The Implication of Neurological Testing on Improving Academic Outcomes for Children with Dyslexia

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Abstract. Learning disorders such as dyslexia currently affect around 2.17 million kids posing a barrier to their ability to achieve academic success and reach their full potential. Individuals with these disabilities are at heightened risk of being held back, dropping out of high school, and facing legal trouble. The current model for dyslexia treatment, Response to Intervention, utilizes behavioral tools to assess the severity of dyslexia and determine the level of remediation, however many children still do not reach their full potential. The missing link is the use of fMRI neurological testing to assess the state of a child's brain development and determine the best programs for each individual. fMRIs allow for the prediction of a child's reading improvements with over a 90% accuracy making them a significantly useful tool for the prescription of dyslexia treatment.

Introduction

In the United States, learning disabilities hinder the academic and economic potential of millions of children. The CDC reports that 2.17 million kids aged 3-21 are currently diagnosed with a learning disability[1]. These disabilities include dyslexia, dyscalculia, and dysgraphia, with approximately 5-17% of all children being diagnosed with dyslexia[2]. In dyslexia, an individual struggles with phonological awareness, or difficulty processing syllables and rhyming, in turn impacting their ability to read and write. This differs from poor reading in low IQ students in the region-specific atypical development of these brain areas[3].The proportion of students with dyslexia is especially staggering when we consider the future trajectories of these children. 18.5% of students with learning disabilities dropout of school compared to the counterparts of whom only 6.1% dropout[1]. Furthermore, 55% of students with learning disabilities are involved with the justice system implicating the effects of these disabilities on communities as a whole[1]. Dyslexia complicates an individual's ability to perform academically, hinders their self-confidence, and poses economic costs to society as a whole. An approach to the treatment of dyslexia that takes into consideration the neurological basis of the disability is needed to bridge the gaps between these children and their peers and allow them to meet their full potential.

Background

In the current model of treatment, students with dyslexia are identified using only behavioral metrics to evaluate their difficulty reading and writing. They are seen by a school counselor who prescribes academic dyslexia and then ascribes weekly phonological lessons and in-class assistance. Response to Intervention is the commonly used model in which children are grouped into one of three tiers depending on disability severity and are treated as such[4]. The remediation lessons allow students to practice reading comprehension and rhythm tasks with the expectation that these exercises will sharpen their phonological processing skills. However, these tiers are formed solely on behavioral testing, and the treatment plans are applied uniformly across each tier. While this can be effective for some kids, it leaves behind too many others given a third of students with learning disorders repeat a grade[1].

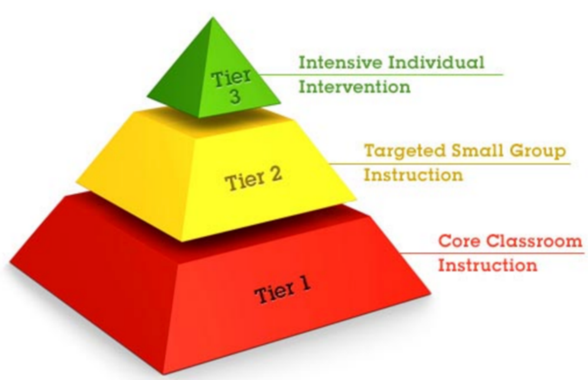

Figure 1. Response to Intervention in dyslexia is applied as a three tier model with tier 3 being the most intensive.[2]

Dyslexia is a condition affecting the reduced size of the specific brain regions central to phonological processing and therefore is an inherently neurological condition. fMRIs are a neuroimaging tool that provide information about task-related brain activity and are useful in determining the neurological correlates of disabilities. fMRI studies of dyslexia demonstrate that the reading difficulties seen in dyslexia are correlated to a reduced size and activation of the phonological processing centers of the brains, such as the left temporal regions. For example, in a review, researcher Temple discusses evidence of reduced activity of the left tempoparietal region, or the language processing region, during auditory and visual phonological processing tasks[5]. Furthermore, research performed by Temple using fMRI studies demonstrate that behavioral treatment of dyslexia increases activation of the language processing centers reinforcing the relevance of neurological functioning in treating dyslexia[6]. Perhaps, the solution to increasing the efficacy of dyslexia treatment lies in the marrying of behavioral tests and neurological assessments to gain a deeper insight into the unique condition of each child.

Recommendation

In a strongly compelling series of studies, researchers Hoeft, McCandliss, and Black, et al. demonstrated that fMRIs can serve as a highly useful tool in assessing the degree of a child's dyslexia in relation to their future reading gains[7]. Hoeft, McCandliss, and Black, et al. recruited children over two-and-a-half years old with dyslexia and performed behavior tests as well as fMRIs to identify the size and activation of the functionally relevant brain regions. Their results demonstrated that using fMRI data, they were able to predict the subjects' future reading gains with over a 90% accuracy. In their studies, Hoeft, McCandliss, and Black, et al. identified that some children had hyperactivation of right inferior frontal gyrus and stronger white matter integrity, suggesting there might be compensatory brain activity facilitating greater gains in reading skills[7]. Through their fMRI data, they were able to find a significant correlation between improvements in reading and comprehension test scores and increased activity in this region as well as some remediation of activity in the left temporal regions bringing the activity closer to that of individual with normal reading skills. Furthermore, in earlier studies, Hoeft, Ueno, and Reiss, et. Al. were able to demonstrate the ability of fMRI's in predicting reading gains with normal reading skills. This emphasizes the utility of fMRI's, and in effect neurological information, in informing about reading development in children[8]. The significance of these researchers' accuracy provides a compelling argument for the utility of fMRIs in predicting reading improvements in children with dyslexia.

This research has significant implications for the potential future outcomes for these students. By utilizing fMRI information, schools can better give children with these learning disabilities the treatment and attention they need. Behavioral tests are a limited indicator of the severity of dyslexia with little ability to predict the needs of each child. Hoeft, McCandliss, and Black, et al. showed that behavioral tests only predicted the reading gains of children at chance[7]. With fMRI data, students who need greater attention can be identified early on and be given more aggressive treatment. Therefore, fMRI's should accompany behavioral testing when students are diagnosed with dyslexia. Because dyslexia occurs over a range of severity, only those in the highest tier of severity, as shown in Figure 1, should receive an fMRI scan upon diagnosis. This is the most vulnerable population for whom the appropriate intensity of treatment it critical to the development of grade-level reading and writing skills. Students in the lower tiers struggle with milder forms of dyslexia and are more responsive to the general treatment programs. Setting these criteria allows fMRIs to be more accessible in terms of cost and availability and allows for the greatest efficacy if its use.

Conclusion

The mention of neurological testing evokes cautionary response for a variety of important reasons. Brain chemistry and connectivity is variable between individuals, and blanket diagnoses can result in over or under diagnosis of dyslexia. However, it is important to differentiate between the use of fMRI to diagnose dyslexia and the use of fMRI to determine the prognosis and treatment plan. The aim here is not to use fMRI's to universally test children for dyslexia. Rather, it is to use fMRI to develop a treatment best suited for each child's neurological condition to allow them to reach their full potential.

Studies have demonstrated the efficacy of fMRIs to predict the need of a child with dyslexia. Given the challenges students with this disability face to completing high school, the use of fMRIs could significantly improve outcomes for these kids. By adding fMRIs to the procedure for treating children with dyslexia, we can maximize their potential of overcoming this disability and achieving success on par with their peers.

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