Language-Based Intervention for the Income Achievement Gap

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Abstract: The income achievement gap is one of the most familiar and pervasive problems facing education. Though experts in education, policy, neuroscience, etc. have weighed in on the root causes and potential solutions for the achievement gap, it remains a stubbornly prevalent issue. Differences in language exposure have been identified as a key driving force behind the achievement gap. Recent brain imaging studies have provided evidence of possible neurological mechanisms for this process, and studies of language-based interventions have shown promising results for academic performance. Based on the evidence from both neurologic and behavioral studies, language-based intervention has a high potential to alleviate the disparities in academic performance and cognitive development.

Background

The Achievement Gap

The income achievement gap refers to the difference in academic performance between children of high- and low-income families. A gap between children of high- and low-socioeconomic status (SES) in math and reading scores on standardized tests already exists by the beginning of kindergarten and tends to remain constant as they move through school. The gap extends to standardized test scores, graduation rates, and college completion.[1] Furthermore, the average difference in standardized test scores has increased from about 0.9 standard deviations in 1970 to 1.25 standard deviations in 2001 and continues in an upward trend.[2] Although shrinking the achievement gap is recognized almost universally as a primary goal for the education system, this is a complex problem and programs that effectively combat it have yet to be implemented on a large scale.

Language Exposure, Cognitive Ability, and Academic Performance

Many neuroscience and education scholars have pointed to disparities in language and literacy as the driving force behind the achievement gap. The media and researchers often reference the "30 million word gap" coined by Betty Hart and Todd Risley. Their 1995 landmark study found that children from families that depend on welfare receive on average half as much verbal input per hour as children in working class families and a third of that of children from professional families, leading to a theoretical deficit of 30 million words by the time the children enter school.[3]

Although Hart and Risley's methods and interpretations have received some criticism over the years, the core principle that unequal language input across socioeconomic divides leads to disparities in academic achievement has been upheld, and early language exposure remains an important predictor of

children's future language ability and literacy skills.[4] Language exposure includes both qualitative and quantitative elements, meaning that both the number of words and the complexity of language that a child hears have an impact on developing language proficiency. These inputs may also influence nonverbal abilities as well, including math skills, social skills, and executive functioning**.** There is a well-documented correlation between educational success and these cognitive skills, and increased language exposure may have positive effects both in cognitive development and in standardized test scores.[5]

The United States' education system has recently become more oriented toward curricula that encourage development of cognitive skills, with Common Core guidelines emphasizing problem solving and abstract reasoning.[5] However, a lack of understanding of the scientific basis of interventions can lead to the implementation of poorly designed programs, which would be a waste of time, money, and public resources. A study by Dekker et al. (2012) found that teachers in the UK and the Netherlands believed 49% of "neuromyths," common misconceptions about the brain and education, such as, "Exercises that rehearse coordination of motor-perception skills can improve literacy skills," and, "Differences in hemispheric dominance (left brain, right brain) can help explain individual differences amongst learners."[6] Educators are aware of difficulties that face their students but may be inadequately informed of evidence-based ways to address these issues, highlighting a need for better communication between the scientific and education communities.

Brain Evidence

Low SES has been broadly associated with atypical grey matter development and regional brain volume differences in the frontal lobe, temporal lobe, hippocampus, amygdala, as well as differences in white matter structure.[7,8] However, the specific underlying causes and experiences that lead to changes in specific regions of the brain remained unclear after these differences were identified.

Some research has associated changes in the language network with variance in language exposure. The language network in the brain is left-lateralized and involves a variety of regions including the left inferior frontal gyrus (LIFG), left superior temporal gyrus (LSTG), left middle temporal gyrus (LIMG), and left inferior temporal gyrus (LITG). Noble et al (2012) note an interaction between SES and age in the LSTG and LIFG, showing that differences in regional volumes between high- and low-income children increase with age. The authors postulate that a disparity in linguistic exposure between these groups that increases with age may underlie these results.[8] More recent work has shown a positive correlation between the amount of adult-child conversational turns (pairs of utterances between children and adults during linguistic interaction) and the strength and coherence of white matter connectivity in the left arcuate fasciculus, which connects critical language areas in the LIFG (Broca's area) and LSTG (Wernicke's area).[9] fMRI evidence has shown that a greater number of conversational turns is also

associated with greater activation Broca's area during language processing.[10] Other research has shown that greater complexity of maternal language is associated with more grey matter volume in the left hemisphere, specifically in language areas.[4] These findings provide important neurological evidence that both quality and quantity of child-adult conversation impact language development, which supports behavioral findings.

Evidence for Intervention

Much of the literature for language-based interventions focus on children with language-related disabilities or deficits, though there have been some studies of programs for typically developing children. Meta-analysis of parent-implemented language interventions in young children with language impairments has shown positive effects on receptive and expressive language skills in children both with and without intellectual disabilities, although it is unclear if these language gains can be maintained in the long-term.[11]

School-based programs have less influence than the home-language environment but can benefit from well-trained instructors and better adherence to program guidelines. A study by Fricke et al. (2013) identified preschool students with poorly developed oral language skills and conducted a randomized controlled trial to assess the efficacy of a 30-week oral language intervention. After the intervention, students showed long-term significant improvement in oral language, spoken narrative skills, and reading comprehension, as well as a lesser effect on word-literacy.[12] The results of this study have promising implications on the possibility of using school-based interventions to help improve the performance of students who perform poorly in both oral language skills and reading comprehension.

Recommendations

Despite widespread, interdisciplinary consensus that the income achievement gap is a substantial problem facing children and the education system, there is a lack of coordinated efforts to combat this problem. Given the connections between language exposure, cognitive development, and academic success, early language programs may be an opportunity for intervention that is effective, non-invasive, and relatively low-cost. Figure 1 demonstrates a possible pathway between low SES and low academic performance and indicates the proposed point of intervention. There are many areas of cognitive ability that can have positive outcomes in school performance, but the potential for language to have such widespread effects makes it a particularly rich target for intervention.

Effective programs will benefit from both school- and home-based components, as positive results have been shown for both kinds of interventions. Further research on intervention programs, particularly longitudinal studies, will be necessary to understand whether they are able to prevent or

reverse the neural differences associated with the achievement gap, but the evidence from existing work indicates that quantity and quality of language input will both be important for maximizing potential benefits of intervention programs.[9,4]

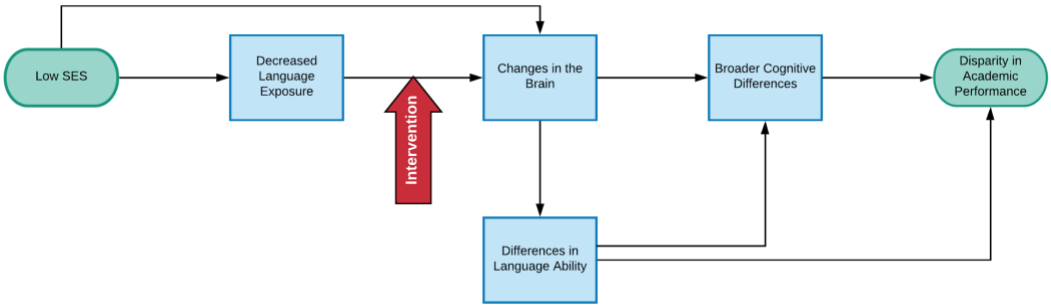

Figure 1

Conclusion

The income achievement gap is a growing problem in the United States education system that demands a response from scientists and policy makers. The growing behavioral and neurological evidence for the role of language exposure in the path between SES and the income achievement gap indicates that language-based intervention will be a promising method to reduce disparities in cognitive development and academic performance. More research will be necessary to determine if language-based intervention programs will have measurable, long-term effects on the achievement gap, but existing work shows potential for positive results. Effective program and policy design will require communication and collaboration between teachers, parents, neuroscientists, and policymakers to ensure that plans are achievable and evidence-based.

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