. Other practical challenges in the implementation of the programs can also include difficulties in collecting individual parental consents, challenges tracking students as they move between schools, and complexities involved in developing stakeholder engagement, particularly amongst parents and teachers (Collins et al., 2022). Furthermore, some United States based studies (Glewwe et al., 2018; Neitzel et al., 2021) have noted that gains may fade over time, arguing that follow up supports and interventions may be necessary to sustain learning improvement. This speaks to one of the largest underlying challenge in implementing and sustaining the effects of a school-based vision program: ensuring students comply with wearing the eyeglasses they have been prescribed and given. Students, for various reasons, may or may not continue to wear their

eyeglasses appropriately. Compliance rates have been connected to background characteristics, suggesting that younger students (Aldebasi, 2013; Alvi et al., 2015; Holguin et al., 2006; Pavithra et al., 2014; Thapa et al., 2020), girls (Gogate et al., 2013; Messer et al., 2012; Pavithra et al., 2014; von-Bischhoffshausen et al., 2014), and students with more severe refractive errors or vision deficits (Alvi et al., 2015; Gogate et al., 2013; Morjaria et al., 2019) tend to demonstrate higher levels of compliance. Others have noted differing impacts based on race and ethnicity, SES, or family educational backgrounds (Kodjebacheva et al., 2014).

Follow-up compliance rates (see Table 13) have been shown to vary widely, but often may be low (Alvi et al., 2015; Ethan et al., 2010; Inns, 2018; Kodjebacheva et al., 2014; Messer et al., 2012; Preslan & Novak, 1998), suggesting that the provision of eyeglasses does not ensure regular use. Observations taken shortly after provision were unsurprisingly more likely to observe stronger compliance rates (such as in the case Zeng et al., 2009, taken one month after provision of eyeglasses, finding a compliance rate of 94.3%). Similarly, self-reported compliance rates often depicted differing rates compared to those gathered through unannounced observations (Ma et al., 2014). Most compliance observations took place at most 12 months following receipt of eyeglasses, with no studies examining eyeglasses use over longer periods. **Table 13.**

Study	Location/Sample	Compliance Rate	Time of Follow Up
		(treatment groups)	
Aldebasi, 2013	Saudi Arabia	33.31% compliant	6 months
Alvi et al., 2015	Philadelphia, PA, USA	71% compliant	12 months
Bhandari et al., 2016	Chawan district, Nepal	48% compliant	12 months
Bhatt et al., 2017	Rohtak, India	40.57% compliant	3 months
Du et al., 2022	Rural China	41% compliant	7 months
Ethan et al., 2010	New York City, NY, USA	47% compliant	NR
Gogate et al., 2013	Rural Pune, India	29.5% compliant	6-12 months

Follow-Up Eyeglasses Compliance Rates from School-Based Vision Programs

Hark et al., 2020 Holguin et al., 2006 Huang et al., 2019	Philadelphia, PA, USA Oaxaca, Mexico Baltimore, MD, USA	67.4% compliant 13.4% compliant 87% compliant	2-4 months4-18 months12 months
Inns 2018	Baltimore, MD, USA	13% compliant	12 months
Kodjebacheva et al., 2014	Southern California, USA	73.3% compliant	12 months
Ma et al., 2014 Ma et al., 2018	Rural China Shaanxi, China	41% compliant 55% compliant	8-9 months 8 months
McCormick et al., 2019	Botswana	60.1% compliant	3-4 months
Messer et al., 2012	Southern Arizona	33.2% compliant	12 months
Narayanan & Ramani, 2018	Chennai, India	38.8% compliant	12 months
Pavithra et al., 2014	Bangalore, India	57.8% compliant	3 months
Thapa et al., 2020	Nepal	51% compliant 57% compliant	3 months 6 months
Von- Bischhoffshausen et al., 2014	Concepcion, Chile	58% compliant	12 months
Zeng et al., 2009	Urban Guangzhou, China	94.3% compliant	1 month

Note: NR = Not reported.

A number of causes may lead to low compliance rates amongst these groups, particularly the culture and attitudes towards eyeglasses use within the school and students' home lives. Young students may more frequently lose or break their glasses (Inns, 2018; Kodjebacheva et al., 2014; Messer et al., 2012; von-Bischhoffshausen et al., 2014), while as students get older, they may cite social influences leading them to elect not to wear their eyeglasses (Inns, 2018; von-Bischhoffshausen et al., 2014). Societal influences and perceptions of eyeglasses appear to become more significant influences on eyeglasses wear compliance as youth age. Participants in a focus group reported feelings including "disappointment, unhappiness, worry, and concern when they realized they needed eyeglasses" (Kodjebacheva et al., 2015). Adolescents in surveys and in focus groups across cultures describe experiences of teasing by classmates and friends (Narayanan et al., 2017). In some cultures, youth may also cite parental disapproval or misunderstanding for glasses use (Aldebasi, 2013; Bhandari et al., 2016; Glewwe et al., 2016; Narayanan et al., 2017). Students from an intervention in secondary schools in Pune, India pointed to being teased (19.8%) and dislike for the glasses (12%) as two of the main reasons they were not wearing at follow-up, while 16.3% noted they had forgotten the glasses at home (Gogate et al., 2013), which may be an obfuscation to cover for other social reasons for non-wear. Urban students have been found to demonstrate higher rates of non-compliance with glasses use, potentially related to issues of self-esteem and more negative self-concept (Jellesma, 2013). A study taking place in Oaxaca, Mexico (Holguin et al., 2006) found that older children and children in urban or suburban areas were more likely to cite concerns about their appearance when wearing glasses or fears of being teased than younger or rural resident respondents.

Measures of eyeglasses compliance may also vary based on the methods used to measure compliance and the definition of compliance or eyeglasses use that is used by researchers in different contexts. In most cases, wearing eyeglasses is straightforwardly measured as students with eyeglasses on their face at the time of observation and those without eyeglasses being worn are considered non-compliant. In some cases, observers have noted when students have eyeglasses on their desk or in their bag (Narayanan & Ramani, 2018), carrying the eyeglasses, or were presented with them (Morjaria et al., 2019). Broadening the definition of eyeglasses use would likely raise a measure of the proportion of students compliant with eyeglasses use at follow up. Similarly, self-reports of eyeglasses use (Ma et al., 2014; Yi et al., 2015) or reports by teachers or school nurses may also inflate the number of students recorded as compliant, with students potentially likely to misreport higher rates of eyeglasses use if they know they should be wearing the eyeglasses, even if they do not for personal reasons or feel guilty for breaking them. This may be more pronounced in adolescents and older students, who may be more likely to

make compliance decisions related to peer pressure or social perceptions of eyeglasses use (Holguin et al., 2006; Narayanan et al., 2017; von-Bischhoffshausen et al., 2014)

School-Based Vision Program Focus on Compliance

These studies point to the importance of ensuring and understanding vision compliance in order to see positive impacts from school-based vision care and eyeglass provision programs. Based on these findings of poor long-term compliance, school-based vision programs might benefit from including initiatives to improve perceptions of eyeglasses amongst youth and their families, share information about the importance of eyeglasses use, and work with stakeholders (such as teachers or admin staff) or enlist para-professional health aides to support tracking of students wearing eyeglasses and ensure they receive replacements in an appropriate time period. Others have suggested multiple sets of eyeglasses, one of which could be kept at school and the other at home or provision of repair kits (Vongsachang et al., 2021; Wahl et al., 2022). These recommendations have been suggested in a number of focus group studies (Narayanan et al., 2017, Vongsachang et al., 2021; Wahl et al., 2022) and program evaluations.

Despite the potential impact of eyeglasses compliance, few SBVPs have managed to effectively incorporate compliance encouragement initiatives into the programs. One program in urban public elementary schools recruited teachers to encourage eyeglasses use through a classroom tracker, verbal reminders and incentives, seeing glasses wearing increase by almost 20 percentage points in the first two weeks of the intervention, but trail off after spring recess (Haag et al., 2022). Narayanan & Ramani (2018) developed a 23-step package of interventions to improve compliance based on identified barriers and means to address compliance from focus groups with teachers, children, parents and eyecare professionals. Their interventions were
screenings. The 23 steps included training of student volunteers as vision ambassadors to monitor compliance and demonstration of screenings for others, allowing children to select their own preferred frames, providing information to parents and invitation of parents to schools to collect glasses and counseling, mailing vision screening reports to schools within a certain period of time after screening, eyeglasses demonstrations for parents, and rewards for compliance through teachers. A Baltimore-based SBVP, Vision for Baltimore, included the creation of storage boxes in classrooms for school eyeglasses, labeled with each child's name and instructions on use and care, coupled with reminders for teachers to have students wear the glasses (Slavin et al., 2018). In this program, vision care staff also visited schools once per month to replace or repair broken glasses and adjust fit as needed. However, none of the studies focusing on eyeglasses compliance supports have done so through an experimental lens, pointing to a need in understanding whether such interventions are truly effective or how they can be improved.

Summary

Refractive errors remain a common issue for children and youth, yet the vast majority of these issues can be addressed through the use of eyeglasses (Ferebee, 2004; Ruderman, 2016). However, many children lack the resources or opportunities to obtain eyeglasses (Qiu et al., 2014), particularly those from poor or underrepresented backgrounds (Basch, 2011; Kemper et al., 2006). School-based eyecare has evolved over the past decades to include comprehensive programs incorporating vision screenings, examinations, and eyeglasses provision. These school-based vision programs have shown positive impacts on student academic outcomes, including reading and mathematics (Glewwe et al., 2018; Hannum & Zhang, 2012; Ma et al., 2014; Neitzel et al., 2021; Slavin et al., 2018).

The impact of these programs may be mitigated by low compliance rates of eyeglasses use, even after provision of eyeglasses through the program without any out-of-pocket costs to the family. Follow-up compliance rates have been shown to vary widely, but often may be low (Alvi et al., 2015; Ethan et al., 2010; Inns, 2018; Kodjebacheva et al., 2014; Messer et al., 2012; Preslan & Novak, 1998), suggesting that the provision of eyeglasses does not ensure regular use. Compliance rates have been connected to background characteristics, suggesting that younger students (Aldebasi, 2013; Alvi et al., 2015), girls (von-Bischhoffshausen et al., 2014), and students with more severe refractive errors or vision deficits (Alvi et al., 2015) tend to demonstrate higher levels of compliance. Others have noted differing impacts based on race and ethnicity, SES, or family educational backgrounds (Kodjebacheva et al., 2014).

The current study explores the results of an effort to support eyewear usage for grade 6-8 students in a school setting in Chicago, Illinois, U.S.A. The Vision for Chicago (V4C) program, implemented between Fall 2016 and Spring 2019, was intended to ensure the provision of eyeglasses to students in need of eyecare, while also improving the culture of eyeglasses use in Chicago Public Schools (CPS). Through educational and communication interventions, V4C worked to ensure students with suspected vision problems received eye exams, promoted awareness of eye health, and streamlined communication between families, school staff, and care providers.

This chapter will explore the impact of the program on student eyeglasses use and the creation of a culture of eyeglasses use in CPS.

Methods

Purpose Statement

While it has been established that school-based vision programs can effectively provide eyecare and eyeglasses, compliance by sixth-eighth grade students with eyeglasses wear may not be assumed. This study will examine student compliance with the use of prescribed eyeglasses in an enhanced school-based vision program (SBVP). A description of the V4C program is included in Chapter 2.

Research Questions

Research Question 1: Were students in schools participating in V4C more likely to wear eyeglasses after one year and two years following provision of eyeglasses and V4C intervention?

This is considered to be a confirmatory analysis. In Vision for Chicago, treatment schools received ongoing eyeglasses supports encouraging eyeglasses wear compliance. These supports included eye health promotion efforts and interventions to improve communication between families, school staff, and care providers. Some eyeglasses loss or breakage is expected, and not all students must wear eyeglasses at all times. However, it was expected that students in treatment schools, where there was more effort to remind students to wear eyeglasses and support their eyeglasses use, would have higher rates of eyeglasses compliance. Previous research on the Vision for Chicago program has found a significant impact of the treatment on eyeglasses use for students in elementary school grades (Storey et al., 2022). This analysis examined whether a difference in compliance was observable between treatment and comparison schools for students in grades 6-8.

Research Question 2: Does eyeglasses usage compliance mediate the relationship between receipt of eyeglasses and reading achievement?

This analysis is intended as an exploratory analysis, with the results considered to be noncausal. A goal of the provision of eyeglasses to students is that they will be better able to engage in learning and classroom activities, and will be able to perform better academically as a result of better vision capabilities. Previous research has connected eyeglasses use to academic performance (Alvi et al., 2015; Glewwe et al., 2016; Hannum & Zhang, 2012; Neitzel et al., 2021; Ma et al., 2014; 2018; 2021), as discussed earlier in this chapter. It stands to reason, however, that the relationship between receiving eyeglasses and performing better academically would be impacted or mediated by how much students actually wear the eyeglasses. They do little good in reading the front board if they are in one's backpack, for instance. It is expected therefore, that the relationship between eyeglasses receipt (treatment in the V4C program) and academic achievement will be mediated by students' eyeglasses wear compliance. In this exploratory analysis, it is hypothesized that receipt of eyeglasses through the Vision for Chicago program (receipt of treatment) leads to greater eyeglasses wear compliance, and that this increased use of eyeglasses leads to greater reading achievement. Essentially, this analysis takes up the question of whether those students who wear their glasses more learn more.

Setting

This study relies on pre-existing data (collected between Fall 2017 and Spring 2019) that have not been analyzed previously. The sample includes a total of 66 schools (including elementary/middle and middle schools) serving sixth through eighth grades located in Chicago. This sample of schools was part of a larger study including 77 K-8 schools participating in the Vision for Chicago program. Schools were eligible for participation if at least 80% of students qualified for free or reduced price lunches.

Research Design

This randomized study assigned schools to either treatment or control conditions prior to Fall 2017, with school-level blocking variables used in the random assignment process as appropriate. The treatment was a schoolwide intervention. The use of a randomized design allowed for stronger conclusions that differences in glasses usage between schools were likely due to the vision program and no other factors.

The Vision for Chicago (V4C) program was intended to examine the most effective approaches to deliver school-based vision care, increase utilization of the Chicago Vision Exam Program (CVEP), and promote compliance with eyeglasses wearing in CPS. Through educational and communication interventions, V4C worked to ensure students with suspected vision problems receive eye exams, promote awareness of eye health, and streamlines communication between families, school staff, and care providers. V4C also helped schools develop teacher monitoring and eyeglass compliance encouragement systems.

Sample

The analytic sample for this study was 58 schools serving students in grades 6-8 with non-missing glasses counts, drawn from a pool of 77 schools. Listwise deletion was used to remove schools missing baseline and outcome eyeglasses compliance measurements. Baseline equivalency based on demographic and prior eyeglasses use are presented in Tables 14 and 15. **Table 14.**

School Baseline	<i>Characteristics</i>	After Attrition
		. /

Category	Overall	Control	Treatment	p-value
Number of Schools	58	29	29	
Enrollment (mean (SD))	542.19 (266.57)	558.45 (298.32)	525.93 (234.77)	0.65

Category	Overall	Control	Treatment	p-value
Bilingual % (mean (SD))	19% (0.18)	20% (0.18)	18% (0.18)	0.72
Special Education % (mean (SD))	13% (0.04)	14% (0.04)	13% (0.05)	0.58
FRL % (mean (SD))	83% (0.09)	82% (0.10)	84% (0.08)	0.62
White (mean (SD))	4% (0.09)	4% (0.09)	4% (0.09)	0.79
Black (mean (SD))	57% (0.45)	58% (0.45)	46% (0.45)	0.85
Latinx (mean (SD))	37% (0.40)	36% (0.41)	38% (0.40)	0.88
Asian (mean (SD))	1% (0.04)	1% (0.05)	1% (0.03)	0.94
Baseline Eyeglasses Compliance (Fall 2017)	18.73% (0.10)	18.34 (0.10)	19.13% (0.11)	0.78

Note: SD = standard deviation

Schools serving elementary and middle schools, including combined elementary-middle schools, were randomly assigned to be part of control and treatment groups. Of the 58 schools serving students in Grades 6-8 with baseline and outcome measures, 29 were part of the control group and 29 were part of the treatment group. The average enrollment of schools across groups was 542 students, with the majority of students recipients of free or reduced price lunches (FRL) (83%). Participating schools enrolled predominantly Black students (on average 57% of school population) but a moderate number of English Language learners (EL) (19%) and students who qualified for special education (13%).

Comparing baseline eyeglasses observation, seen in Table 15, the sample demonstrates baseline equivalence of the treatment and comparison school groups. As the effect size of the difference between groups (ES = 0.08) does not exceed 0.25 standard deviations, this meets the criteria established by What Works Clearinghouse (WWC) for baseline equivalence of pretest measure.

Table 15.

Eyeglasses	Treatment	Control	Treatment	Control	Treatment	Control	Effect
Observations	Schools	Schools	Mean	Mean	SD	SD	Size
Grades 6-8	29	29	0.19	0.18	0.10	0.11	0.08

School-Level Baseline Observations

Note. SD = standard deviation

Power analysis was conducted for the study based on the sample of 29 schools in the treatment and 29 in the control group. Based on these analyses, the minimum detectable effect size for the study was 0.13.

Data Collection

As described above, students who failed a vision screening before the study began were included in the analytic sample. CPS provided student and school-level demographic information and academic performance data. Following the provision of eyeglasses, V4C school vision advocates (SVAs) conducted observations in all treatment and control schools each school year at the beginning and end of each school year to determine the number of children wearing glasses in academic classes.

Outcome measures.

To examine the impact of receiving V4C services, including eyeglasses and compliance encouragement interventions, individual and school-level demographic, compliance, and academic achievement data from CPS from the 2017-2018 through 2018-2019 school years were collected.

Student eyeglass compliance rate. To examine the impact of the V4C program on student eyeglasses use, student eyeglasses compliance data will be used. Following the provision of eyeglasses, V4C SVAs conducted observations in all treatment and control schools each school

year at the beginning and end of each school year to determine the number of children wearing glasses in academic classes. All counts were conducted in the morning, prior to the start of the lunch period, in order to find as many students in academic class lessons as possible. Observers visited each class, counting both the number of students wearing glasses and the number of students present. The compliance rate was determined by calculating the percentage of students wearing glasses in each grade at each school.

Student reading achievement measure. In the exploratory analysis, student reading achievement measures will be included in the model, in order to examine how eyeglasses use mediates the relationship between receipt of intervention and reading achievement. Reading achievement is included as a student level variable given the presence of students who did not benefit from the Vision program that would be part of school-level variables of reading achievement.

Due to real world changes in reading assessment in CPS, multiple achievement measures were used. Academic measures included the Partnership for Assessment of Readiness for College and Careers test (PARCC), and the Illinois Assessment of Readiness (IAR).

The Partnership for Assessment of Readiness for College and Careers test (PARCC) is a standardized mathematics and English language arts test administered to students in grades three through eight. The PARCC exams were given in spring 2016, spring 2017, and spring 2018, at which point the state test was changed. The Illinois Assessment of Readiness (IAR) is a standardized assessment for students in the state of Illinois, given to students in grades three through eight. It includes tests of both English language arts and mathematics, and was administered in spring 2019, replacing the PARCC.

In the exploratory mediation analysis, spring 2016 PARCC will serve as a pretest measure, while spring 2018 PARCC and spring 2019 IAR assessments will be used as outcome measures at one-year and two-year impact analyses, respectively.

Independent measures.

In addition to the reading and eyeglasses compliance measures, the confirmatory and exploratory analyses included student and school level characteristics.

The confirmatory analysis included variables at the school level. These variables include treatment condition, demographic variables (race/ethnicity, FRL percentage, race/ethnicity, special education percentage) and blocking variables that were used in the school random assignment process. The percentage of bilingual students at each school was eliminated from the model due to being over-correlated with one of the blocking variables. The data for these variables were provided by the school district.

Data Analysis

Research question 1: Impact of treatment on eyeglasses compliance. To answer this first question, hierarchical linear modeling was used. The treatment was a schoolwide intervention (V4C with compliance interventions), and treatment status for each student was dictated by the school of their enrollment for the first year of the study (School Year 2017-2018). The analysis controls for school baseline eyeglasses compliance (Fall 2017) as indicated by the pretest measure, school enrollment, and demographics (including percentage of bilingual students, special education students, FRL-qualified, and White, Black, Latinx, Asian). This step employs the following regression model: Reading Achievement

 $= \beta_{0} + \beta_{1}Treatment + \beta_{2}Baseline Eyeglasses Compliance Rate$ $+ \beta_{3}Enrollment + \beta_{4}Special Education Rate + \beta_{5}FRL Rate$ $+ \beta_{6}Race/Ethnicity Rate + e$

In this model, participation in V4C predicts endline eyeglasses wear compliance rates for each grade, holding all else equal. A dummy-coded treatment indicator (Treatment, where 1 = V4C participation and 0 = not a part of V4C) was used to make this prediction. Effect sizes were calculated to estimate the overall impact on eyeglasses wear compliance of participation in the V4C program.

The impact of the program was analyzed at the end of the first year (1-year impact) and the end of the second year (2-year impact). Differential effects of V4C for students based on school demographic characteristics were assessed by adding interaction variables between the V4C indicator and school-level covariates of interest to the model, as described in the following model:

Reading Achievement

 $= \beta_{0} + \beta_{1}Treatment + \beta_{2}Baseline Eyeglasses Compliance Rate$ $+ \beta_{3}Enrollment + \beta_{4}Special Education Rate + \beta_{5}FRL Rate$ $+ \beta_{6}Race/Ethnicity Rate + \beta_{7}Treatment * Enrollment + \beta_{8}Treatment$ $* Special Education Rate + \beta_{9}Treatment * FRL Rate + \beta_{10}Treatment$ * Race/Ethnicity Rate + e

Using this model, the performance of students with specific characteristics receiving V4C services was compared to similar, comparison peers.

Research Question 2. Exploratory analysis of relationship between treatment and reading achievement.

In an exploratory thought experiment, this chapter examined whether eyeglasses wear compliance might mediate the effect of the treatment (receipt of V4C services including efforts to develop a culture of eyeglasses use) on students' reading achievement. This analysis will rely on causal mediation analysis (CMA) in assessing this model. In this analysis, eyeglasses compliance may be considered a latent variable representing the development of a culture of eyeglasses use in V4C treatment schools. Student reading performance data collected by the district through standardized computer assessments will serve as an outcome variable in the mediation analysis stage.

The mediation analysis examined whether treatment in the program affects reading achievement either in part or totally through the culture of eyeglasses use in each school. It was expected that eyeglasses culture meets the definition of mediator as described by Baron & Kenny (1986), as it is hypothesized to account, at least in part, for the relation between receipt of eyeglasses use and reading achievement. Eyeglasses use has been demonstrated to improve reading achievement, a sign that it may support not just the reading itself but also testing competence and comfort. Students may persevere in stressful or challenging experiences, such as testing, for a longer period of time because they find it easier to read the test material. Straining less to read, they would become frustrated or bored less quickly, and more likely to complete the test, performing better than before in part because they have gotten farther than they would have if they had to overcome poor vision and resultant fatigue.

CMA was conducted using the R package "mediation" (Tingley et al., 2014). Following common causal frameworks set out by previous researchers (Baron & Kenny, 1989; Imai et al.,

2010; Murphy et al., 2020), an unmediated model and a mediation model were calculated over the course of four steps. First, the effect of treatment (independent variable) on reading achievement (dependent variable) was calculated through linear regression. Next, the effect of the independent variable treatment on the mediator, eyeglasses compliance, was calculated through linear regression. Third, linear regression was used to test the effect of eyeglasses compliance on reading achievement, while controlling for receipt of treatment. Finally, the full causal mediation model was run, producing estimates of average causal mediation effects, average direct effects, and the total effect. Throughout this analysis, clustered standard errors were used given the student- and school-level variables used as part of the mediation model. In addition, estimating the indirect effects at the 2.5th and 97.5th percentiles allowed the estimation of the 95% confidence interval.

In the first unmediated model (seen below in Figure 7), path c describes the total effect of the treatment on students' reading achievement scores (measured through a standardized reading assessment). The mediation model includes three paths, a, b, and c'. Paths a and b represent the mediation paths hypothesized by this paper, where the Vision for Chicago treatment potentially has an effect on student reading achievement scores. This path hypothesizes that receipt of eyeglasses through the Vision for Chicago program leads to greater eyeglasses wear compliance, and that this increased use of eyeglasses leads to greater reading achievement. Path a is the effect of the treatment on eyeglasses wear compliance, and path b is the effect of the compliance mediator variable on students' reading achievement scores. In this case, the product of these two paths (ab) indicates the mediation effect (Murphy et al., 2020). Path c' in the mediation model describes the direct effect of the treatment on students' reading achievement (described by path c) is the sum of the

direct path *c*' plus the mediation effect, *ab* (Murphy et al., 2020). These relationships were modeled for the program after both one year of implementation (with variables from the end of the 2017-2018 school year) and after two years of implementation (with variables from the end of the 2018-2019 school year).

Figure 8.

Single Mediator Mediation Path Diagram



These models may also be described using the following forms:

$$Y(Reading)_i = i_1 + c(Eyeglasses Compliance)_i + e_1$$

 $Y(Reading)_{ij} = i_2 + c'X(Treatment)_i + bM(Compliance)_i + e_2$

$$M(Compliance)_{ij} = i_3 + aX(Treatment)_i + e_3$$

In the mediation model, the independent variable (X = Treatment) is connected to the mediator (M = Eyeglasses Compliance) through path a, which is itself connected to the dependent variable (Y = Reading Achievement) through path b. Patch c' connects the dependent

variable X to the dependent variable Y, while adjusting for the presence of the mediator (MacKinnon, 2008). Here the error terms, e_1 , e_2 , and e_3 represent the parts of each variable (X, Y, M), respectively, that are not explained by their relationships to the other variables.

As an exploratory analysis, results from this analysis are considered to be non-causal, and recommendations for future research are described below.

Results

Research Question 1: Impact analysis

The outcomes for all schools are summarized in Table 16, describing one-year and twoyear effects. These findings suggest that students in Grades 6-8 in participating schools did not demonstrate greater eyeglasses compliance after one or two years in the program. Based on these results, no statistical differences in eyeglasses use between treatment and control school students were detected (Table 16), so we are unable to reject the null hypothesis. This is the case both after one year (ES = -0.11, p = 0.70) and after two years (ES = +0.04, p = 0.86). These effect sizes are statistically insignificant, nor do they meet the minimum detectable effect size described above. As seen in the table, the adjusted means for treatment and control eyeglasses compliance at the end of each year of implementation differ by just one point.

Table 16.

Outcome	Pretest	Treatment Schools	Control Schools	Adjusted Mean Control	Adjusted Mean Treatment	Impact SE	Effect Size	p- Value
1 Year Imp	oact				-	_	-	-
Spring 2018	Fall 2017	29	29	0.20	0.21	0.00 (0.02)	0.04	0.86
2 Year Imp	act	-		-		_	-	

Impact Analysis of Effect of Treatment on Student Eyeglasses Compliance

Outcome	Pretest	Treatment Schools	Control Schools	Adjusted Mean Control	Adjusted Mean Treatment	Impact SE	Effect Size	p- Value
Spring 2019	Fall 2017	29	29	0.20	0.19	-0.01 (0.03)	-0.11	0.70

Note. The models also controlled for student grade level, prior achievement, and blocking variables used in random assignment (charter school status, school type, pilot study participation, school proportion of low-income and Black students, and whether the school served more than 25% Latino students), with no astigmatism as the reference group. Model also controlled for variables used to signify variables for which values have been imputed.

The results of the linear model analysis for all covariates is described in Table 17. This table describes the impact of treatment on eyeglasses compliance after two years of program implementation, after one year of program implementation, and over the course of the second year of implementation. While these results do not find significant impacts on eyeglasses compliance from the treatment, we do find that baseline compliance is a significant indicator of later eyeglasses compliance over the course of both years of program implementation, holding all else equal.

Table 17.

Impact of Treatment on Eyeglasses Compliance over Two Years

Category	Estimate	SE	t-value	p-value				
One Year Impact (Fall 2017-Spring 2018)								
Intercept	0.20	0.01	15.60	<0.001***				
Treatment	0.00	0.02	0.19	0.858				
Baseline Compliance (F2017)	0.71	0.28	2.52	0.036*				
School Enrollment	0.00	0.00	0.69	0.507				
Special Education %	-0.09	0.56	-0.15	0.883				
Bilingual %	0.01	0.29	0.05	0.960				
FRL Recipients %	-0.10	0.31	-0.33	0.749				
White %	-2.77	2.56	-1.08	0.311				
Black %	10.84	11.33	0.96	0.367				
Latinx %	11.09	11.52	0.96	0.364				
Asian %	10.30	11.78	0.87	0.408				

Category	Estimate	SE	t-value	p-value
Pacific Islander %	16.55	22.99	0.72	0.492
Minority %	-13.58	10.91	-1.24	0.248
Two Year Impact (Fall 20	17-Spring 2019)			
Intercept	0.20	0.02	12.05	<0.001***
Treatment	-0.01	0.03	-0.40	0.698
Baseline Compliance (F2017)	0.85	0.36	2.35	0.047*
School Enrollment	0.00	0.00	0.89	0.398
Special Education %	-0.31	0.72	-0.43	0.680
FRL Recipients %	-0.11	0.40	-0.28	0.789
White %	-2.16	3.28	-0.66	0.530
Black %	13.67	14.55	0.94	0.375
Latinx %	13.93	14.80	0.94	0.374
Asian %	14.38	15.13	0.95	0.370
Pacific Islander %	3.72	29.52	0.13	0.903
Minority %	-15.56	14.01	-1.11	0.299

Note. The models also controlled for student grade level, prior achievement, and blocking variables used in random assignment (charter school status, school type, pilot study participation, school proportion of low-income and Black students, and whether the school served more than 25% Latino students), with no astigmatism as the reference group. Model also controlled for variables used to signify variables for which values have been imputed. *Note.* *p < .05. **p < .01. ***p < .001

Finally, the analysis was conducted incorporating interaction analysis to determine if there were differential effects for schools with particular demographic characteristics, including school size. The results from this analysis are described in Table 18. These interaction terms were created by interacting receipt of treatment with certain school-level variables included in the previous analysis (race/ethnicity, school enrollment, percentage of students receiving special education services, and percentage of students receiving FRL).

Table 18.

Differential Regression Results Depicti	g Treatment Interaction	n Effects at One an	nd Two Years
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Category	Estimate	SE	t-value	Impact SE	p-value
One	Year Impact (Fal	l 2017-Spring 2	2018)		
Intercept	0.2	0.05	3.77	0.20 (0.05)	0.17
Treatment	-0.02	0.11	-0.22	-0.02 (0.11)	0.86
Baseline Compliance (F2017)	-0.28	1.71	-0.16	-0.28 (1.71)	0.90
School Enrollment	0.00	0.00	-0.18	0.00 (0.00)	0.89
Special Education %	-3.09	5.15	-0.60	-3.09 (5.15)	0.66
FRL Recipients %	-0.26	1.25	-0.21	-0.26 (1.25)	0.87
White %	22.07	23.04	0.96	22.07 (23.04)	0.51
Black %	17.03	91.8	0.19	17.03 (91.80)	0.88
Latinx %	15.83	94.77	0.17	15.83 (94.77)	0.89
Minority %	3.36	94.56	0.04	3.36 (94.56)	0.98
Treatment* Baseline Compliance	0.88	2.65	0.33	0.88 (2.65)	0.80
Treatment* Special Education	2.36	4.51	0.52	2.36 (4.51)	0.69
Treatment* FRL	2.43	2.57	0.94	2.43 (2.57)	0.52
Treatment*Enrollment	0.00	0.00	0.21	0.00 (0.00)	0.87
Treatment* White	21.40	22.80	0.94	21.40 (22.80)	0.52
Treatment* Black	2.06	8.41	0.24	2.06 (8.41)	0.85
Treatment*Latinx	1.58	7.47	0.21	1.58 (7.47)	0.87
Treatment*Minority	13.52	29.72	0.45	13.52 (29.72)	0.73
Two	Year Impact (Fal	ll 2017-Spring	2019)		
Intercept	0.17	0.02	9.36	0.17 (0.02)	0.07
Treatment	0.04	0.04	1.01	0.04 (0.04)	0.5

Category	Estimate	SE	t-value	Impact SE	p-value
Baseline Compliance (F2017)	-0.82	0.57	-1.43	-0.82 (0.57)	0.39
School Enrollment	0.00	0.00	-1.71	0.00 (0.00)	0.398
Special Education %	-4.48	1.73	-2.59	-4.48 (1.73)	0.23
FRL Recipients %	-0.82	0.42	-1.96	-0.82 (0.42)	0.30
White %	17.00	7.73	2.20	17.00 (7.73)	0.27
Black %	-29.6	30.79	-0.96	-29.60 (30.79)	0.51
Latinx %	-32.00	31.79	-1.01	-32.00 (31.79)	0.50
Minority %	42.93	31.71	1.35	42.93 (31.71)	0.41
Treatment* Baseline Compliance	1.67	0.89	1.88	1.67 (0.89)	0.31
Treatment* Special Education	4.29	1.51	2.84	4.29 (1.51)	0.22
Treatment* FRL	3.83	0.86	4.43	3.83 (0.86)	0.14
Treatment*Enrollment	0.00	0.00	1.94	0.00 (0.00)	0.61
Treatment* White	5.39	7.65	0.70	5.39 (7.65)	0.26
Treatment* Black	6.57	2.82	2.33	6.57 (2.82)	0.85
Treatment*Latinx	5.69	2.51	2.27	5.69 (2.51)	0.26
Treatment*Minority	-9.35	9.97	-0.94	-9.35 (9.97)	0.52

Note. The models also controlled for student grade level, prior achievement, and blocking variables used in random assignment (charter school status, school type, pilot study participation, school proportion of low-income and Black students, and whether the school served more than 25% Latino students), with no astigmatism as the reference group. Model also controlled for variables used to signify variables for which values have been imputed. *Note.* *p < .05. **p < .01. ***p < .001

No differential effects were found in this analysis, either at the end of the first year or second

year of implementation. These results are in line with the findings from the previous tables.

Research Question 2: Exploratory mediation analysis

In an exploratory analysis, we engaged in a thought experiment to examine whether

eyeglasses compliance rates, an indicator of the prevalence of a culture of eyeglasses use and

care in a school, might mediate the relationship between receipt of the Vision for Chicago treatment and later reading achievement.

Data for this analysis was drawn from the standardized assessment data reported by CPS. Data were limited to students in grades 6-8 from participating treatment and control schools. In the previous section, the baseline equivalence of these schools was demonstrated (see Table 14). In Table 19, the baseline equivalency of students according to their pre-test reading achievement data is demonstrated. As shown, these two groups of students do not differ at a statistically significant level (p = 0.47).

Table 19.

Baseline Equivalency of Student Reading Achievement Level

Category	Overall	Control	Treatment	p-value
Number of Students	2,589	1,278	1,311	
PARCC Spring 2017 (pretest)	724.18 (26.11)	724.55 (25.06)	723.81 (27.10)	0.47

Mediation at Year One

First, the relationship between variables after one year of implementation was considered. The mediation analysis was conducted through three steps. In the first step, the total effect of receipt of treatment on reading achievement at the end of 2017-2018 school year was calculated through linear regression (path c in Figure 1, above). Here we find no significant effect of treatment on reading achievement (b = 4.32, p = 0.26). This indicates that the relationship between these two variables is not statistically significant. This is in line with the findings found in the previous section of this chapter.

Next, the effect of treatment on eyeglasses compliance (path a in Figure 1) was estimated through linear regression in order to determine if any mediation exists. Here we find that the total effect of treatment on compliance is not significant (b = -0.01, p = 0.64). This does not allow us to confirm the presence of a mediation effect. While Baron & Kenny (1986) argued that finding significance at this stage should be considered a precondition for moving forward with mediation analysis, this paper follows the guidance of Shrout & Bolger (2002), who argued that mediation analysis can still proceed despite the lack of statistical significance if there is good theoretical or scientific evidence to support the existence of mediation occurring. As we have theoretical evidence supporting the presence of a relationship between these variables, as described in the earlier section of this chapter, it is determined that we can proceed with the analysis.

In the third step, the effect of eyeglasses compliance on reading achievement level (path b in Figure 1), while controlling for treatment, was estimated through linear regression. In this model, we see that the mediator, eyeglasses compliance, had a significant effect on reading achievement (b = 82.54, p<0.001). We see also that the magnitude of the effect of treatment on reading achievement (b = 5.54, p = 0.07.) is smaller than that of eyeglasses compliance on reading achievement, suggesting that partial mediation may be occurring. The effect of treatment on reading achievement also appears to be marginally significant.

Finally, the full model is assessed through causal mediation analysis, using clustered standard errors. The results indicate that the average causal mediation effects (ACME) was -1.25 (p = 0.62), indicating that the indirect effect of receipt of treatment on reading achievement through the mediator was not statistically significant.

We also find that the average direct effect (ADE) was 5.57 (p = 0.05.), indicating that the direct effect of treatment on reading achievement while controlling for eyeglasses compliance was marginally statistically significant. This is significant in the sense that it complements previous research connecting higher rates of eyeglasses use to reading achievement. The total

effect (the sum of the ACME and ADE) of treatment on reading achievement is described next, with a coefficient of 4.31 (p = 0.28). This is not statistically significant, indicating that the total effect of treatment on reading was not statistically significant. This figure matches the estimate of the total effect estimated in step one.

Finally, we see that the proportion of the effect of treatment on reading achievement was -0.09 (p = 0.86). This is likely due to the direct and indirect effects having oppositive directions, as seen in Figure 8.

Figure 9.





As the ACME was not statistically significant, we can at best argue that the effect of treatment on reading achievement was only partially mediated via compliance at the end of the first year. As Figure 2 illustrates, the regression coefficient between treatment and reading was not statistically significant while the regression coefficient between compliance and DV was marginally so. Because the 95% confidence interval of the ACME ranged from -1.90 to -0.55, we can confirm that the indirect effect was not statistically significant (p<.001).

A sensitivity analysis was conducted to assess the sequential ignorability assumption and consider the possibility of unobserved or omitted pre-treatment covariates (Imai et al., 2010), which suggests the existence of a wide confidence interval (see Figure 9). This does point to the potential existence of informative omitted variables from the model.

Figure 10.

Sensitivity Analysis for Model 1 Mediation Analysis



Mediation at Year Two

In the interest of understanding this relationship over the full length of the program, the relationship of these variables at the end of the second year of implementation was also estimated. First, the total effect of receipt of treatment on reading achievement at the end of 2017-2018 school year was calculated through linear regression. Here the effect of treatment on reading achievement (b = 0.41, p = 0.91) was not statistically significant.

Next, the effect of treatment on eyeglasses compliance (recorded through observations of eyeglasses use at the end of the 2017-18 school year) was estimated through linear regression in order to determine if any mediation exists. As in the first mediation analysis above, we find that

the total effect of treatment on compliance was not statistic-ally significant (b = -0.02, p = 0.42). This suggests that mediation may not be taking effect, but as before we have theoretical evidence for a relationship here, so may proceed with the analysis.

In the third step, the effect of the eyeglasses compliance on reading achievement level was estimated through linear regression. In this model, we see that the mediator, eyeglasses compliance, did have a significant effect on reading achievement (b = 73.04, p = < 0.001). We see also that the magnitude of the effect of treatment on reading achievement (b = 2.21, p = 0.53) is smaller than that of eyeglasses compliance on reading achievement, which may suggest that partial mediation may be occurring. This does suggest that there may be another effect of treatment on reading achievement that does not go through the mediator.

Finally, the full model is assessed through causal mediation analysis, using clustered standard errors. The results indicate that the average causal mediation effects (ACME, the total effect minus the direct effect) was -1.71 (p = 0.43), indicating that the entire indirect effect of receipt of treatment on reading achievement through the mediator was not statistically significant at the end of the second year. We also find that the average direct effect (ADE) (2.16, p = 0.54) was not statistically significant. It follows from our previous analysis that the direct effect of treatment on reading achievement while controlling for eyeglasses compliance was not statistically significant at the end of the second year.

The total effect of treatment on reading achievement (without the mediator) is described next (0.45, p = 0.92). This is also not statistically significant, indicating that the total effect of treatment on reading was not statistically significant. This also follows from the findings from the impact analysis in the first section of this chapter.

Finally, we see that the proportion of the effect of treatment on reading achievement that goes through the mediator was 0.19 (p = 0.80). This suggests that the portion of the effect of treatment going through the mediator was not statistically significant.

Figure 11.

Model 2. Mediation Model of Receipt of Treatment, Eyeglasses Compliance, and Reading Achievement After Two Years



As seen in Figure 10, the regression coefficient between treatment and reading achievement was not statistically significant, while the regression coefficient between compliance and reading achievement was significant. However, as in the case of Model 1, the indirect effect was not statistically significant. In both cases, as the path between the mediator and dependent variable is statistically significant, we can at best say that the relationship between the treatment and reading achievement is partially mediated by eyeglasses compliance . As in Model 1, this suggests that some other variables that were not measured or included in the model have an effect on reading not through the mediator.

Once more, a sensitivity analysis was conducted to assess the potential for omitted covariates (Figure 11). These results mirror those from Model 1, with the potential for omitted variables to be likely.

Figure 12.





Discussion

This study sought to investigate the impact of the Vision for Chicago program, an intervention designed to provide eyecare and eyeglasses to students while also fostering school and home culture of eyeglasses wear and care, on student eyeglasses use. The results from the impact analysis reflect similar results when examining the effect of the V4C program on students in grades K-8 (Storey et al., 2022), in which a positive effect was found for elementary grade students during the first year, but effects diminished over time, while no significant effects were found for older students at any time point. The results of the mediation analysis for middle grades students point to eyeglasses compliance having a significant effect on reading achievement, so ultimately, we do not find evidence that eyeglasses use significantly impacted the relationship between treatment and reading achievement. While this impact decreased by the end of year two, these findings stand in line with previous studies of the impact of receipt of eyeglasses on reading achievement (Neitzel et al., 2021) and builds on the findings from the first

section of this chapter, which had not found a significant impact of treatment on eyeglasses compliance.

These discrepancies in effect reflect the fact that children at different ages may be influenced differently by compliance interventions and make decisions to wear or not wear eyeglasses based on different criteria. In studies that have gathered data on child perceptions of eyeglasses and their rationale for complying or not complying with eyeglasses use, younger children have commonly claimed that broken or missing eyeglasses are among the main reasons for not wearing their prescribed glasses (von-Bischhoffshausen et al., 2014). In contrast, older students are much more likely to opt not to wear their eyeglasses based on social or peer pressure, including perceptions that eyeglasses are unflattering or uncool (von-Bischhoffshausen et al., 2014). The lack of significant results in this study may not mean that the program did not have some effect, but the results do suggest that interventions targeting different age groups may do well to target them in different ways. For instance, SBVPs focusing on encouraging eyeglasses use may ask teachers to track students who are wearing eyeglasses and remind those who are not to do so or seek out replacements for broken or lost spectacles (Kodjebacheva et al., 2014). However, this is much more practical in elementary schools, where students often forget their glasses, and are typically in the same room with the same teachers throughout the school day, making remembering who a teacher's eyeglasses wearers are much simpler. In middle and high schools, students move more from class to class, and it is a much larger ask to require teachers to remember who should be wearing eyeglasses but is not and that they need to remind them. Different means of reaching these students at higher grades is therefore needed.

The adjusted mean compliance rate at the end of year one and year two of the intervention differed by just one percentage point, at about 20% compliance in both treatment

and control schools. Meanwhile, in 2019, the CDC reported that nationwide, about 35.3% of boys and 48.2% of girls aged 12-17 wore glasses or contact lenses (Reuben, 2021). Others have estimated that about one in five (or 20%) youth require eyeglasses (Ethan et al., 2010). It is possible, therefore, that the V4C program also faced a ceiling effect, in which despite provision of eyeglasses to students, a difference in eyeglasses use was not able to be detected because both treatment and control group schools already featured the average number of students wearing eyeglasses.

Many SBVP or eyeglasses compliance studies have focused on elementary school aged children, or children from a range of ages including elementary and middle school grades. As a result, many measures of compliance reflect compliance rates for a different set of subjects to this study. Results from other SBVP research providing eyeglasses or encouraging eyeglasses compliance for secondary school students range drastically from study to study, from 38.8% after 12 months in India (Narayanan & Ramani, 2018) to 94.3% after just one month in Guangzhou, China (Zeng et al., 2009). SBVP studies typically do not last as long as the V4C program, meaning there are few true comparable measures to the compliance rate assessed at the end of the second school year of this intervention. Only a study of students between the ages of 5-18 years old in Oaxaca, Mexico that recorded eyeglasses compliance (13.4%) between 4-18 months (Holguin et al., 2006) is comparable in length, and in that study the compliance rate reflects compliance between four and eighteen months, instead of compliance at 18 months.

This study stands out not just for the duration but for how eyeglasses compliance was defined and measured. Most other research concerning the impact of eyeglasses provision and compliance programs have focused on smaller populations, with observations following up with students known to have received eyeglasses at various time points (often, as has been said,

within one year of the program start and eyeglasses provision). Various definitions of compliance have been used as well, with the most obvious being that a child has their eyeglasses on their face at the time of observation without prompting. However, some studies have also considered compliance as being "wearing or carrying," self-reports of wearing, or the purchase of glasses (Morjaria et al., 2019). Given the city-wide nature of the V4C intervention, following up with individual students was not feasible. Instead, classroom level observations took place in the mornings at the beginning and end of each school year. While this is different from other SBVPs, which have often also focused on elementary grades, this created a measure not just of compliance but in fact a measure of the efficacy of creating a school culture of eyeglasses use. As a result, this study builds on existing research about SBVPs through introducing an alternative means of measuring compliance at scale and providing the basis for examining the impact of a SBVP in creating or supporting a school culture of eyeglasses use.

Recommendations for Practice and Research

Programs such as CVEP and V4C are real-world interventions in complicated settings. The results of this study serve as a strong reminder of the fact that while ostensibly straightforward, interventions such as the Vision for Chicago project are complex initiatives that require sustained efforts to ensure continued success. Challenges related to available resources and supports, low rates of participation (Neitzel et al., 2021), and procedures may all inhibit the ability for programs to reach as many children as possible or ensure they receive the greatest benefits.

School-based care programs also require considerable inputs from school personnel (Neitzel et al., 2021), including school nurses and teachers, to ensure that students return consent forms, know where and when to access eye screenings and exams, and continue to wear

eyeglasses. As teachers see students every day, they can serve as an important bulwark against students losing or forgetting their eyeglasses, and can work to encourage eyeglasses use. However, this can be particularly challenging when there is staff and teacher turnover, and when schools are understaffed. While teachers can provide a role in reminding and encouraging (Inns, 2018; Vongsachang et al., 2021), school vision programs should be careful as teachers and school nurses are often overworked and have limited time and resources they can dedicate to school-based vision programs (Slavin et al., 2018).

Researchers have pointed in particular to the importance of outreach to parents or caregivers (Basch, 2011), who can serve as the frontline in encouraging their children to wear the eyeglasses they are prescribed, to ensure they follow up on referrals for eye examinations, and notice when their children have broken or misplaced their eyeglasses. The ability of parents to support vision programs is limited by their understanding of the impact poor vision has on learning, their trust in a vision program, and their beliefs about their children's vision (Vongsachang et al., 2020), requiring successful vision programs to rely on school resources to reach parents. Families need to have awareness of the program and how to access the program services to take advantage of its benefits, so it is important for future SBVP interventions to have a clear plan for reaching parents or caregivers and sustaining that outreach.

Procedures, such as requirements about how many screenings students must fail before being referred for eye examinations or how long eyeglass lens prescriptions last before students need to be reexamined, can serve as barriers to programmatic reach. This could lead to delays in getting needed eyecare or commitment to following through on the process. From a programmatic perspective, it can be difficult to ensure monitoring of eyeglasses use. Even when replacements (at no out-of-pocket expense to families) are included in the program, replacements

are not always easily obtained, as students may face delays in receiving their replacements due to expiration of prescription after one year, delays in scheduling follow-up examinations, and longer production and delivery time.

Success is often found in the first year of a program, with interest in the program high and stakeholders engaged in ensuring and pursuing the benefits of eyecare. But without renewed efforts to ensure continued impact, the impact can slow over time, as people turn their attention to other initiatives. In particular, ongoing and new efforts to raise awareness and commitment to eyeglasses use and care may be necessary for future programmatic success. Further efforts to remind parents and students about exam scheduling or to wear eyeglasses may have ensured greater compliance over time. Future school-based eyecare programs could implement monitoring initiatives as a means of addressing this as well. Creating a strong culture of eyeglasses wear and care in schools and at home is a complicated process, which may benefit from renewed thinking of what ongoing support and intervention can and should look like in the school setting. In addition, differentiated efforts to address compliance decision making of adolescents, given the different influences on older children to wear or not wear their eyeglasses, may be worth considering.

Future research exploring this issue may consider differing the means of observing student eyeglasses use. While this study relied on unannounced classroom and grade-level spot checks to count the number of students wearing eyeglasses at different time points, future research studies of the impact of eyeglasses provision programs on eyeglasses compliance might consider following up on specific students known to have received eyeglasses through the school-based vision program. In the case of this city-wide program, this was deemed too timeconsuming and cost-intensive, but smaller interventions may find this more feasible.

This study also sought to explore the relationship between receipt of treatment through the program and student reading achievement, and whether this relationship is mediated by students' eyeglasses compliance. Though these results were part of an exploratory analysis and the findings should not be considered to be causal, the findings point to a potential mediative role of compliance in the relationship between receipt of eyeglasses through ha school-based vision program and eyeglasses wear encouragement on later reading achievement. As in the case of the eyeglasses compliance analysis of this chapter, these findings also point to the need for future school-based vision programs to place an even greater emphasis on compliance and awareness of the benefits of eyeglasses, in order to see greater eyeglasses use and care. School-based vision programs are complex initiatives, requiring inputs and support from a wide variety of stakeholders, including parents, educators, vision professionals, and students themselves. Seeing lasting impacts from these programs will require additional infrastructural planning and efforts.

Future research efforts along these may seek to enable causal non-exploratory conclusions through several key alterations. First, the use of student-level eyeglasses observation and reading data will ensure that data in the analysis are more closely linked. The addition of student-level eyeglasses observation in particular could improve reliability. In addition, the inclusion of student-level covariates that may inform student compliance and their reading scores may provide important information in understanding the relationship between receipt of treatment, eyeglasses compliance, and reading achievement. These variables include student background and demographic data, and prior reading achievement, for instance. Student perceptions appear to play a strong role in student reception to wearing eyeglasses, so survey data of student reporting of eyeglasses acceptance and use may also contribute to the model. The

inclusion of these variables may expand the explanatory power of the mediation analysis and improve reliability.

In addition, school-level variables may also contribute to both student compliance and reading achievement, including student enrollment, demographic variables, and timing of eyeglasses provision. The development of this multilevel mediation model would improve the model and ensure that there are no omitted influences on the model.

Study Limitations

This study was conducted in a real-world school-based program implementation context. As such, there were limits to the control researchers had over implementation that differ from research laboratory conditions. Implementation of the study, particularly during the first year, was impacted by practical challenges related to finalization of a memorandum of understanding (MOU) with CPS and personnel changes. These implementation challenges are common in education settings, but may have limited the effectiveness of the intervention implementation.

While the researchers attempted to ensure that eyeglasses observations were as consistent as possible, including conducting reliability checks and ensuring that all observations took place in the same time period at each school, these observations were conducted at the class level before being summed up for each grade. In addition, school observations took place at the beginning and end of each school year, regardless of eyeglasses distribution schedules. As such, these measures provide a different level of reliability than would a study using student-level observations of those students known to have received eyeglasses through a SBVP. In the case of these observations, it is possible that eyeglasses would have been distributed to a school after the date of observation.

The observation method also introduces another limitation, creating a grade- or schoollevel variable of eyeglasses use throughout the school, without specific information on students who received eyeglasses through the V4C program. As such, the variable may be best used not as a measure of or means of assessing eyeglasses compliance but an indicator of the extent to which a school has fostered a culture of eyeglasses wear and care. This may be considered a component of a latent variable, requiring other characteristics of the school intervention to be gathered to better illustrate the eyeglasses culture. Future studies of SBVPs seeking to improve eyeglasses compliance should build in additional program evaluation tools designed to gather this information, such as student, teacher, nurse, and parental surveys, individual eyeglasses observations, or focus groups.

Mediation analysis is based on the assumptions of correct functional form, lack of omitted influences, accurate measurement, and well-behaved residuals (MacKinnon, 2008), requiring linear relations among variables that do not interact, a model that correctly reflects the underlying relationship researchers seek to model, reliable and valid measures, and residuals uncorrelated with the independent variable. While the assumptions of functional form and residuals can be confirmed by this analysis, a non-exploratory research study could ensure causal mediation through inclusion of variables omitted from this exploratory analysis at both the student and school levels. In both mediation analyses done here, the proportion of the effect of treatment on reading achievement going through the mediator was not statistically significant, and was a small figure. This points to the existence of other variables that might support the mediation analysis. In addition, researchers should give thought to the reliability of measures of eyeglasses compliance. While the researchers in this study implemented the most effective measure they could in a large-scale city-wide intervention, classroom-level surveys of students

wearing eyeglasses does differ in reliability to individual-level follow up observations of students known to have received eyeglasses through a school-based vision program.

Chapter 6: Conclusions

Review of Dissertation Studies

The studies in this dissertation were designed to examine several different dimensions of effective interventions to improve secondary student reading achievement. Students in the middle grades who are still struggling academically, particularly with foundational skills such as reading, require evidence-based supports to ensure they are able to succeed academically. These studies centered on two specific interventions, Tutoring with ThemeReads (ThemeReads) and Vision for Chicago (V4C). The ThemeReads program was designed to provide quality reading tutoring following the QAIT framework (Slavin, 1994) to improve the reading skills of adolescents in grades six through eight. The goal of the V4C program was to provide eyecare and eyeglasses to all students in need of eyecare while also seeking to develop a stronger culture of eyeglasses use and care in participating schools.

The first study, a pre-pilot examination of the ThemeReads program, focused on exploring the impact of tutoring on the reading achievement of students after participation in the program for one semester. The study gathered active consent from participating students and passive consent from comparable students within the same schools, allowing one-to-one within school propensity score matching. Results of the analysis were inconclusive, though a strong positive impact was found for those middle grades students in the tutoring program on reading achievement and pace of progress, compared to similar students. These results point to the challenges of implementing a pilot program over a short period during a time of regular COVIDrelated disruptions, and the promise of this approach to intervention.

The second study focused specifically on the students participating in the ThemeReads program, examining the relationship between participation in the program and student self-

perceptions of their efficacy as readers. Reading self-efficacy refers to the beliefs that individuals hold about their own reading ability, based on mastery experiences, vicarious experiences, social persuasion, and physiological arousal (Usher & Pajares, 2006). By assessing student perceptions of their reading self-efficacy at the end of their time in the ThemeReads program, this study found that students in the pilot of the intervention displayed similar or higher RSE perceptions than other adolescent striving readers post-intervention (Rhew et al., 2018; Urban, 2022), and even comparable RSE perceptions to average adolescent students (Henk et al., 2012). While based on a small non-comparison sample, these results indicate the Tutoring with ThemeReads program may support student self-efficacy development.

The third study explored another means of addressing student literacy, the Vision for Chicago program, which provided students with eyecare and eyeglasses, as well as implanted efforts to develop a culture of eyeglasses wear and care in CPS schools and amongst families. In the first part of this study, an analysis was conducted to examine whether receiving the treatment had an impact on students' use of eyeglasses—whether students who received eyeglasses in the program were more likely to wear their eyeglasses compared to students from schools not part of the program. Results from this analysis were inconclusive, with no significant impact on eyeglasses compliance seen for treatment students.

The second part of the study engaged in an exploratory thought experiment to explore whether eyeglasses compliance mediates the relationship between receipt of treatment (encouragement and monitoring of eyeglasses use) and later reading achievement. This analysis found that at best, compliance only partially mediates or influences the impact of treatment on reading achievement. However, the findings did indicate a significant direct effect of treatment on reading achievement at the end of the first year. These results complement previous findings
(Neitzel et al., 2021), which found positive impacts of school-based vision programs on reading achievement, but suggest additional processes may be needed to ensure higher eyeglasses uptake rates as the program continues.

Cross-Cutting Themes

These three studies explored different dimensions in efforts to address the reading development of adolescent students, particularly those who are still struggling as they enter secondary school, yet revealed several overarching themes.

Multidimensional Determinants of Learning

The first theme that emerged from across these three studies was that reading (and learning in general) may best be addressed by recognizing that learning is a multidimensional process. Those adolescents who struggle academically often do so for reasons that predate their middle school academic careers (Caggiano, 2007), including inadequate or inconsistent instruction in the early grades, minimal secondary school teacher preparation to teach reading, misunderstandings of their role in teaching reading, disparate school and classroom resources and opportunities, and systemic structural disparities in education (Leko et al., 2019; Moreau, 2014; Rubie-Davies et al., 2006). These systemic disparities in educational opportunities, the opportunity gap, are also often exacerbated by environmental and physical factors, including issues physical health, economic stability, self-motivation, social environment, physical environment, and psychosocial health (Sanderson et al., 2021). These factors are often based in the socioeconomic and racial/ethnic backgrounds of students, and have nothing to do with their ability or interest in learning.

Because learning is influenced by so many non-academic factors, efforts to address student learning must do so from a wide variety of angles in order to move the needle even a tiny

bit. It is not sufficient to change the course materials or pedagogy alone, though some studies have pointed to pedagogical and classroom reforms as contributing somewhat to learning gains (Baye et al., 2019; Cheung & Slavin, 2012; Dietrichson et al., 2017; Herrera et al., 2016; Neitzel et al., 2021). These efforts are likely to be most effective in improving learning when complemented by other initiatives addressing other determinants of learning, such as student psychosocial (or socioemotional) health and learning, or their physical health. The best learning materials can only support learning for those who have the ability to access them. Without accurately prescribed eyeglasses, for instance, how would a child with poor vision read class materials? Without socioemotional supports to improve their motivation and self-efficacy, students who are struggling may not develop the perseverance to overcome their struggles with reading or testing. In the RSPS-2 survey, these struggling students, who have been labeled as struggling for years, have demonstrated that they enjoy reading and view themselves positively. With additional reading tutoring in which their progress is noticed and acknowledged, these students may be able to demonstrate even greater reading gains and put those gains into practice in the classroom.

Evaluation

The two programs evaluated here are, on paper, relatively straightforward programs. A reading tutoring program has a clear directive—provide students additional reading instruction. The Vision for Chicago sought to enhance eyewear use by those who were diagnosed with poor vision that could be corrected with spectacles by boosting school and community support for vision exams and compliance with use of prescription eyeglasses. However, implementing these programs effectively is a complex and challenging endeavor, requiring evaluation to allow implementers to learn from and improve implementation.

Program evaluations, such as those used here to assess the impacts of ThemeReads and V4C, have the potential to allow for continuous improvement of program implementation and ensure greater effects of these efforts to support student learning. These evaluations provide useful information about effective duration and dosage of program activities, whether participants or recipients are receiving the message or services of a program and making behavior change, or whether changes need to be put into place to improve the intervention. Future evaluations of the ThemeReads program may consider a larger sample drawing from multiple participating and non-participating schools, and explore the impact of the tutoring program over the course of a full school year. Future evaluations of the Vision for Chicago program may consider tracking individual students known to receive eyeglasses over the course of the program to examine compliance with wearing eyeglasses, potentially with surveys to explore student reasoning behind their compliance or lack thereof.

Evidence-Based Interventions

A final important theme that has emerged from these studies has been the importance of evidence-based interventions designed for real world settings. Both programs' implementation were subject to disruptions due to school scheduling. Vision and tutoring services, as well as the processes of disseminating and collecting consent forms and raising awareness of program activities, were subject to other school schedule pressures, and are often put on hold due to state and federal testing, holidays, field trips, and absences, for instance. In addition, the COVID-19 pandemic caused school disruptions which interrupted ThemeReads tutoring sessions, and prevented vision exams from continuing in Chicago.

Evidence-based programs provide the most likely means of addressing student losses during the pandemic, as well as those opportunity gaps that predated the pandemic and continue

to affect student lives. Gathering more information about the impact of these programs contributes to the evidentiary base for implementing these programs and supports future efforts to design and implement learning support programming.

Implications for Research and Practice

The evaluation of programs designed and implemented in real world contexts are important and provide guidance for these programs to continuously improve and have a greater impact on their target populations. The findings of these studies point to a number of practical and research-focused next steps. As noted, these findings suggest that the length of an intervention matters. In regard to the Tutoring with ThemeReads program, promising gains in reading performance and positive reading self-efficacy perceptions seen for students tutored suggest that an extension of tutoring services to a fully year could result in significant outcomes. A year-long implementation of the ThemeReads program would allow a higher dosage of tutoring sessions, more time for students to receive feedback and encouragement from tutors and peers related to their progress, and greater impacts on reading. A longer intervention would also provide more opportunities for students to see themselves grow as readers compared to their peers, receive positive feedback on their progress from teachers and tutors, and put their improved reading skills into practice in different reading settings, which could have important impacts on their classwork as well as their perseverance on academic assessments. In addition, drawing from a larger, cross-school sample population with between school comparison groups would also be recommended in order to ensure greater power and comparability between similar students.

While the V4C program was a large city-wide research study, the ThemeReads program was much smaller. A larger, more diverse population of students across schools, in comparison

to similar students not participating in a study would have allowed for a stronger assessment of the ThemeReads tutoring program and provided more detailed findings as to the impact of the program as well as any differential effects based on student subgroups. A larger analytic sample with a comparison group also in the future will allow a more detailed assessment of the impact of the study on student reading self-efficacy perceptions and their growth over time in the program. The ThemeReads program is based around brief, content-rich passages centering on the thematic areas of community, social studies, and science, intended to be of particular interest to students at the appropriate reading level. As a result, they offer an interesting opportunity to convey important and relevant information to students. For instance, these passages could be used to disseminate information about health topics or social studies concepts that students might apply in non-academic life. Researchers may consider studies exploring student responses to the content and themes found in existing ThemeReads materials and any new content developed for the program.

School-based vision programs are complex programs requiring engagement with a wide variety of stakeholders to ensure success. Given the diminishing effects found by this and other studies of school-based vision programs, researchers focused on the V4C program may consider efforts to sustain programmatic gains from the first year in reading and compliance (as seen in previous research: Neitzel et al., 2021; Storey et al., 2022) into the second year and beyond, when engagement might start to flag. These efforts could capitalize on the effect found in this study on the direct relationship between compliance and reading achievement. To ensure a strong and lasting culture of eyeglasses use in schools, more efforts may be necessary in terms of outreach to and engagement with parents, educators, and other stakeholders, particularly the students themselves.

Seeing that the magnitude of the effect of the program on compliance decreased over time, future school-based vision programs targeting older students should consider interventions that may address concerns and reasons that are unique to secondary school aged children that lead to them not using their eyeglasses or reporting when they are broken or lost. These may include interventions focusing on parental outreach, attempts to address social stigma of eyeglasses use, or offering more freedom in glasses frame selection, for instance, as have been highlighted by previous studies of perceptions of students, parents, and school staff on eyeglasses compliance barriers. These interventions should also be organized so that they continue or even increase during the second year of implementation and beyond, ensuring lasting engagement with the program and impact.

A potentially informative research study could use behavior change communication theory to examine the effectiveness of efforts to develop a culture of eyeglasses use and care in schools. Surveys or qualitative data collection processes such as focus groups could help researchers to learn more about what communication is most effective in reaching students of different age groups, what messages can change the minds of parents who may not believe that their children need or should wear eyeglasses, or what communications would best involve teachers and school health leaders in the effort to improve eyeglasses use.

Future large-scale interventions examining eyeglasses compliance may consider alternative means of observing student eyeglasses use. Smaller studies are more easily able to follow up with specific students known to have received program eyeglasses, but this was not feasible in the city-wide V4C program. Following up with a randomly selected sub-sample of eyeglasses recipients might be one approach. Another option could be timing visits around when eyeglasses were distributed to schools. There may have been schools where observations took

place prior to students in the program receiving eyeglasses, which would limit the observable impact.

Conclusion

Reading and learning are multidimensional and complex processes that require supports addressing various needs of students. Tutoring has been established as one of the most effective means of supporting struggling students and closing academic gaps, while equity-based interventions designed to provide eyeglasses to students who may otherwise be unable to access eyecare may further the ability of students to access learning opportunities.

However, while real world programs, such as ThemeReads and V4C may seem simple on the face—tutor students in reading and give students with poor vision eyeglasses—but implementing and assessing these programs is significantly more complex. The results of these studies highlight how these interventions require coordination with multiple stakeholders, navigation of complex school schedules, and resource management, among other considerations. Better understanding these interventions' ability to support learning ensures that implementation can be stronger and more effective over time, allowing interventions to better address student learning, build awareness and compliance with program intervention goals, and ensure longerlasting success for all students.

Appendix

Reader Self-Perception Scale 2



Default Question Block

By completing this survey or questionnaire, you are consenting to be in this research study. Your participation is voluntary and you can stop at any time.

Listed below are statements about reading. Please read each statement carefully. Then select the response that shows how much you agree or disagree with the statement.

Example: I think pizza with pepperoni is the best kind.

If you are really positive that pepperoni pizza is the best, select Strongly Agree. If you think that it's good, but maybe not best, select Agree. If you can't decide whether or not it's best, select

Undecided.

If you think that pepperoni pizza is not all that good, select Disagree.

If you are really positive that pepperoni pizza is not very good, select Strongly Disagree.

Reading is a pleasant activity for me.

- O Strongly Agree
- O Agree
- O Undecided
- O Disagree
- O Strongly Disagree

I read better now than I could before.

- O Strongly Agree
- O Agree
- O Disagree
- O Strongly Disagree

I can handle more challenging reading than I could before.

- O Strongly Agree
- O Agree
- O Disagree
- O Strongly Disagree

Other students think I'm a good reader.

- O Strongly Agree
- O Agree
- O Undecided
- Disagree
- O Strongly Disagree

I need less help than other students when I read.

- O Strongly Agree
- O Agree
- O Undecided
- O Disagree
- O Strongly Disagree

I feel comfortable when I read.

- O Strongly Agree
- Agree
- Disagree
- Strongly Disagree

When I read, I don't have to try as hard to understand as I used to do.

- O Strongly Agree
- Agree
- O Disagree
- O Strongly Disagree

My classmates like to listen to the way I read.

- O Strongly Agree
- O Agree
- O Disagree
- O Strongly Disagree

I am getting better at reading.

- O Strongly Agree
- O Agree
- O Undecided
- 🔿 Disagree
- O Strongly Disagree

When I read, I can figure out words better than other students.

- O Strongly Agree
- O Agree
- O Undecided
- O Disagree
- O Strongly Disagree

My teachers think I am a good reader.

- O Strongly Agree
- O Agree
- O Disagree
- O Strongly Disagree

I read better than other students in my classes.

- O Strongly Agree
- O Agree
- O Undecided
- O Disagree
- O Strongly Disagree

My reading comprehension level is higher than other students.

- O Strongly Agree
- O Agree
- O Disagree
- O Strongly Disagree

I feel calm when I read.

- O Strongly Agree
- O Agree
- O Disagree
- O Strongly Disagree

I read faster than other students.

- O Strongly Agree
- O Agree
- O Disagree
- O Strongly Disagree

My teachers think that I try my best when I read.

- O Strongly Agree
- O Agree
- O Disagree
- O Strongly Disagree

Reading tends to make me feel calm.

- O Strongly Agree
- O Agree
- O Disagree
- O Strongly Disagree

I understand what I read better than I could before.

- O Strongly Agree
- O Agree
- O Undecided
- O Disagree
- O Strongly Disagree

I can understand difficult materials better than before.

- O Strongly Agree
- O Agree
- O Disagree
- O Strongly Disagree

When I read, I can handle difficult ideas better than my classmates.

- O Strongly Agree
- O Agree
- O Undecided
- O Disagree

O Strongly Disagree

When I read, I recognize more words than before.

- O Strongly Agree
- O Agree
- O Disagree
- O Strongly Disagree

I enjoy how I feel when I read.

- O Strongly Agree
- O Agree
- O Undecided
- O Disagree
- O Strongly Disagree

I feel proud inside whn I think about how well I read.

- O Strongly Agree
- O Agree
- O Undecided
- O Disagree
- O Strongly Disagree

I have improved on assignments and tests that involve reading.

- O Strongly Agree
- O Agree
- O Disagree
- O Strongly Disagree

I think that I'm a good reader.

- O Strongly Agree
- O Agree
- O Disagree
- O Strongly Disagree

I feel good inside when I read.

- O Strongly Agree
- O Agree
- O Undecided

O Disagree

O Strongly Disagree

When I read, my understanding of important vocabulary words is better than other students.

- O Strongly Agree
- O Agree
- Disagree
- O Strongly Disagree

People in my family like to listen to me read.

- O Strongly Agree
- O Agree
- O Disagree
- O Strongly Disagree

My classmates think that I read pretty well.

- O Strongly Agree
- O Agree
- O Undecided
- Disagree
- O Strongly Disagree

Reading makes me feel good.

- O Strongly Agree
- O Agree
- O Undecided
- O Disagree
- O Strongly Disagree

I can figure out hard words better than I could before.

- O Strongly Agree
- O Agree
- O Undecided
- O Disagree
- O Strongly Disagree

I think reading can be relaxing.

- O Strongly Agree
- O Agree

O Disagree

O Strongly Disagree

I can concentrate more when I read than I could before.

- O Strongly Agree
- O Agree
- O Undecided
- O Disagree
- O Strongly Disagree

Reading makes me feel happy inside.

- O Strongly Agree
- Agree
- O Undecided
- O Disagree
- O Strongly Disagree

When I read, I need less help than I used to.

- O Strongly Agree
- O Agree
- O Disagree
- O Strongly Disagree

I can tell that my teachers like to listen to me read.

- O Strongly Agree
- Agree
- O Disagree
- O Strongly Disagree

I seem to know the meanings of more words than other students when I read.

- O Strongly Agree
- O Agree
- O Disagree
- O Strongly Disagree

I read faster than I could before.

O Strongly Agree

- O Agree
- O Disagree
- O Strongly Disagree

Reading is easier for me than it used to be.

- O Strongly Agree
- O Agree
- O Undecided
- O Disagree
- O Strongly Disagree

My teachers think that I do a good job of interpreting what I read.

- O Strongly Agree
- O Agree
- O Undecided
- Disagree
- O Strongly Disagree

My understanding of difficult reading materials has improved.

- O Strongly Agree
- O Agree
- Disagree
- O Strongly Disagree

I feel good about my ability to read.

- O Strongly Agree
- O Agree
- O Undecided
- O Disagree
- O Strongly Disagree

I am more confident in my reading than other students.

- O Strongly Agree
- O Agree
- O Undecided
- O Disagree
- O Strongly Disagree

Deep down, I like to read.

- O Strongly Agree
- O Agree
- O Disagree
- O Strongly Disagree

I can analyze what I read better than before.

- O Strongly Agree
- O Agree
- O Disagree
- O Strongly Disagree

My teachers think that my reading is fine.

- O Strongly Agree
- O Agree
- Disagree
- O Strongly Disagree

Vocabulary words are easier for me to understand when I read now.

- O Strongly Agree
- O Agree
- O Disagree
- O Strongly Disagree

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