BOSTON CONSULTING GROUP

UCSF Dyslexia Center

Whitepaper

The Economic Impact of Dyslexia on California

The Economic Impact of Dyslexia is published by Boston Consulting Group in collaboration with the UCSF Dyslexia Center

July 2020

Dyslexia is the trillion-dollar problem we don't know we have.

Dyslexia and its consequences are estimated to cost California approximately $12 billion in 2020 and $1 trillion over the next 60 years.

Dyslexia is a learning disability that results in the learner struggling to read or write.[1] While millions of people in California struggle with dyslexia—experts estimate up to 15% to 20% of the population[2] —few actually know dyslexia is at the root of their learning issues.[3] Among those that have been diagnosed, few receive adequate treatment.[4]

This is preventable. Investing in early screening and teacher training would provide an astonishing 800% to 2000% return. This reflects an upfront investment of less than 10% of this year's $12 billion cost to kick-start the initiative. This investment is projected to break even in seven years and unlocks 5% of California's yearly budget. A return of this scale dwarfs those of other state projects—for example, California's High-Speed Rail is projected to yield a 250% return.[5] This is because the cost of addressing dyslexia early in a student's development is minimal in comparison to the costs associated with the downstream impact of dyslexia if ignored. By addressing the learning gap before it widens, we can reallocate what is currently spent on serving the disproportionately high numbers of dyslexic individuals within the welfare and criminal justice systems to education budgets statewide. At a school level, benefits of early intervention will have near-term cost savings through a reduction in more cost-intensive needs for students, including special education and absenteeism.

Addressing the needs of children with dyslexia will positively impact a range of issues that concern Californians deeply. It will reduce homelessness, improve the economy, raise test scores in the lowest performing majority-minority schools, lower incarceration rates, and increase access to higher education. With literacy as a social determinant of physical and mental health, addressing the needs of children with dyslexia will improve the overall well-being of California residents. According to the American Medicine Association paper entitled Education and Education Policy as Social Determinants of Health, "one of the best ways for us to improve the health of the whole population is to focus on evidence-based policies that optimize both early childhood development and education. In one critical sense, they are the

same thing; adequate social and cognitive development in childhood is a necessary foundation for success in education, which in turn is necessary for health and success in life."[6]

If properly remediated, dyslexia goes from being a problem to an asset, as research has shown that dyslexic learners have differentiated strengths in other areas of learning, such as emotion processing and spatial awareness.[7] They bring a massively underutilized potential to boost intellectual diversity and talent in our classrooms and our workforce. As evidence, a study showed 35% of entrepreneurs are dyslexic.[8] Dyslexic individuals can be found among our nation's leaders, innovators, and entertainers—Gavin Newson, Charles Schwab, Whoopi Goldberg, and Steven Spielberg are some examples.

In this paper, we highlight the problem and why it matters, describe the current state of dyslexia in neuroscience and education, and present a set of policy and public investment recommendations. Dyslexia's implications can be felt far outside the classroom, so solutions must embrace stakeholders within the classroom and beyond. Together, through collaborations between public and private sectors, Californians can unlock an enormous financial and intellectual resource.

In the month since we started this research, the COVID-19 crisis has enveloped the world and our state. At the moment, it is still too early to tell what impact this will have on legislative priorities and budget availability, but it is a reasonable assumption that a significant portion of the investment funds needed for dyslexia education may now be unavailable. This does not change the fundamental opportunity laid out in this report. It does, however, increase the challenge to finding lower-cost, more scalable, possibly technology-based solutions; experimenting with smaller-scale pilots; and working within the current budget constraints to still get started. The prize is simply too big to put off any longer.

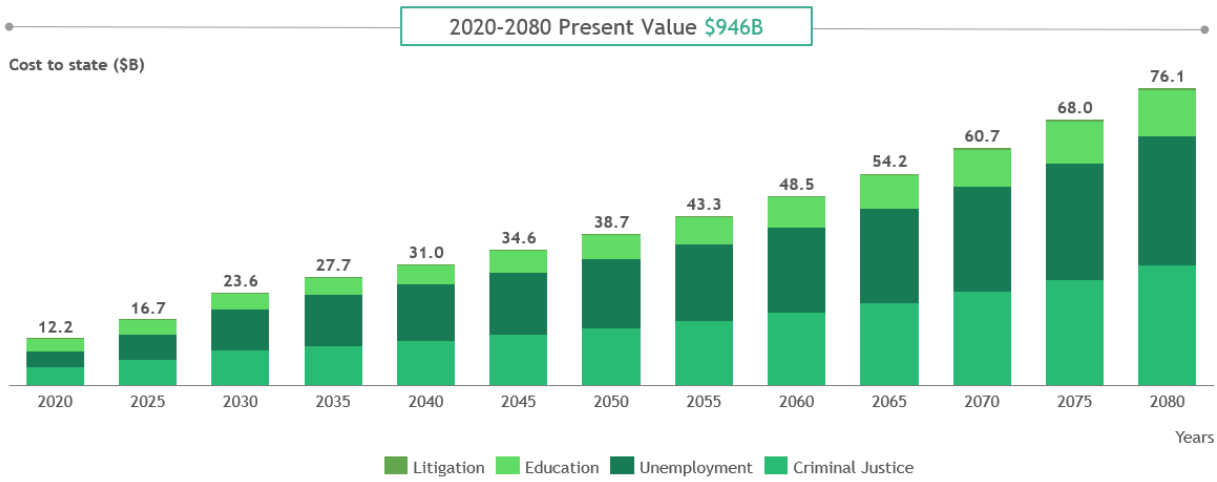
Section 1: THE CASE FOR CHANGE "Why should we care?"

1.1 Financial Cost of Dyslexia

Neglecting dyslexic learners has a huge financial cost to society. Dyslexia will cost the state of California $12 billion this year. Projecting out the next 60 years (representing the working

lifetime of students now entering school) the cost will be $1 trillion. (See Figure 1). These costs accumulate over time, starting in kindergarten and continuing throughout an individual's lifetime. Within the model, we have included costs pertaining to education, litigation, unemployment, and criminal justice.

Figure 1. Financial Cost of Dyslexia to the State of California



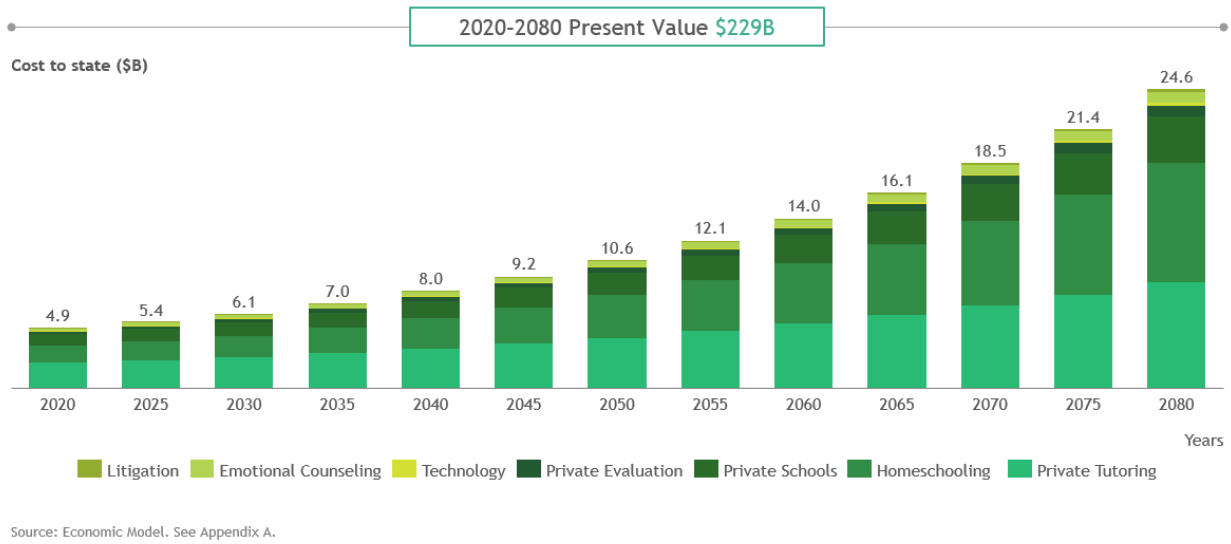
Source: Economic Model. See Appendix A.

In addition to the cost to the state's budget, California will miss out on nearly $340 billion in GDP due to unemployment caused by dyslexia over the next 60 years. In relation to today's GDP, this is a 0.3% boost in GDP if the needs of dyslexic learners were properly addressed.

Lastly, the failure to address the needs of dyslexic learners in California is illustrated by the many family costs incurred by families with dyslexic children. Families spend $5 billion every year on private school, private tutoring, homeschooling, private evaluations, technology, counseling, and litigation. (See Figure 2). This means, on average, families are spending $15,000 per year on additional support for a child with dyslexia, with many families spending more than $20,000 per year. The total cost to families is about 50% of the costs incurred by the state of California for dyslexia in 2020, highlighting the significance of dyslexia to parents and the lengths they are willing to go to in order to ensure their child's learning and well-being. This, in turn, contributes to dyslexia as a social equity issue. Children in more affluent families are able to get the right support to identify and remediate their dyslexia, allowing

them to succeed in school and careers, while children of low-income families are left to struggle, their dyslexia becoming a severe obstacle.

Figure 2. Financial Cost of Dyslexia to Families



Source: Economic Model. See Appendix A.

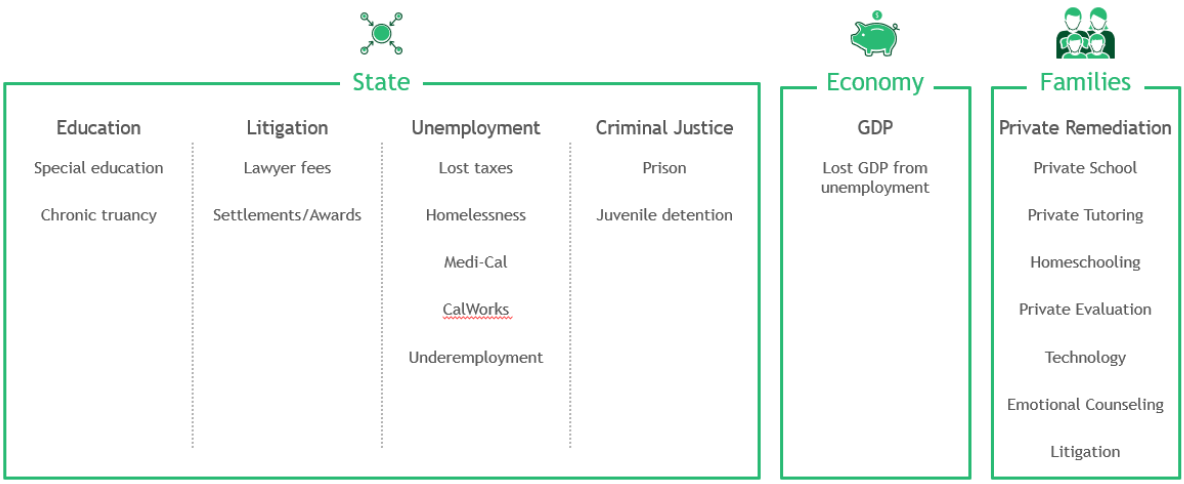
Methodology

Through interviews with 26 stakeholders, ranging from educators to neuroscientists to individuals with dyslexia, we identified 19 costs within three major categories—the state, the economy, and families of California. (See Figure 3). Identifying the major drivers of costs across these perspectives, three key data points were broadly used to estimate each cost: 1) population for each cost driver, 2) cost per person, and 3) percentage of prevalence of dyslexia in each population in comparison to the general population.[9]

Given recent research that dyslexia is a neurobiological condition rather than an environmental one, it follows that its prevalence should be similar across populations regardless of factors such as race, income, or gender. As a result, assuming that 15% of the general population is dyslexic, costs associated with prevalence of dyslexia above that threshold are attributed to dyslexia. Similar studies have used this approach. KPMG and the Every Child a Chance Trust looked at this in the United Kingdom in 2009. They analyzed the overrepresentation of dyslexic individuals across similar cost buckets of education,

unemployment, and criminal justice involvement. With a proposed set of interventions, they came to a similar conclusion of a 20 times return over the course of a lifetime.[10]

Figure 3. Costs of Dyslexia Included in the Model



Source: Economic Model. See Appendix A.

For example, to estimate the cost of dyslexia in prisons in 2020, we utilize data on the prison population along with the cost per prisoner to calculate the total cost of prisons to California, approximately $12 billion. Research suggests that nearly 50% of the prison population has dyslexia.[11] Employing that statistic, the potential total cost attributable to the needs of dyslexic learners is approximately $5.5 billion. Subsequently, accounting for the scenario that 15% of the prison population would still have dyslexia and its related costs—about $1 billion—we calculate prison cost attributable to the needs of dyslexic learners as approximately $4.5 billion. For studies that do not quote dyslexia explicitly, we use illiteracy as a proxy, assuming one-third of illiteracy cases are driven by dyslexia, based on the knowledge of dyslexia prevalence and poor literacy rates within the school system. This is a conservative estimate, given some research has shown that 70% to 85% of illiteracy in adults could be driven by dyslexia.[12]

While employed in a number of economic benefit studies,[13] the differential incidence method used for the prevalence of dyslexia does have its limitations as it does not account for the interaction of dyslexia with other learning difficulties such as autism and assumes that they are additive. As a result, we account for this by conservatively estimating the

percentage of costs that can be remediated through our proposed intervention for dyslexia, described later on in the paper.

1.2 Other Costs of Dyslexia

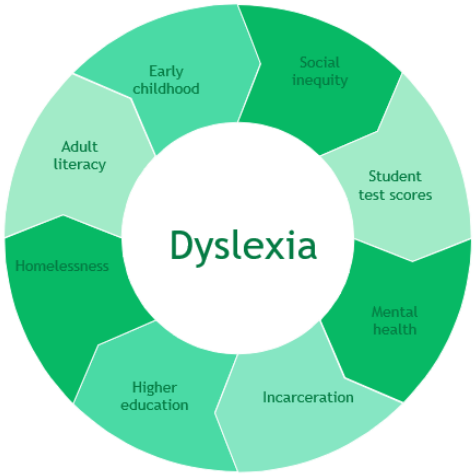
In addition to the financial costs, there are non-financial costs to improperly diagnosing dyslexia. For many students with dyslexia, school can be agonizing.[14] Many teachers are not prepared to diagnose dyslexia[15], and as a result, many children never receive the services they need. The consequence is that a struggling reader is left to struggle for years. Students with dyslexia are often perceived as incompetent or lazy because of their struggles[16], and many people perceive dyslexia as a negative trait.[17] These perceptions can cause emotional and social impact on a child, such as low motivation[18], low self-esteem,[19] anxiety,[20] and depression.[21] After several agonizing years in school, many dyslexic students never graduate high school.[22] In addition to the student's personal strain, families face other difficulties. While struggling with their child's feelings of failure and deteriorating relationship with school, many families also grapple with their own feelings of failure for not being able to support their child's learning.[23]

As an adult, the non-financial costs continue. Literacy is a social determinant of health—a social condition that impacts health risks and outcomes.[24] People with low literacy skills are up to three times more likely to experience poor health outcomes, ranging from having less health knowledge, lower general health, a higher likelihood of disease, and shorter life spans,[25] to experiencing dementia later in life.[26] With literacy being linked to poverty, low literacy also impacts happiness—people in poverty tend to experience more depression than their wealthier peers.[27] Researchers have also found a link between literacy and safety for females—lower levels of literacy were associated with favoring violence towards women, and women who were married to an illiterate spouse were more likely to experience violence.[28] Overlooking dyslexia costs society greatly, both financially and at a more personal level.

1.3 Dyslexia in Relation to Key Issues

Dyslexia is related to other topics that matter deeply to Californians, beyond just K–12 education and child literacy. (See Figure 4). While often viewed in a silo, these matters are interconnected and will be positively impacted by an effective dyslexia intervention.

Figure 4. Dyslexia is Interconnected with Other Key Issues



- Early childhood development

  Early childhood education is critical to a person's development.[29] Without diagnosing dyslexia early, many children will start school behind before they even start, severely impacting their future potential.[30] California knows that early childhood education is important—Governor Gavin Newsom committed $2.5 billion for early childhood education in 2019-20.[31] An investment in early childhood education without supporting dyslexia screening and intervention will fail to achieve its outcome goals.

- Social/racial inequity in access to resources

  Students from low-income communities, who are disproportionately students of color, face additional barriers. Specifically, they are less likely to go to well-resourced schools.[32] A recent report from the California Department of Education showed that poorer schools tended to have a higher proportion of "inexperienced or unqualified

teachers" (unqualified defined as teachers who have not yet met subject matter competence or were hired on short-term staff permits).[33] This impacts all students, but particularly dyslexic students, who need experienced and trained teachers to identify, diagnose, and support them.[34] In addition, low-income families are not able to pay for an assessment or provide the private education and supplemental support for their dyslexic children that wealthier families are able to provide. Dyslexia fundamentally becomes a social and racial equity issue as access to the proper assessment, instruction, and support is only available to those that can afford it. By addressing dyslexia, California can address social inequity broadly.

- Student test scores

  Students are failing at appalling rates in California[35] —approximately half of all students scored below proficient on the California Assessment of Student Performance and Progress (CAASPP) in the last five years.[36] With approximately 20% of students potentially dyslexic,[37] dyslexia-based interventions can have a significant impact on student test scores. In addition, many of these interventions help non-dyslexic students build strong reading skills.[38] Addressing dyslexia in California broadly addresses the dismal standardized testing performance in the state, while also providing support to students who desperately need it.

- Student mental health

  Dyslexia co-occurs with many behavioral and mental health concerns—ADHD,[39] anxiety, depression[40] —that must also be addressed. Approximately 75% of California's K–12 principals cited students' social, emotional, and mental health as a primary need in their schools.[41] The California State Legislature set aside $50 million to expand and improve services to address student social, emotional, and mental health in 2019 through the Mental Health Student Services Act, which moves mental health services from the mental health clinics to the schools.[42] By addressing dyslexia, and the concurrent behavioral and mental health issues that often accompany it for dyslexic learners, California can build on its critical effort to address and improve mental health within schools for all of California's children.

- Incarceration

  Incarceration is a huge problem in California—prisons are at capacity[43], minorities are disproportionately imprisoned within them, and there is a troubling correlation between illiteracy and incarceration.[44] Governor Newsom has pledged to change the prison system, from closing private prisons to building campus-like prisons for young offenders.[45] Furthermore, President Trump signed the First Step Act in fall 2019, which aims to reduce recidivism, increase productivity within prisons, and enhance access to medical treatment.[46] The bill also promises to screen prisoners for dyslexia,[47] since the prison population is disproportionately dyslexic.[48] Prison reform is gaining steam federally and locally. By addressing the needs of dyslexic learners, California can continue to contribute to prison reform by reducing the number of people who become incarcerated and providing education to those in prisons.

- Diversity in higher education

  Sixty percent of the adult population in California has a high school degree or less.[49] Yet universities struggle to recruit and retain students, with experts estimating that 25%[50] to 50%[51] of colleges will go bankrupt in the next decade. Students with dyslexia are a largely untapped pool of future college students—students who could thrive if they were given the proper support prior to and through college.

- Homelessness

  Homelessness is a huge challenge for California; approximately 130,000 people were homeless in 2018.[52] Californians view homelessness as one of the top concerns for state residents (along with housing affordability).[53] By ensuring that students with dyslexia receive the literacy education they need to be successful, millions more will be eligible for better-paying jobs and will no longer be relegated to unemployment and homelessness.

- Adult literacy

  Ranging from cleaning services to food production, many jobs in the past that did not require much interaction with technology require literacy today as employees are expected to use and apply information from mobile apps and other technology.[54] However, 52% of adults are not proficient in reading,[55] and California ranks among

the lowest in the United States.[56] By ensuring that children receive a strong foundation in literacy, fewer adults will be hindered by their limited reading proficiency.

- Competition for talent

  Organizations have always sought to attract and retain strong talent. Today, more than ever, companies are focused on how to do so, given skilled workers are in short supply. In fact, California's current economy depends greatly on highly educated immigrants, and researchers continually emphasize the need to support California's youth to become productive participants of our workforce.[57] Companies, the Boston Consulting Group included, are constantly looking for ways to recruit a diverse workforce that can drive the most innovative thinking. Investing in and supporting dyslexic learners unlocks a large population of talent in California that is currently being overlooked and underdeveloped. Companies can access and acquire this new talent by providing early support to dyslexic students and creating an environment where they can succeed in the workforce. People like Cisco's John Chambers and HP's Bill Hewlett all struggled with dyslexia and leveraged their talents to lead innovative companies.[58] In fact, many large companies, including HP, Microsoft, and SAP, have reformed their HR processes to better access neurodiverse talent.[59]

1.4 Personal Stories of Learning with Dyslexia

The importance of early diagnosis and support

Gary and Lacey have three children in a wealthy Northern California public school district. Two of their children—Charlotte and Paul—have dyslexia. (Pseudonyms used). Charlotte, a fifth grader, was diagnosed in her prior school district in Southern California. She received literacy interventions focused on language structure and was able to make progress while there. However, when the family moved to the Bay Area, they faced a new reality. Charlotte's parents fought for years to get her dyslexia recognized in the school district which is often perceived as well-resourced and academically strong. According to Lacey, the school district would not even say the word "dyslexia." Eventually, in fifth grade, Gary and Lacey refused to take no for an answer. They obtained a Section 504 plan to get Charlotte access to the support she needs, such as audiobooks in the classroom.

By contrast, their youngest child Paul, a first grader, was recognized as potentially dyslexic by his first-grade teacher. They were grateful for the diagnosis. Since his literacy struggles were recognized early, Paul does not need a special education plan. Instead, he receives additional reading support from a school specialist. At a young age, Paul is able to put a label on his difficulties—dyslexia—and is working to improve before he falls behind.

Lacey and Gary believe that their son obtaining this early diagnosis will have a profoundly positive impact on his self-esteem. While their daughter has shed many tears over her struggles in the classroom and her teachers' inability to recognize her learning disability, Paul is able to name his struggle and work actively to overcome it. They wish that their daughter had been given the same opportunity. They hope that school districts will give other families the support they need, first by naming dyslexia and then by providing the research-backed literacy services students need.

The importance of self-advocacy

Ben and Julia are seniors at University of California Davis, and both have dyslexia. As successful college students at a top public university, both students reflected on the role of self-advocacy in their success stories.

Ben was diagnosed with dyslexia in fifth grade. His mother was his biggest advocate, and she spent much time and energy monitoring his progress as a stay-at-home mother. Julia's mother was trained as a lawyer and worked as a mediator for parents and children with disabilities within the state education department. When Julia was diagnosed in third grade with dyslexia and other learning disabilities, her mother became her biggest champion. She also taught her daughter how to advocate for herself.

Now, as college students, both seniors are vocal about their learning disabilities. Julia explained that at the beginning of every course, she walks up to the professor, introduces herself, and tells them that she has dyslexia, which means that she is just as intelligent as her peers but will struggle with spelling and grammar. Doing this allows her professors to grade her for her thoughts, rather than the writing mechanics. Ben also discusses his

learning disability with his professors. Both have been successful in college and have ambitious postcollege plans. Julia has been accepted into the Peace Corps, and Ben plans to continue his advocacy for students with learning disabilities and is targeting a career in politics.

Both students acknowledge how difficult it would have been to receive the services they needed if their parents had not been such vocal advocates and supporters. Both hope that California will move toward early screening, identification, and intervention, so that all children will receive the services they need.

The burden of costly diagnoses

Sami is a doctoral student at Stanford University. She was not diagnosed with dyslexia until her second year of college at University of California Santa Cruz. As a sophomore, Sami began to struggle in her large science courses that required a formal diagnosis to provide accommodations. After several low grades, she and her mother decided that it was time to spend approximately $600 on the exam.

While Sami and her mother suspected that she had dyslexia and ADHD—several of Sami's family members, including her father, have learning disabilities—they only paid for one diagnostic exam. With the expense to consider, they decided to focus on dyslexia since the more comprehensive accommodations would likely support her ADHD. Since obtaining these accommodations, Sami has had a successful academic career. Currently studying biogeochemistry at Stanford University, Sami's advisors have been supportive in providing her the time and support that she needs.

Sami wishes that families could be released from the costly burden of diagnosis and the retesting that is necessary over the years. She encourages educators to build more flexible classrooms that are more supportive of students with learning disabilities broadly—providing more time for tasks and being conscious of tricky fonts, for example—so that fewer accommodations are needed. By building more inclusive classrooms, all students can thrive.

Section 2: CONTEXT "What do we know?"

2.1 Literacy and Dyslexia in California

The United States faces a staggering literacy problem. In 2020, 52%[60] of adult Americans had below proficient literacy skills.[61] California is a large contributor to this issue, failing in comparison to other US states. In fact, it is the least literate state in 2020.[62] The results are equally troubling among California's children. In California, approximately half of all students failed to meet California's English Language Arts standards between 2014 and 2019.[63]

One contributor to this is California's high proportion of non-native English speakers—19% of the public school students have English as a second language. However, this contributes to less than half of the cases of reading deficiencies. Learning differences, such as dyslexia, are the other large drivers. Therefore, the high rate of ESL students is no excuse for low literacy rates, especially since ESL learners are dyslexic at the same prevalence as native English learners and addressing dyslexia in these students is no less important.

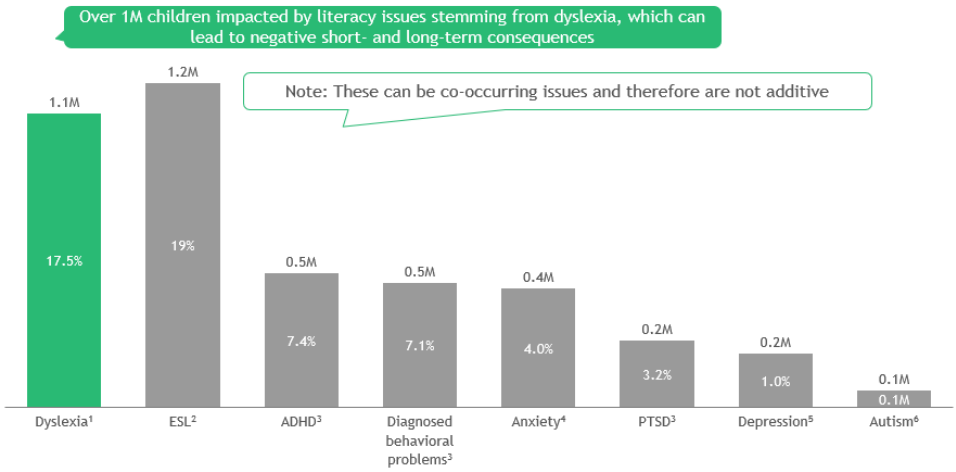
> Research shows that as many as 15-20% of people may experience dyslexia.

It is clear something must be done to improve literacy and addressing dyslexia is a good place to start. Five percent of school children are diagnosed with dyslexia,[64] but many children may not be properly diagnosed for years, if ever diagnosed.[65] Research shows that as many as 15% to 20% of people may experience dyslexia.[66] Of the six million students in California's public school system, an estimated one million students are dyslexic.[67] These one million students are expected to make up one-third of the approximately three million students with poor literacy skills in California.

Of course, there are still approximately two million children with below-proficient literacy skills who are not dyslexic. Dyslexia is only one of many issues facing children in schools that can impact literacy. (See Figure 5). However, evidence suggests that the teaching methods that benefit dyslexic learners also benefits other students. (See Section 2.4). In addition, by addressing the needs of dyslexic learners, we can concurrently address the often comorbid

social, emotional, and mental health needs that arise for these students, improving literacy among a large number of children in California.

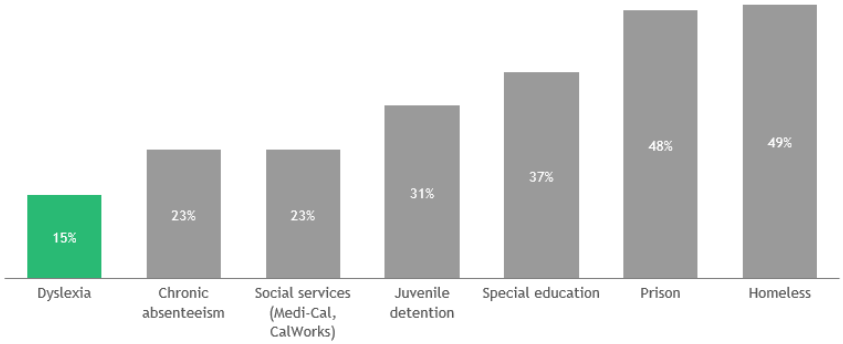
Figure 5. Dyslexia's Prevalence Among Learning Issues Facing School Children



Note: Based on California student population in 2018 (6,186,278)
Source: 1. Decoding Dyslexia, International Dyslexia Association, University of Michigan (US estimate) 2. California Department of Education 3. Centers for Disease Control and Prevention, 2011 (CA estimate) 4. Centers for Disease Control and Prevention, 2016-18 (US estimate) 5. Child Adolescent Psychiatric Clinics of North America, 2012 (US estimate) 6. Sacramento Bee, 2016 (CA estimate)

Dyslexia's direct connection to literacy makes it particularly urgent; poor literacy is linked to a host of social problems that severely impact Californians, limiting their productivity, independence, and health.[68] Reading problems constitute 80% of all special education referrals.[69] People with literacy issues at age seven are 74% less likely to attain a higher level of education and 56% less likely to attain a higher level of income as an adult.[70] Dyslexic individuals are overrepresented among many negative life outcomes. (See Figure 6). This is because reading is the fundamental skill that enables students to learn throughout the rest of their education. As described above, if unable to read, students are very likely to disengage and avoid school, leading to chronic absenteeism and dropping out of high school. Illiteracy and a lower level of education are contributors to underemployment and unemployment and exposes the individual to a higher likelihood of criminal justice involvement.

Figure 6. Representation of Dyslexic Learners in Negative Life Outcomes



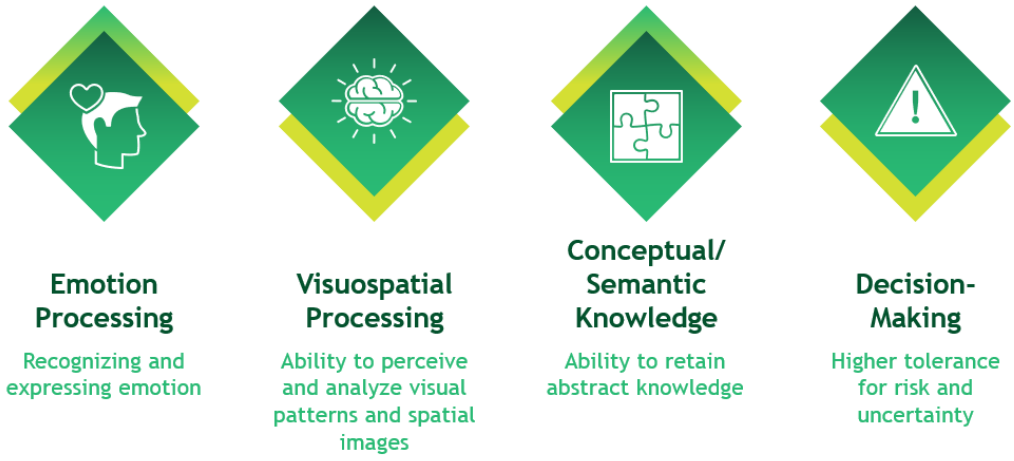
Source: Sources: California Dept. of Education, Attendance Works, Employment Policy Institute, Proliteracy, Reading Horizons, National Council on Disability, Literacy Project, Literacy Matters, Moody, K.C., et al. (2000), Fabelo et al. (2004), Barwick & Siegel (1996), Olise (2010), Paterson et al. (2012), Insights into Learning Disabilities.

2.2 Defining Dyslexia

Dyslexia is a specific learning disability that impacts much of the population through difficulties using or understanding written language. [71] A child with dyslexia may demonstrate weaknesses in tasks that measure functions considered building blocks for proficient reading (for example, phonological awareness, letter identification, letter–sound knowledge, and rapid naming).[72] Dyslexia is thought to be one of the most common language-based learning disabilities—it is the most prevalent cause of reading, writing, and spelling difficulties.[73] 4.9% of students in CA were diagnosed with a specific learning disability in 2018. As stated earlier, 15% to 20% of the population actually has dyslexia.[74]

Dyslexia can co-occur with other specific cognitive challenges, such as dyspraxia (difficulty with motor skills), dyscalculia (math challenges), challenges in executive skills, and poor memory.[75] Approximately 40% of students with a reading disability have a math disorder.[76] Additionally, dyslexia often co-occurs with mental health concerns. Children with reading disabilities exhibit higher rates of depression and generalized anxiety,[77] and 15% to 40% of children with dyslexia also have at least a mild form of ADHD.[78]

Figure 7. Strengths of Dyslexic Learners



Source: University of California San Francisco Dyslexia Center.

While dyslexia is often associated with many challenges, dyslexic individuals are known to have many strengths. Many are known as out-of-the-box thinkers, visual artists, performers, and entrepreneurs. In fact, a study showed that 35% of entrepreneurs are dyslexic.[79] From leaders like Charles Schwab[80] and Governor Gavin Newsom,[81] to artists like Keira Knightley, Whoopi Goldberg,[82] and Stephen Spielberg,[83] dyslexic learners have contributed greatly to society. Many more will emerge if their strengths are recognized and supported.

The University of California San Francisco's Dyslexia Center has found that subgroups of dyslexic learners show specific strengths in both cognitive and socioemotional tasks, such as emotion processing, visuospatial processing, conceptual/semantic knowledge, and decision making. (See Figure 7).[84] Others have found additional strengths, such as increased peripheral vision and visual gist—an ability to take in the whole visual rather than focus on details.[85] These strengths are still being explored but could help explain why dyslexic learners seem to be overrepresented in the arts[86] and among entrepreneurs.[87]

The latest research has determined that dyslexia is neurobiological in origin.[88] Dyslexic brains have brain patterns ("neural signatures") that reflect poor phonological [89] and

"The latest research has determined that dyslexia is neurobiological in origin, occurs consistently across all types of dyslexia, and is often genetic.

orthographic[90] processing. Regardless of age, these "neural signatures of dyslexia" are often seen in students with dyslexia. Even before they are formally taught how to read, children show these unusual patterns if they are at a high risk for developing dyslexia. Research is also underway to determine whether subtypes of dyslexia can be reliably identified so that individuals can receive individualized intervention plans based on their specific brain structure.[91]

Both low-performing and high-performing dyslexic students have these neural signatures, showing brain pattern consistency across dyslexic people regardless of academic performance. Dyslexia is often familial; a child at high risk for dyslexia may have a related family member (such as a parent or sibling) with dyslexia or other learning disability.[92] While some genes have been identified as possible contributors, there is no specific dyslexia gene that imparts clear heritability.[93] These neural signatures are evident in students with dyslexia, even if they speak languages and use writing systems other than English.[94]

Dyslexia occurs across the population; dyslexic learners exist among all genders, socioeconomic classes, and racial groups. Nearly the same percentage of people from different ethnic and socioeconomic backgrounds have dyslexia.[95] Dyslexia also occurs across the range of intellectual abilities—many dyslexic learners have high IQs and perform well in other academic areas.[96] While there is clear evidence of dyslexia-related "signatures" in the brain, researchers are still investigating the precise neurobiological causes of dyslexia.[97]

2.3 Identifying Dyslexia

Current diagnostic processes are focused on screening for language abilities. Research shows that early identification is possible and important for intervention. Early identification of children at risk is possible even before a child is able to read, through reviewing family history of dyslexia and/or identifying weaknesses in critical pre-reading skills (for example, phonological awareness, letter identification, letter–sound knowledge, and rapid naming).[98] Several types of screeners exist and most determine if a child may need additional assessments by professionals, such as neuroscientists or educational psychologists.

Dyslexia is a life-long condition,[99] but appropriate interventions can improve outcomes and quality of life.[100] Neural brain patterns for dyslexia can change through reading interventions and can show a pattern that becomes similar to that seen in students without dyslexia.[101]

However, obtaining a diagnosis can be difficult, particularly for disadvantaged children. Evaluation for dyslexia is not currently covered by health insurance and families often need to undergo neuropsychological evaluations privately. These private screenings can cost hundreds or thousands of dollars.[102] With over 50% of California students qualifying as low-income (eligible for free or reduced priced lunch)[103], many find it difficult to get a diagnosis and obtain support for dyslexia.[104]

Furthermore, many children in under-resourced schools are never diagnosed. Only a few schools in California screen for dyslexia,[105] and often children are not diagnosed with dyslexia until they are failing in school. Despite failing, some are never diagnosed and never receive services.[106] For a child to receive services, their teacher must notice the condition, a psychologist must assess, and an instructor must provide services.[107] Most schools lack the resources to identify, diagnose, and provide these services for all students who need it.[108]

In addition, high performers often miss early diagnosis. Since high performers are able to perform well on early reading tests by compensating with other methods (such as memorization, informed guesses based on context), many high-performing dyslexic students are only diagnosed much later or are misdiagnosed.[109] However, high performers can only fully compensate at lower reading levels and end up struggling in later grades with more complex reading tasks. High performers still show the neural signature (left temporo-parietal dysfunction), making them eligible for early intervention services if properly diagnosed.[110]

Furthermore, without remediation, all dyslexics must exert more mental energy in visually processing the text, leaving them with less attention left for comprehension. And since comprehension is the goal of reading, overall learning performance is degraded. A dyslexic student of any ability will require more time, will exert more mental energy, and will have less stamina than their neurotypical peer, requiring extra time and other accommodations to keep pace.

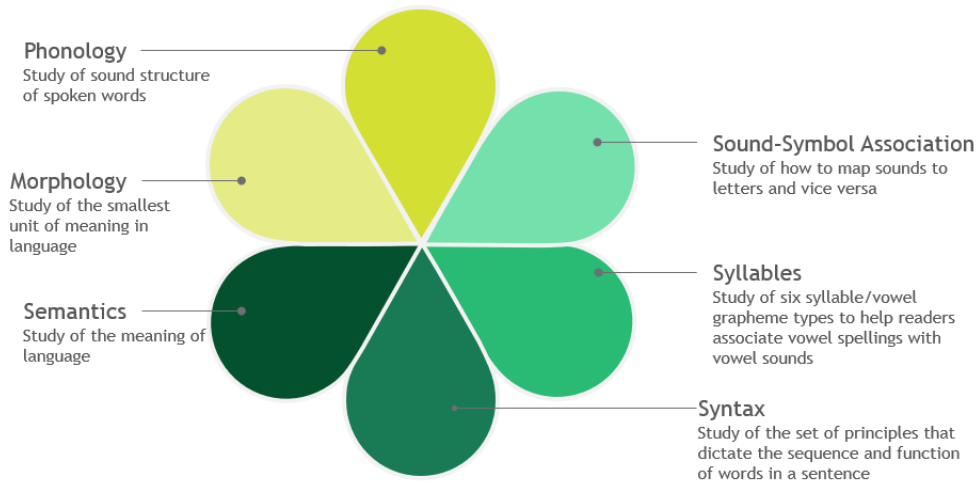
Once identified with dyslexia, many students are not regularly tested to assess progress. The result is that often more affluent parents pay for private screening and tutoring, which can cost between $50 and $200 an hour[111], while low-income students are left behind. Beyond testing, affluent families can often afford and access tutoring, after school remediation instruction, and specialized private schools—all of which is out of reach for most all low-income students.

2.4 Solutions to Dyslexia

Dyslexia is usually treated through educational approaches focused on building the student's literacy skills.[112] While there are many approaches to teaching literacy, there is resounding evidence for the importance of teaching all children the structure of language, especially students with dyslexia.[113]

Children with dyslexia struggle with understanding language structure, such as sound structure, language meaning, and the sequence and function of words in a sentence, so interventions must invest in teaching students explicitly how to develop those skills. (See Figure 8).[114] Cognitive science research on reading has shown that encouraging students to use the structure of language, rather than contextual and visual clues, leads to better reading comprehension for students.[115]

Figure 8. Components of Structured Literacy



Source: International Dyslexia Association

Beyond the skills that are taught, research also recommends additional practices that should guide how literacy is taught to children. Teachers must teach these concepts in a systematic order, starting with the most basic elements and working toward more difficult concepts.[116] In addition, teachers must engage in continuous assessment of student progress.[117]

Unfortunately, most teacher training programs do not currently prepare educators to teach language in this manner, and as a result teachers are often not equipped with the skills to do so.[118] A study in Mississippi uncovered that most teachers were not implementing research-backed language instruction in their classrooms.[119] After implementing an intervention focused on equipping teachers with scientifically-backed literacy strategies, Mississippi students made significant reading gains within the last five years. (See Mississippi case study). Any intervention for dyslexic learners must engage these scientifically-backed methods for teaching literacy.

SECTION 3: ACTION PLAN "What can we do?"

3.1 Proposed Approach and Return on Investment (ROI)

While there are many proposed approaches to remediating dyslexia at scale, we believe any intervention implemented by California should encompass the key elements of early assessment, teacher training, and assistive technology.

We have modeled that a comprehensive intervention will cost $880 million in the first year, with the average cost in subsequent years decreasing to an average of $440 million (in present value dollars). Using data from the California Department of Education, we model the costs of a proposed approach that includes screening, teacher training, resource specialists, literacy coaches, and technology. (See Figure 9).

Figure 9. Initial Cost of Interventions to Remediate Dyslexia at Scale

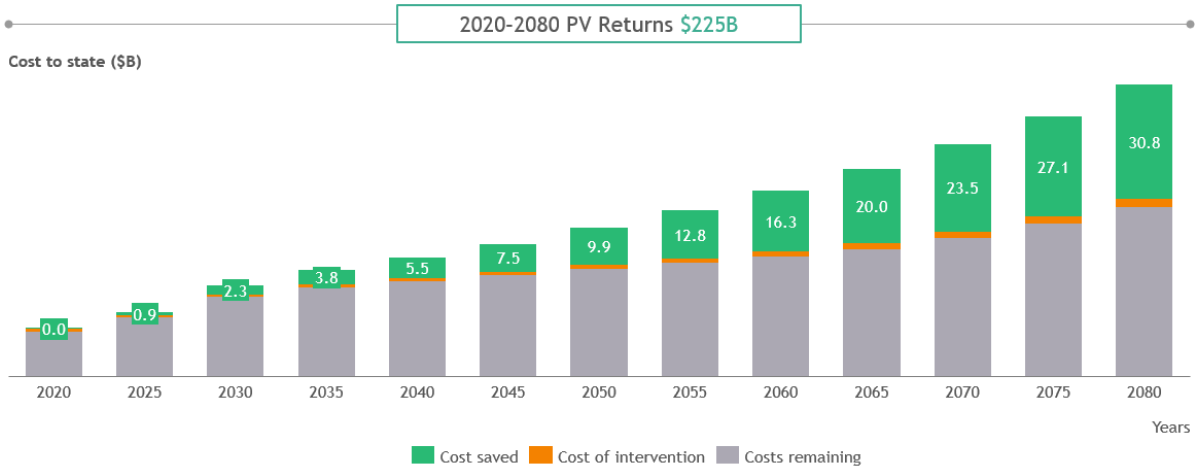
Intervention	Cost associated to dyslexia ($M)
Screening	193
Teacher Training	369
Resource Specialists	81
Literacy Coaches	96
Technology	137
TOTAL	**876**

Source: Economic Model. See Appendix A.

Investing in young children will naturally take time to realize its full benefits. Every year, savings will increase as students gradually progress into the workforce. By 2030, we expect an approximate $5 billion to $13 billion payback, unlocking 5% of California's yearly budget. (See Figure 10). Over the next sixty years, this amounts to a return on investment of 800% to 2000%. The range depends on the anticipated level of effectiveness (40% to 100%) of the intervention across all students. The lower bound of 40% was selected based on improvements seen in other literacy initiatives. The state of California will recoup its cumulative investments in about seven years and break even, assuming 40% effectiveness of interventions. (See Figure 11).

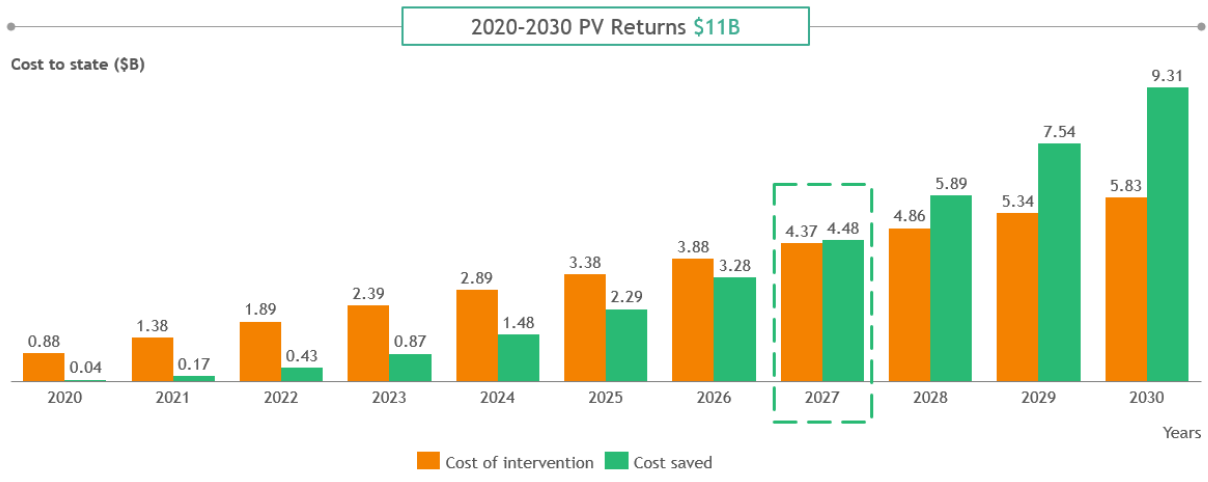
On a school level, there are immediate monetary gains from the reduction of truancy, litigation, and special education expenses, with potential savings up to $10,000 per school in 2021 and average savings of up to $30,000 in the first five years of implementation. Although the proposed intervention requires additional investments, much of it would be from the reallocation of existing special education to general education costs. If addressed early, many dyslexic learners can avoid special education altogether, which is a solution provided only once a child has failed enough to qualify.[120] At that point, special education costs are much higher than what early intervention would have cost from the start.

Figure 10. Sixty-Year Impact of Intervention on Costs to the State ($B), Base Case Assuming 40% Effectiveness



Source: Economic Model. See Appendix A.

Figure 11. Cumulative Impact of Intervention on Costs to the State ($B), Base Case Assuming 40% Effectiveness



Source: Economic Model. See Appendix A.

3.2 Rationale of Solution

There are many potential solutions to solve the impact of dyslexia on California. However, three main approaches stood out consistently throughout the 26 interviews with California

stakeholders. Collectively, these responses aim at the root of the problem—the unacceptable number of Californians who live their entire lives unsupported—ensuring maximum impact.

Early screening

Schools must screen all children early to identify the students with learning difficulties. Research shows that early screening is imperative.[121] Children's brains are the most malleable at an early age, increasing the likelihood of learning the skills needed for proficient literacy.[122] As a result, we propose a digital screener that is administered annually to all pre-kindergarten to third grade students to identify students not meeting learning standards. One such digital screener is AppRise, a screener that is currently undergoing a pilot in California schools with UCSF's Dyslexia Center, funded by the state of California and private donors. It provides a suite of tablet-based games that translate current screening tests and new research-based measures into a digital tool for screening reading disorder risk.

Early screening can reduce the funds spent on special education by allowing children to be identified early within tier 1 education before special education identification is required. In these early stages, children experiencing literacy difficulties can be flagged as "at risk" and given literacy instruction without requiring more intensive special education services. These children will be monitored through the yearly assessments to track improvements. Of course, formal assessments will be conducted for those who need more intensive special education services if they are unable to benefit from the early interventions. With 80% of special education referrals stemming from literacy concerns, early screening and intervention will significantly reduce the funds required for special education diagnosis and intervention. This includes special education costs associated with addressing the comorbid needs that arise for many students who are not identified and supported early.

Intervening early will also help mitigate student disengagement with school. When children experience prolonged failure, they disengage from the reading process. With this repeated failure, students dislike reading and read less frequently than their proficient peers. Since reading is required to learn in later grades, this creates a skills gap that widens over time.[123] The students who are unable to read properly become students unable to learn properly. By incorporating screening into tier 1 instruction, we can reduce this skill gap.

Teacher training

Many educators feel inadequately trained to teach students to read and write,[124] and fewer than 20% feel "very well prepared" to teach children with learning disabilities.[125] Early intervention by teachers is imperative for addressing dyslexia appropriately, so teachers must be trained adequately.[126] As a result, we propose implementing a statewide training of evidence-based literacy techniques for all pre-kindergarten to eighth grade reading teachers.

While there are many literacy approaches, literacy teachers must teach children the structure of language, particularly early on in a child's education.[127] These methods have been proven as effective by researchers for decades, according to a congressional study in 1999 based on studies conducted since the 1960s.[128] In addition to past success, these interventions have also been successful in the present decade. In 2014-2015, Mississippi implemented a statewide literacy intervention which involved retraining teachers on phonics. (See Mississippi case study)[129]. They experienced a six percentage point growth in reading proficiency.[130]

Furthermore, teacher preparation can impact more than just student literacy—it also impacts teacher retention. As stated earlier, teachers feel ill-equipped to teach literacy, and spend hours per week searching for effective resources for their students as a result.[131] By receiving effective training, teachers will be better supported and prepared to effectively teach their students. And when teachers are better supported and prepared, they are more likely to stay in the classroom.[132]

Training all of California's literacy teachers will be an undertaking. A proposed approach is to spend the next three to five years providing all existing and new literacy teachers a continuing education training on research-based literacy instruction. Ideally, this education can be fully incorporated into regular teacher education for new teachers and therefore not require a supplemental investment once the current teacher population is trained.

In addition, we propose an increase in reading coaches at schools as a resource for literacy teachers. Reading coaches will ensure teachers have continual support as they incorporate

evidence-based literacy practices into their teaching, until eventually they are reading experts themselves.

These changes will require coordination and testing before full implementation, as well as an upfront investment of time and energy from teachers. However, these investments in effective teacher preparation will lead to stronger student performance, increased teacher retention, and better teacher support—all key to driving the program ROI.

Assistive technology

Although early assessment and teacher training are the primary fundamental requirements for a solution, investments in assistive technology can provide additional benefits. Computer-based learning programs, audiobooks, and other tools can help provide more targeted instruction to each student. Students can use these tools to supplement their traditional in-class education if more focused instruction is needed for their learning difference. These solutions can take many forms and, as the technological center of the world, no state is better equipped than California to make strides in developing new and innovative solutions. We encourage California's innovators and entrepreneurs to take up this call and meet the need for assistive technologies inside California's schools.

Mississippi as a Case Study in Statewide Literacy Interventions[133]

For decades, Mississippi's children were failing. The state consistently ranks as one of the worst in the country for education, recently ranking 46th according to US News and World Report.[134] In 2013, Mississippi legislators decided to put an end to the state's abysmal reading achievement and established the Literacy-Based Promotion Act.

The Act aimed to reform literacy in Mississippi so that all children would be able to read on grade level by third grade. The Act required individual reading plans for students identified with reading difficulties, instituted stricter third-grade promotion criteria, and required all teachers to pass a foundational reading certification exam. Importantly, the law also required statewide training for teachers on research-supported reading strategies and embedded reading coaches in schools to support K–3 literacy.

By 2017, Mississippi had improved. On the National Assessment of Education Progress (NAEP), Mississippi's fourth grade reading scores improved six percentage points—from 21% proficiency in 2013 to 27% in 2017. In 2019, Mississippi experienced the largest reading gains in the country, finally achieving the nation's average.[135] During the same time period, California remained steadily three to six points below the nation's average.

3.3 Questions for Consideration

While we strongly recommend three broad solutions—early screening, teacher preparation, and assistive technology— we also have several questions for further consideration. As public and private stakeholders come together to address the needs of dyslexic learners, we encourage careful consideration of the following:

- How can we build an integrated solution that addresses dyslexia, all learning differences, and mental health issues as part of one comprehensive "whole child" approach rather than assessing and treating these incompletely in silos? How do we bring together health care and education to address these needs?

- Can we be innovative in defining a new "at-risk" category for young students that does not trigger a special education route, and as a consequence, disincentive early screenings? How can mandatory early screenings be viewed as a resource to teachers and not a burden to students or schools?

- What factors need to be considered to roll out this solution within a public/private partnership as many across sectors are addressing these challenges and finding solutions? How should we pilot, learn, and implement in a way that allows for collective learning given public schools are often addressing a more complex set of needs within children?

- Can we construct a solution where a portion of the projected long-term benefits can be felt by teachers immediately? How can we develop an approach that makes demands on teachers more manageable today? As teachers are integral to the solution, making

sure the approach is workable for and meets the needs of teachers is essential to adoption in the classroom.

CONCLUSION

Few understand dyslexia, despite the fact that up to one-fifth of the population is dyslexic. With such a large proportion of people affected, investments made to address dyslexia would produce dramatic savings, equivalent to unlocking 5% of California's existing budget. We can no longer afford to be complacent to this issue. California must take action.

Millions of people experience difficulty with reading and writing as a result of dyslexia. Through implementing these recommended solutions—early screening, teacher preparation, and assistive technology—we can help those people rise above the barriers they face as a result of their often undiagnosed learning disability.

California can emerge as a statewide leader on dyslexia. In addition to immediately remediating issues of K–12 literacy and special education in public schools, these solutions have a downstream impact on several other matters plaguing California—early childhood education, social and racial inequity in schools, student test scores, mental health, incarceration, higher education, homelessness, workforce competition for talent, and adult literacy. Dyslexia is the multifaceted solution California has been waiting for.

Dyslexia will cost California $12 billion this year. Yet, investments in remediation will yield a return of 800% to 2000%. No state can leave such opportunities on the table. Specifically, up to $500 billion can be reallocated over the next 60 years to general education and away from unnecessary costs for special education, litigation, chronic truancy, and the criminal justice system. Dyslexia is a huge problem, but unlike many problems, it has a clear solution. With collective and strategic statewide action, millions of Californians will benefit tomorrow from today's trillion-dollar challenge.

APPENDIX

Figure A1. Metrics, Sources, and Assumptions for State Costs

State costs associated with dyslexia = [Total $ cost to state of California] * [% attributable to dyslexia] - [$ cost to state of California if representative population had 15% dyslexics]

Inflation rate and population growth used for projections beyond 2030, unless specified otherwise

Category	Cost item	Metrics	Source, assumption
General	N/A	• Discount rate: 3% • $ cost/budget growth: 2% • Number of cases growth: 0.5%	• 30-year muni bond yield: 2%-3% • Bureau of Labor Statistics inflation rate: ~2% • 2014-2019 CA population growth: 0.5%
Prison	Prison	• % dyslexic: 48% • 2020-2030 cost per case growth: 8%	• Texas Dept. of Criminal Justice/Maria Luisa: 48%-70% • CDCR, Vera Institute, Legislative Analyst's Office (LAO)
	Juvenile detention	• % illiterate: 85% • % dyslexic of illiterate: 33% • 2020-2030 cost per case growth: 5%	• Literacy Project, Literacy Matters • 33% of students below literacy level are estimated to be dyslexic; Reading Horizons, Proliteracy: 50%-85% • CDCR, Center on Juvenile and Criminal Justice
Unemployment	Lost taxes	• Median income used—CAGR: 3.2% • State tax rate: 5% based on ~70K median income • % illiterate: 70%; % dyslexic of illiterate: 33%	• Bureau of Economic Analysis, FRED • Average tax rate used • Percent of illiterate on welfare used as a proxy (see below)
	Homelessness	• Cost/Budget growth: 25% for next 3 years, tapered by 5% every 3 years to inflation rate • % dyslexic: 49%	• US Interagency Council on Homelessness, LAO, CA State Budget • Barwick and Siegel 1996, Olise 2010, Paterson et al. 2012, Insights into Learning Disabilities

Figure A1. Metrics, Sources, and Assumptions for State Costs

Category	Cost item	Metrics	Source, assumption
Unemployment	Medi-Cal	• % illiterate on welfare: 70%; % dyslexic of illiterate: 33% • 2020-2030 budget growth: 8%	• EPI, Proliteracy, Literacy Project: 70%-75% • LAO
	CalWorks	• Budget includes county and district funds • 2020-2030 budget growth: 3%	• LAO
	Under-employment	• Underemployment calculated as difference of median incomes • Median income—CAGR: 3.2% • % dropouts that are functionally illiterate: 60% • % dyslexic of illiterate: 33%	• Median incomes grown at the same rate; FRED, PBS, US Census Bureau, Bureau of Labor Statistics • Hernandez et. al 2011
Education	Special Ed.	• Budget includes county and district funds • % dyslexic of Special Education: 37%	• California Dept. of Education, LAO, PPIC, Kids Data • Calculated based on CDE's special education enrollment
	Truancy	• Median truancy cost per day: $45 • % cases of Special Education: 63% • % dyslexic of Special Education: 37%	• Multiplied by 18 to account for chronic truancy • Calculated as 21% based on CDE enrollment; scaled by 3x to account for undetected cases • California Dept. of Education, Attendance Works, EdSource, EdWeek, KPBS, Governing, The 74
Litigation	Due process	• 2020-2030 number of lawsuits growth: 6% • Lost/split decisions: 46% of total • Lawsuits for dyslexia: 37% • Median settlement/award: $27,356 grown at inflation • Median attorney fees: $23,852 grown at inflation	• California Dept. of General Services, LA Times, California Special Education, SFGate • Calculated based on CDE's special education enrollment • Scaled by 2x to compensate plaintiff attorney fees

Figure A2. Metrics, Sources, and Assumptions for Family Costs

Family costs associated with dyslexia = [number of dyslexic children receiving interventions] * [% children receiving intervention] * [average $ cost of intervention]

Inflation rate and population growth used for projections, unless specified otherwise

Category	Cost item	Metrics	Source, assumption
General	N/A	• # of children in public schools: 6,186,278 • # of children in private schools: 495,496 • % children receiving intervention: 5%	• California Dept. of Education (Data Quest + Private School Affidavits) • Assumed based on IDEA data
Family costs	Private School	• Median cost: $37,442	• Private school fees (e.g., Charles Armstrong, NorthBridge) • Not accounting for private school fees paid by school districts
	Private Tutoring	• % utilization: 79% • Median tutoring cost: $65	• Decoding dyslexia survey • Assumed 3x a week for 40 weeks a year; AP News, Washington Examiner
	Homeschooling	• % utilization: 13% • Lost income: 50% of ~70K median income	• Decoding Dyslexia, accounting for statewide stay-at-home parents (40%); FRED
	Private Evaluation	• % utilization: 74% • Median evaluation cost: $873	• Decoding Dyslexia Survey, Lexercise, Atlanta Child Psych, Umich Dyslexia, Expert interviews
	Technology	• % utilization: 65% • Median cost: $200	• Decoding Dyslexia Survey, Learning Ally, SmartPens, Speech-to-text average costs
	Emotional Counseling	• % utilization: 37% • Median cost: $90	• Decoding Dyslexia Survey, Thervo • Assumed 1x every two weeks for 40 weeks
	Litigation	• % rulings against parents: 54% • Median attorney fees: $23,852 grown at inflation	• See methods for state costs

Figure A3. Metrics, Sources, and Assumptions for Interventions

Inflation rate and population growth used for projections, unless specified otherwise

Category	Cost item	Metrics	Source, assumption
General	N/A	• # of children in elementary: 2,799,322 • # of children in middle school: 1,435,870 • # of teachers in elementary: 149,035 • # of teachers in middle school: 47,875 • # of schools (Pre-K-8th grade): 8,600	• California Dept. of Education
Interventions	Screening	• Pre-K to 3rd grade students: 1,893,528 • Average cost: $100	• Digital/physical screener administered every year • California Dept. of Education
	Teaching Training	• Pre-K to 8th grade teachers: 157,804 • Average training cost: $1500 • Teacher compensation: 40 hours @ $21 • Part of general teacher training after 5 years	• Only reading teachers included for middle school; CDE • IDA, Orton Gillingham courses, expert interviews • Indeed, ZipRecruiter
	Resource Specialists	• Cater to 5% of the total Pre-K to 8th graders • Case load of 28 children each • Existing resource specialists: 6,031 • Average yearly salary: $51,384	• California Dept. of Education • California State Laws, EdSource • Glassdoor, PayScale, Salary.com
	Literacy Coaches	• 1 literacy coach for ~5 schools • Average yearly salary: $55,355	• Expert interviews • ZipRecruiter, Glassdoor
	Technology	• Cater to 15% of the total Pre-K to 8th graders • Median cost: $200 • Teacher compensation: 2 hours @ $21 • Part of general teacher training after 5 years	• Learning Ally, SmartPens, Speech-to-text average costs

Figure A4. Metrics and Assumptions for Return on Interventions

		Remediation ramps up at a steady rate after the first cohort of Pre-K-3rd grade students receive the benefit		% effectiveness of intervention: 40%-100%
Category	Cost	Return on Investment begins in …	Benefit reaches steady state by …	PV 2020-2080 cost remediated ($B)
Criminal Justice	Prison	8 years	2067	75-186
	Juvenile detention	4 years	2037	1-3
Unemployment	Unemployment—lost taxes	10 years	2078	4-9
	Homelessness	Immediate[1]	2062	49-121
	Medi-Cal	10 years	2078	31-77
	CalWorks	10 years	2078	2-6
	Underemployment	10 years	2078	1-2
Education	Special Education	Immediate	2029	55-138
	Chronic truancy	Immediate	2029	2-5
Litigation	Due process	Immediate	2029	6
				ROI = 8-20x

1. Improved literacy makes it more likely for homeless youth to remain in school, leading to improved visibility of the extent of homelessness for the state to better appropriate its budget.

ENDNOTES

[1] US Department of Education https://sites.ed.gov/idea/regs/b/a/300.8
[2] https://www.nytimes.com/2018/09/21/health/dyslexia-shaywitz-yale.html; Shaywitz et al. 1999
[3] https://dyslexiaida.org/why-is-it-so-difficult-to-diagnose-dyslexia-and-how-can-we-do-it-better/
[4] https://www.documentcloud.org/documents/6770772-California-Dyslexia-Initiative.html
[5] https://www.hsr.ca.gov/docs/about/business_plans/BPlan_2014_Sec_7_CaHSR_Benefit_Cost_Analysis.pdf
[6] https://journalofethics.ama-assn.org/article/education-and-education-policy-social-determinants-health/2006-11
[7] UCSF Dyslexia Center presentation https://www.youtube.com/watch?v=Zq0a__Ltr3Q&t=1535s
[8] Analysis of the incidence of dyslexia in entrepreneurs and its implications, Julie Logan, Cass Business School
[9] Note that the definition of dyslexia across studies may vary and relevant adjustments have been to account for that.
[10] See Every Child a Chance Trust & KPMG, "The long term costs of literacy difficulties", January 2009
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[34] https://edsource.org/2020/newsom-wants-more-dyslexia-screenings-services-for-california-students/623701
[35] In CA in 1994, 59 percent of the California residents who performed in Level 1 on the prose literacy scale were foreign-born, compared with 24 percent of the entire state population. Twenty-two to 25 percent of the California respondents performed in the next higher level of proficiency (Level 2) on each literacy scale. While their skills were more varied than those of individuals performing in Level 1, their repertoire was still quite limited.

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ACKNOWLEDGEMENTS

The Economic Impact of Dyslexia on California is a whitepaper published by Boston Consulting Group in collaboration with UCFS Dyslexia Center.

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