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Literacy, Poverty, and Brain Development: Toward a New, Place-Based Educational Intervention

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LITERACY, POVERTY, AND BRAIN DEVELOPMENT: TOWARD A NEW, PLACE-BASED EDUCATIONAL INTERVENTION

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I. INTRODUCTION

This paper provides an overview of emerging research focused on how living in an area of concentrated poverty can impact brain development and explores some possible applications of this research to education policy. One of the key findings is that state and federal policy-makers may need to adopt programs that integrate educational policy with housing and planning policy in order to protect and fulfill each child's educational rights.

In order to impress upon readers the scale of the nation's current educational failures and the need for a significant change in policy, this paper first addresses adult illiteracy in the United States. After defining functional illiteracy according to metrics derived from the National Adult Literacy Survey, this paper then explores the various ways in which high rates of functional illiteracy negatively impact our society. The negative effects of living in an area of concentrated poverty, which correlates with functional illiteracy, and the difficulty inherent in escaping such areas of concentrated poverty are also briefly examined.

The paper then proceeds to discuss the evolution of educational rights, and how federal and state courts have interpreted state obligations to provide a fair, equal, and meaningful opportunity to a sound basic education.[1] The paper also examines the effectiveness of various remedies instituted as a result of successful education litigation. This discussion aims to establish not only the existence of educational rights, but also the inadequacy of previous efforts to implement and enforce such rights. The key problem identified in the paper is that previous approaches to effectuate educational rights, including court-ordered remedies, have failed to account for circumstantial factors relating to the socio-economic conditions within particular school districts.

Finally, the paper provides an overview of emerging neuroscience research related to cognitive development and socioeconomic status, which illustrates how the circumstances in which a child is raised can significantly inhibit that child's educational opportunities. While the field of neuroscience has only just begun to investigate the effects of socioeconomic status, including both family and community wealth, on brain development and function, preliminary studies indicate a correlation between socioeconomic status and some aspects of brain development

[1] 20 U.S.C. § 6301 (2006).

which may have an impact on student performance in typical school settings.

The bulk of this new research suggests that the observed correlation between socioeconomic status and academic achievement results from the impacts of maturing in a high-poverty area, with all the environmental and social factors that status entails, on the developing brain. While some may wish to argue that observed biological differences along socioeconomic lines are more innate or immutable than differences in relation to behavior, the consensus among researchers tends to be that there is little evidence to support that theory. Research instead indicates that prenatal factors, parent-offspring interactions, cognitive stimulation and environmental conditions at least partly underlie the effects of socioeconomic status on brain development.[2] Essentially, the studies suggest that it is nurture, rather than nature, which plays the primary role in brain development and cognitive function in children living in areas of concentrated disadvantage.

This paper concludes by considering policy options that should be pursued if a causal link between socioeconomic status and cognitive development is concretely established. If the emerging neuroscience turns out to provide a compelling causal link between socioeconomic status and brain developments that in fact impairs students' ability to take advantage of the educational opportunities provided in our public schools, then States may need to modify education policies to provide children from a low-socioeconomic background an equal opportunity to exercise their right to a comprehensive educational opportunity. Early education approaches that focus on literacy skills, for example, have the potential to mitigate at least some of the inherent disadvantages held by students from low-socioeconomic backgrounds.[3] The neuroscience research suggests, however, that including housing policy considerations alongside educational reforms, with the aim of eliminating areas of concentrated poverty, may be an even more effective method of addressing educational inequity and may, in some cases, be a constitutional requirement.

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[2] Daniel A. Hackman, Martha J. Farah & Michael J. Meaney, Socioeconomic Status and the Brain: Mechanistic Insights from Human and Animal Research, 11 NATURE REVIEWS: NEUROSCIENCE 652 (2010), available at http://repository.upenn.edu/cgi/viewcontent.cgi?article=1071&context=neuroethics_pubs.

[3] Id. at 655 ("[T]he level of cognitive stimulation in early childhood predicts language-related skills in low SES adolescents independently of the quality of parental care and maternal intelligence.").

II. LITERACY AND INTERGENERATIONAL POVERTY

The CIA World Factbook lists the literacy rate of the United States, defined as the percentage of citizens age 15 or over who can read and write, at 99%.[4] However sunny a statistic it may be, this figure is misleading. Literacy is not binary, and is more accurately measured on a graduated scale such as the one used by the National Center for Education Statistics in its assessments of adult literacy.[5] An adult may be able to read and write her own name, or locate simple information in a short passage of text, but in an increasingly text-based society these skills are not enough;[6] in order to thrive now and, even more importantly, going forward, a high minimum of literacy will be necessary for the citizens of the United States.

Data from the 1993 National Adult Literacy Survey report shows that a significant number of adults in the United States are less than functionally literate, which causes inefficiency in the collection and use of public resources.[7] The study provides evidence that children whose parents did not graduate high school are the group of students most at risk of remaining functionally illiterate.[8] A change in how state governments regard their obligation and administer their education programs may be necessary to break out of this slump;[9] evidence shows that between the 1993 and 2006 literacy reports there was no significant change in literacy rates among the population.[10]

A. Literacy's Impact

A high literacy rate is a hallmark of a successful education system, and higher levels of literacy are associated with a greater chance of high school

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[4] Central Intelligence Agency, The United States, THE WORLD FACTBOOK (last updated Aug. 22, 2013), https://www.cia.gov/library/publications/the-world-factbook/geos/us.html.

[5] IRWIN S. KIRSCH ET AL., Adult Literacy in America: A First Look at the Findings of the National Adult Literacy Survey, NAT'L CTR. FOR EDUC. STATISTICS (3d ed. 2002), available at http://nces.ed.gov/pubs93/93275.pdf [hereinafter KIRSCH ET AL.].

[6] Id. at xxii.

[7] IRWIN S. KIRSCH, ANN JUNGEBLUT, LYNN JENKINS & ANDREW KOLSTAD, NAT'L CTR. FOR EDUC. STATISTICS, ADULT LITERACY IN AMERICA: A FIRST LOOK AT THE FINDINGS OF THE NATIONAL ADULT LITERACY SURVEY, 12 (1993), available at http://files.eric.ed.gov/fulltext/ED358375.pdf [hereinafter KIRSCH 1993]; JACKSONVILLE COMMUNITY COUNCIL INC., IMPROVING ADULT LITERACY, 2 (1999), available at http://www.jcci.org/jcciwebsite/documents/99%20Adult%20Literacy.pdf.

[8] KIRSCH 1993, supra note 7, at 28-29.

[9] For instance, considering early education as a right.

[10] National Assessment of Adult Literacy (NAAL), NAT'L CTR. FOR EDUC. STATISTICS, http://nces.ed.gov/naal/kf_demographics.asp (last visited Sept. 5, 2013).

graduation, an important measure of educational attainment. Higher levels of literacy are associated with decreased instances of poverty and food stamp usage, and correlates with a greater likelihood of receiving interest from savings or other bank accounts, and higher rates of employment.[11] A recent study by Henry Levin et al. shows that for every new high school graduate, the public will reap a benefit of $209,000 in increased tax revenue and decreased government spending over the course of that graduate's lifetime.[12] Considering that nearly a quarter of 20 year old men in the United States are high school dropouts, as are 15% of 20 year old women,[13] it appears that improving overall literacy could increase high school graduation rates and result in a net economic benefit to the public.

Another social benefit that may result from increased literacy is greater public political engagement. Robust political participation by a state's citizens is indicative of good governance, and exercising the right to vote is often characterized as a citizen's duty.[14] It should come as no surprise that higher rates of literacy are also associated with greater instances of voter participation.[15] A certain minimum level of literacy is necessary for expressing one's political opinions at the polls, and state courts have even recognized the legality of literacy tests designed to promote intelligent use of the ballot.[16] It stands to reason that increased levels of literacy would be a boon to an increasingly gridlocked political system.

Increased literacy will allow citizens to more effectively exercise the right to vote, thus carrying out their duty of political participation, and state governments would be able to more accurately interpret and carry out the will of the people. Without a minimum level of literacy, a citizen of the United States has little chance of exercising her right to vote in an informed manner, meaning her vote will not accurately reflect her political preferences. Under this political system, at our country's current literacy rates, we run the risk of transforming citizens into subjects, second class to those who have the education and ability to inform themselves before they cast a vote.

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[11] KIRSCH ET AL., supra note 5, at 68.

[12] Henry Levin et al., The Costs and Benefits an Excellent Educat*ion for All of America's Children* (2007), http://www.literacy.cooperative.org/documens/Thecostsandbenefitsofanexcellentedforamerchildren.pdf.

[13] Id. at 3.

[14] Loren E. Lomasky & Geoffrey Brennan, Is There a Duty to Vote?, 17 SOC. PHIL. & POL'Y 62 (2000).

[15] KIRSCH ET AL., supra note 5, at 53.

[16] Lassiter v. Northampton Cnty. Bd. of Elections, 360 U.S. 45 (1959).

Data shows that a significant number of adults in the United States are less than what can be considered sufficiently literate, and this may cause inefficiency in the use and collection of public resources.[17] Increasing adult literacy in the United States could result in greater tax revenue, as well as savings on government expenditures related to crime, health and welfare. A program with the effect of increasing literacy would likely provide significant economic benefit to federal, state, and local governments across the board, and could improve public health. The question remains, however, as to what level of literacy is required to result in such net social gains.

B. Defining Functional Literacy

Over the last century there have been many different definitions of literacy. In the early twentieth century an individual was considered literate if she could read and sign her own name, whereas by 1958 the conception of literacy had progressed to the point that the United Nations Educational, Scientific, and Cultural Organization only defined an adult as literate if she could read and write a simple statement about daily life.[18] This is a fairly substantial increase in the expectation of what literacy entails; in the early 1900s all that was required was recognition of one's own name, while the 1958 standard requires at least some composition skills.[19] Since then, the definition of literacy has continued to develop. In the Workforce Investment Act of 1998, Section 203, literacy is defined as "[a]n individual's ability to read, write, and speak English, compute, and solve problems, at levels of proficiency necessary to function on the job, in the family of the individual, and in society."[20] Taking this definition into account, literacy is not only better measured on a graduated, rather than binary, scale, but is also better understood as an individual's ability to function at a proficient level in various situations, and across a multitude of disciplines.

The National Adult Literacy Survey ("NAAL") provides a nuanced look at literacy rates among adults in the United States. Literacy is divided into three different scales of prose, document, and quantitative, and literacy is measured along a spectrum of four different levels of competency, with Level 1 being the lowest.[21] Prose literacy concerns the knowledge and skills

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[17] KIRSCH ET AL., supra note 5, at xi–xii; Levin et al., supra note 12, at 2 (observing that educational "inequalities may create costly consequences for the larger society").

[18] LITERACY IN AMERICA: AN ENCYCLOPEDIA OF HISTORY, THEORY, AND PRACTICE 19 (Barbara J. Guzzetti ed., 2002).

[19] Id.

[20] 20 U.S.C. § 9202(12)(2006).

[21] KIRSCH ET AL., supra note 5, at 8–9.

necessary to understand and use information from various texts, including editorials, news stories, poems, and fiction.[22] Document literacy relates to knowledge and skills needed to locate information in materials such as job applications, maps, transportation schedules, tables, and graphs.[23] Finally, quantitative literacy measures the knowledge and skills required to perform arithmetic using numbers contained within printed materials.[24]

Generally, those adults performing at Level 1 in prose literacy can do no more than locate a single piece of information in a relatively short text, if that piece of information is identical to or synonymous with information given in the question.[25] Adults performing at Level 1 on the document literacy scale are limited to locating a piece of information based on an identical match and entering information into a document from personal knowledge.[26] At Level 1 on the quantitative scale, adults can perform single, rather simple arithmetic operations based on a passage of text when the numbers used are provided and the operation is specified.[27] Adults having only these basic skills would not be able to calculate the difference in price between tickets for two different shows, or locate an intersection on a street map.[28] It is clear that adults functioning at Level 1 in all skill levels cannot be said to have the proficiency necessary to function well on the job, in the family, and in society.

Adults performing at Level 2 on the NAAL survey are not significantly better off than those performing in Level 1 in terms of their capacity to function at a high level on the job, in the family, or in society. At Level 2, an adult is unable to write a brief letter explaining an error made on a credit card bill, use a bus schedule to determine the appropriate bus for a given set of conditions, or use a calculator to figure the difference between regular and sale price given in an advertisement.[29] At Level 3, an adult exhibits the literacy levels that support the idea that she may be able to function well on the job, at home, and in society. At Level 3, an adult can interpret instructions from an appliance warranty, identify information from a bar

[22] Id. at 3.
[23] Id. at 3.
[24] Id. at 3-4.
[25] Id. at 10-11 (Figures 1 and 2).
[26] Id. at 11.
[27] Id.
[28] Id. at 10.
[29] Id. at 10.

graph depicting source of energy and year, and use a calculator to determine the discount that would result if a bill is paid within 10 days.[30]

As evidenced by the significantly lower levels of poverty and food stamp usage exhibited by those in Level 3 or above,[31] as well as this group's higher rate of employment,[32] these literacy skills seem to represent the basic minimum proficiencies necessary to thrive in our increasingly information based society. Level 3 represents what seems to be a fair, achievable, minimum level of literacy, referred to hereinafter as "functional literacy," which should be the goal for every state to aid its citizens in reaching for all of the reasons laid out in the preceding section.[33] An examination of the information provided by the 1992 National Adult Literacy Survey reveals the extent of functional literacy problems, which is especially prevalent in low-wealth populations.

C. Functional Literacy in the United States

The 1993 publication Adult Literacy in America, reporting on the results of the National Adult Literacy Survey conducted in 1992, indicated that 47 to 51% of adults in the United States scored in the two lowest levels of prose, document, and quantitative literacy.[34] In other words, nearly half of the nation's work force could not be considered functionally literate in 1992. Unfortunately, the 2003 report from the National Assessment of

[30] Id. at 11.

[31] Id. at 62 (Figure 2.6).

[32] Id. at 63 (Figure 2.7).

[33] While this level of literacy is significantly below that advocated by other legal and educational scholars, I believe it to be a more reasonable and attainable goal given the current state of literacy in the United States. Our current conception of what literacy standards ought to be (literacy which enables competition in a global marketplace) is supposedly reflected in standardized tests administered to students. However, anecdotal evidence suggests these standardized tests require literacy skills far above what is actually necessary for success, and such high standards may actually be hindering educational attainment. See generally Marion Brady, When an Adult Took Standardized Tests Forced on Kids, WASH. POST (Dec. 5, 2011, 4:00 AM), http://www.washingtonpost.com/blogs/answer-sheet/post/when-an-adult-took-standardized-tests-forced-on-kids/2011/12/05/gIQApTDuUO_blog.html?tid=sm_btn_twitter. Since literacy levels in children are strongly correlated with parental education and home literacy environment, I believe any true remedy for prevalent functional illiteracy will require multiple generations to implement. Until parental education and home literacy environments for those at the bottom of the literacy scale somewhat equalize with those at the upper end of the literacy scale, we need to set realistic standards. Until the whole of the country is on equal footing we cannot hold all students to the same high standards; we cannot so rapidly advance literacy standards in this country, with all the social and economic inequities currently present, without leaving behind a significant portion of our population.

[34] KIRSCH 1993, supra note 7, at 17 (Figure 1.1).

Adult Literacy shows little in the way of significant change in those statistics.[35]

A more in depth examination of the information contained in the 1993 publication reveals an even starker picture of existing disparities along racial and socioeconomic lines which, if left untreated, threaten to divide this country. Increasingly, the more literate, more educated worker is taking a larger piece of the economic pie, while those with only basic skills are being left behind.[36] It bears repeating that this problem of functional illiteracy, if left untreated, may lead to the underrepresentation of a large portion of the public in our political system, and the United States runs the risk of making subjects of its citizens.

The public school system is the primary method instrument though which the state can influence literacy levels. Unsurprisingly, an individual's level of educational attainment, out of all the distinguishing factors explored by the 1992 survey, is most strongly related to their level of literacy.[37] As previously mentioned, high school graduation is a significant educational achievement, resulting in economic and social benefit to both the individual and the state.[38] Of those surveyed who did not graduate from high school, 87.5% did not meet the standards of functional literacy on the prose scale, 90% did not score as functionally literate on the document scale, and 86.5% received scores indicating less than functional literacy along the quantitative scale.[39] Additionally, the level of education achieved by an individual's parents, which the authors of the 1993 study take as a given to be a proxy for socioeconomic status,[40] has a strong impact on that individual's literacy levels. The study shows that students whose parents did not graduate high school will not, on average, achieve functional literacy, even if they graduate high school.[41]

The 1993 publication contains information directly relating literacy levels to socioeconomic status, considering nonwage income or support, and poverty rates. According to the survey's definitions, approximately 20% of those surveyed were living in poverty.[42] Of this 20%, nearly three-

[35] KIRSCH ET AL., supra note 5, at 17 (Figure 1.1).
[36] Id. at xxii.
[37] Id. at 26 (Figure 1.3).
[38] NAT'L CTR. FOR EDUC. STATISTICS, supra note 10.
[39] KIRSCH ET AL., supra note 5, at 26 (Figure 1.3).
[40] Id. at 28.
[41] Id. at 29 (Figure 1.4).
[42] Id. at 17 (Figure 1.1), 61 (Figure 2.5). The statistics in these figures were averaged together to find the percent of population living in poverty.

quarters were functionally illiterate.[43] An individual who is functionally illiterate is approximately three times more likely to live in a state of severe economic disadvantage when compared to a functionally literate individual, and is also nearly three times more likely to receive food stamps.[44] Those who are functionally literate are significantly less likely to be in an economically stable living situation.[45]

The functionally illiterate are underrepresented in the country's political dialogue, and overrepresented in its prison system. The interests of the functionally illiterate as a group are underrepresented in government; the functionally illiterate make up only about 43.5% of the actively voting electorate, less than their overall share of the general population, whereas the functionally literate are almost 30% more likely to vote in an election.[46] Furthermore, while the functionally literate only make up 47 to 51% of the general population, they make up 68 to 72% of the prison population.[47]

The functionally illiterate make up a significant number of the nation's high school dropouts, are more likely to be living in socioeconomically disadvantaged situations, more likely to receive food stamps, and less likely to have steady income during turbulent economic times. Furthermore, the functionally illiterate's interests are underrepresented in government, and they are jailed at a disproportionate rate. The functionally illiterate as a group deserve special attention from state governments, since safeguarding the health and welfare of its citizens is a state's primary obligation.

Functional illiteracy seriously hinders the nation's social, economic, and political systems, and must be treated as such. From the evidence above, students whose parents did not graduate high school have an elevated risk of remaining functionally illiterate, even if they manage to achieve a high school graduation themselves. These children come from families that are far more likely to be socioeconomically disadvantaged, and to live in high-poverty areas or school districts that are educationally underserved. As such, access to post high school education is an exception, rather than the norm, for these children. Families living in these areas of concentrated poverty, especially when they have lived in such areas for more than one generation, are most likely to produce students that never achieve functional literacy, and should be the focus of intervention efforts.

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[43] Id. at 61 (Figure 2.5).
[44] Id. at 62 (Figure 2.6).
[45] Id. at 62.
[46] Id. at 17 (Figure 1.1), 54 (Figure 2.1). The statistics in these figures were used to draw the stated conclusions.
[47] Id. at 51 (Figure 1.12).

D. The High-Poverty Trap

Areas of concentrated poverty are especially deleterious to social, economic, and political development, and serve as bastions of enduring inequality. In a new book, Stuck in Place, Professor Patrick Sharkey examines the nature of urban ghettoes, focusing on how and why multiple generations live in similarly impoverished contexts, and the impact this multigenerational inhabitation of ghettos has on our most disadvantaged citizens.[48] Sharkey conceives of the ghetto "as the 'spatial expression of social processes' – including process of social and economic exclusion, exploitation, abandonment, disinvestment, and racial stigmatization and domination."[49] It is important to note that inequality extends far beyond the individual or family level, such that "various forms of inequality are organized or clustered in social settings like neighborhoods, schools, and political districts, and these social settings represent crucial sites at which American inequality is generated, maintained, and reinforced."[50]

The full impact of these detrimental social processes cannot be realized without examining the "disadvantages faced by children in poor or violent neighborhoods in relation to a history of disadvantage experienced by family members."[51] "The consequences of living within deprived residential environments over multiple generations are much more severe than the consequences of living in a poor neighborhood at a single point in time, or even in a single generation."[52] According to Sharkey,

> [I]t is the cumulative effect of living in concentrated disadvantage, over generations, that is particularly severe. When families live in disadvantaged neighborhoods over multiple generations, children show substantially worse developmental outcomes when compared to families that live in poor neighborhoods in a single generation, and this remains true even after we account for everything else about a family that might affect children's development.[53]

The high-poverty trap is an especially important problem in the context of African American students, because "almost three out of four black families living in today's most segregated, poorest neighborhoods are the

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[48] PATRICK SHARKEY, STUCK IN PLACE: URBAN NEIGHBORHOODS AND THE END OF PROGRESS TOWARD RACIAL EQUALITY (University of Chicago Press 2012).
[49] Id. at 13.
[50] Id. at 14.
[51] Id. at 10.
[52] Id. at 7.
[53] Id. at 46.

same families that lived in the ghettos of the 1970s."[54] While there is no one single factor that explains why high-poverty areas are so difficult for families to escape, a confluence of many influences, such as "social and psychological ties to places, discrimination, informal intimidation, and individual preferences" all contribute to the lack of intergenerational contextual mobility.[55]

In addition to a dearth of resources and investment, high-poverty neighborhoods have a much higher unemployment rate than the nation as a whole, more than triple the national average in the year 2000.[56] This high unemployment rate may be explained by the fact that "multiple generations of family members have been taught in the nation's worst schools and have been exposed to the nation's most unhealthy and most violent environments."[57] The prevalence of violence could also contribute to the unemployment rate. As Sharkey observed:

> Violence undermines community organization and cohesion, and it 'gets into the minds' of children to affect every aspect of their daily lives, from their willingness to leave the home to the way they interact with peers to the way they behave and perform in the classroom. 'Men tangled in the criminal justice system become permanent labor market outsiders, finding only temporary or unreliable jobs that offer little economic stability. Without the realistic prospect of stable employment, it is extremely unlikely that these men can support a family, and the pathologies of everyday life in America's prisons make it difficult to reengage in the social life of a community. The result is a segment of the community that is detached from the legal labor market and detached from the family unit.[58]

Evidence suggests that as neighborhood conditions decline, rates of crime increase,[59] and exposure to violence has been observed to inhibit student performance.[60] Researchers using information from the Project on Human Development in Chicago Neighborhoods ("PHDCN"), have stated that "within the PHDCN study, there is evidence that test scores are lower

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[54] Id. at 45.

[55] Id. at 34. Contextual mobility is defined as the overall degree of movement across neighborhoods characterized by differential levels of economic resources and status. Contextual mobility is defined as the overall degree of movement across neighborhoods characterized by differential levels of economic resources and status. Id. at 16.

[56] Id. at 30.

[57] Id. at 26.

[58] Id. at 76 (citing BRUCE WESTERN, PUNISHMENT AND INEQUALITY IN AMERICA (Russell Sage, 1st ed. 2006)).

[59] LEE ELLIS, KEVIN M. BEAVER, JOHN WRIGHT, HANDBOOK OF CRIME CORRELATES 237 (2009).

[60] See Patrick Sharkey, *The Acute Effect of Local Homicides on Children's Cognitive Performance*, 107 PNAS, 11733, 11733–11738 (2010), available at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2-900647/pdf/pnas.201000690.pdf.

for children tested within a week of a homicide occurring in their neighborhood compared to children from the same neighborhood assessed at a further point in time from the most recent local homicide."[61] Building an enduring, high-quality educational system in areas of concentrated poverty is an especially difficult task, since "it is not surprising that quality teachers are unwilling to devote their energies to teaching in schools where safety and discipline become more important than learning, where violence can be as great a concern as educational advancement."[62]

Educational equity has been the subject of much litigation[63] and has met with varying levels of success, which in turn has defined the contours of the right to an education held by our citizens. Generally it has been recognized that students should be afforded substantially similar educational opportunities.[64] Mounting evidence now exists that any policy focused on providing students with an objectively meaningful opportunity to receive the benefits of an equal education must focus on long-term inhabitants of concentrated poverty.[65] Unfortunately, despite decades of litigation focused on improving education, significant gaps in achievement between students of different race and economic class remain,[66] indicating it may be time for a different, broader approach to educational inequities.

III. THE RIGHT TO AN EDUCATION

All three branches of the federal government have acknowledged the importance of education in the lives of American citizens. The Supreme Court has not only recognized the crucial role a quality education plays in preparing an individual to be an active participant in modern society,[67] but

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[61] JULIA BURDICK-WILL ET AL., CONVERGING EVIDENCE FOR NEIGHBORHOOD EFFECTS ON CHILDREN'S TEST SCORES: AN EXPERIMENTAL, QUASI-EXPERIMENTAL, AND OBSERVATIONAL COMPARISON 26–27 (2010), available at http://cas.uchicago.edu/workshops/education/files/2010/03/Burdick-Will-Ed--Workshop-20100301.pdf (published for the Brookings Institution "Project on Social Inequality and Educational Disadvantage: New Evidence on How Families, Neighborhoods and Labor Markets Affect Educational Opportunities for American Children").

[62] SHARKEY, supra note 48, at 14.

[63] See Derek Black, Unlocking the Power of State Constitutions with Equal Protection: The First Step Toward Education as a Federally Protected Right, 51 WM. & MARY L. REV. 1343, 1347 (2010) (citing Kadrmas v. Dickinson Pub. Schs., 487 U.S. 450 (1988); Papasan v. Allain, 478 U.S. 265 (1986); San Antonio Indep. Sch. Dist. v. Rodriguez, 411 U.S. 1 (1973)).

[64] See Black, supra note 63, at 1360.

[65] Id. at 1354 (describing the educational inequality, despite the states' efforts, between students who are poor and students that are not).

[66] Id. at 1354.

[67] Wisconsin v. Yoder, 406 U.S. 205, 221 (1972) ("[E]ducation prepares individuals to be self-reliant and self-sufficient participants in society.").

the difficulties and stigma attached to illiteracy in our society as well.[68] Congress, too, has gone on record "[r]ecognizing that the Nation's economic, political, and social security require a well-educated citizenry."[69] Congress has stated that the Nation's goal of providing citizens an equal educational opportunity, sufficient to bring about each student's full potential without financial barriers, is one of high priority.[70] Congress has not only focused on ensuring provision of equal educational opportunities to children from a low socioeconomic background,[71] but has also highlighted the importance of early literacy programs,[72] and recognized the importance of early childhood development in educational attainment.[73] Finally, the President has also pronounced that "[e]ducation is essential to our success as both a people and a Nation," and has indicated that "providing a complete and competitive education for every student, from cradle through career" should be the nation's educational goal.[74]

Over the past several decades, state courts have been fertile grounds for education litigation, with many state courts recognizing a fundamental state constitutional right to an education.[75] However, this strategy has its limits; state courts are not designed for continuous oversight and some commentators question whether state court litigation has produced significant benefits.[76] While they may be less than perfectly effective, the courts still remain one of the most viable avenues through which education reform, especially reform directed at improving educational opportunities for disadvantaged groups in our society, can occur.[77] Indeed, courts may be

[68] Plyler v. Doe, 457 U.S. 202, 223 (1982) ("The stigma of illiteracy will mark them for the rest of their lives. By denying these children a basic education, we deny them the ability to live within the structure of our civic institutions, and foreclose any realistic possibility that they will contribute in even the smallest way to the progress of our Nation.").

[69] 20 U.S.C. § 1221-1 (2006).

[70] Id.

[71] See 20 U.S.C. § 6301 (2006).

[72] 20 U.S.C. § 6361 (2006).

[73] 20 U.S.C. § 1431 (2006).

[74] Proclamation No. 8602, 75 Fed. Reg. 71,005 (Nov. 16, 2010).

[75] Peter Enrich, Leaving Equality Behind: New Directions in School Finance Reform, 48 VAND. L. REV. 101, 185-94 (1995) (providing a dated, but still useful list of state court decisions profiling the status of state educational rights in relation to school finance).

[76] See Derek Black, Unlocking the Power of State Constitutions with Equal Protection: The First Step Toward Education As A Federally Protected Right, 51 WM. & MARY L. REV. 1343, 1371-72 (2010) (citing John Dayton & Anne Dupre, *School Funding Litigation: Who's Winning the War?*, 57 VAND. L. REV. 2351, 2409-10 (2004) (indicating that school funding victories still often leave serious inequalities and problems behind)).

[77] Id. at 1372. See also MICHAEL A. REBELL, COURTS & KIDS 28 (2009) (making note of instances "where major reforms were quickly and effectively implemented within months of the court's ruling").

better suited to the declaration of educational rights than the various state legislatures due to advantages in evidence gathering and deliberation.[78]

Although there is currently no recognized federal right to an education, many state courts have recognized a fundamental right to an education emanating from state constitutions, while others recognize a right to an education of a specific, minimum quality. In states recognizing education as a fundamental or a statutory right, equal protection theories may be combined with recent neurocognitive research to move the educational system toward an objectively meaningful opportunity for students of every socioeconomic background to receive the benefits of an equal education.[79]

A. Education Rights in the Supreme Court

In Brown v. Board of Education, the Supreme Court applied the Fourteenth Amendment's Equal Protection Clause to determine that segregation of schools based on students' race, all other aspects of the educations being equal, was a violation of equal protection and unconstitutional, because such a scheme denied to minority children equal educational opportunities.[80] The Court stated that:

> [Education] is the very foundation of good citizenship. Today it is a principal instrument in awakening the child to cultural values, in preparing him for later professional training, and in helping him adjust normally to his environment. In these days it is doubtful that any child may reasonably be expected to succeed in life if he is denied the opportunity of an education.[81]

Despite this strong language, the Court rejected the appellees' argument in San Antonio Independent School District v. Rodriguez that education is a fundamental right, local control of which is subject to strict scrutiny under the Equal Protection Clause of the Fourteenth Amendment.[82]

The Rodriguez court considered arguments that Texas's system of public school financing violated the Equal Protection Clause of the Fourteenth

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[78] MICHAEL A. REBELL, COURTS & KIDS 28, at 10-11 (2009) (observing the "evidentiary records accumulated in the court cases were more complete and had more influence on the actual decision-making process than did the factual data obtained through legislative hearings" and that "courts' discovery processes are sometimes more comprehensive than the data-gathering techniques available to professionals in the field" of social science.).

[79] See Enrich, supra note 75, at 185-94 (discussing state courts); see also 20 U.S.C. § 1221-1 (2006) (discussing national policy with respect to equal education opportunity).

[80] Brown v. Bd. of Educ. (Brown I), 347 U.S. 483, 488 (1954), supplemented sub nom. Brown v. Bd. of Educ. (Brown II), 349 U.S. 294 (1955).

[81] Brown I, 347 U.S. at 493.

[82] San Antonio Indep. Sch. Dist. v. Rodriguez, 411 U.S. 1, 18 (1973).

Amendment because it had a disparate, discriminatory effect on the educational opportunities of children from comparatively poor school districts. The Court found "the Texas system of financing public education [did not operate] to the disadvantage of some suspect class or [impinge] upon a fundamental right explicitly or implicitly protected by the Constitution."[83] Furthermore, the Court rejected the idea that socioeconomically disadvantaged persons could be regarded as a suspect class deserving of special scrutiny under the Fourteenth Amendment.[84] Even after the Supreme Court's rejection of a federally protected right to an education in Rodriguez, the Court has repeatedly stressed the importance of education, and a willingness to consider equal opportunity issues.

In Goss v. Lopez, a decision handed down only two years after Rodriguez, the Supreme Court recognized "a student's legitimate entitlement to a public education as a property interest which is protected by the Due Process Clause" in states which have compulsory school attendance laws.[85] The Court's decision indicates a continued willingness to apply provisions of the Fourteenth Amendment to protect a student's legitimate interests in an education, even outside the context of education as a federal right. True to this early indicator, the Court continued to apply Fourteenth Amendment protections to students' educational rights, and continued the loaded rhetoric concerning the importance of literacy and education in modern American society.

In Plyler v. Doe, en route to upholding a challenge directed at a Texas law denying the children of illegal immigrants the right to a free public education, the Supreme Court referenced the "pivotal role of education in sustaining our political and cultural heritage,"[86] and observed that"[i]lliteracy is an enduring disability. The inability to read and write will handicap the individual deprived of a basic education each and every day of his life."[87] The Court further acknowledged "[t]he inestimable toll of that deprivation on the social economic, intellectual, and psychological well-being of the individual, and the obstacle it poses to individual achievement."[88] While not a federally protected right, the Court reaffirmed

[83] Id. at 17.

[84] Id. at 28 ("The system of alleged discrimination and the class it defines have none of the traditional indicia of suspectness: the class is not saddled with such disabilities, or subjected to such a history of purposeful unequal treatment, or relegated to such a position of political powerlessness as to command extraordinary protection from the majoritarian political process.").

[85] Goss v. Lopez, 419 U.S. 565, 574 (1975).

[86] Plyler v. Doe, 457 U.S. 202, 221 (1982).

[87] Id. at 222.

[88] Id. at 203.

that providing to citizens an equal opportunity to fully benefit from their "education is perhaps the most important function of state and local governments,"[89] and the Supreme Court can be expected to ensure that "[s]uch an opportunity, where the state has undertaken to provide it, is a right … made available for all on equal terms."[90]

Furthermore, in Lau v. Nichols, a case concerning the educational rights of Chinese-speaking students in California, the Supreme Court observed that because non English-speaking students in California public schools received fewer benefits than English-speaking students, the non English-speakers were denied "a meaningful opportunity to participate in the educational program."[91] The Court did not reach the Equal Protection claim advanced by petitioners, instead relying solely on section 601 of the Civil Rights Act of 1964 to find that "there is no equality of treatment merely by providing students with the same facilities, textbooks, teachers, and curriculum; for students who do not understand English are effectively foreclosed from any meaningful education."[92]

The Supreme Court explicitly took issue with the Ninth Circuit's reasoning that the State's inaction on behalf of non English-speaking students did not result in a denial of educational opportunities under the Fourteenth Amendment. The Ninth Circuit reasoned there was no violation because "(e)very student brings to the starting line of his educational career different advantages and disadvantages caused in part by social, economic and cultural background, created and continued completely apart from any contribution by the school system;" the Supreme Court disagreed, stating that "in our view the case may not be so easily decided."[93] The Court's special attention to, and disapproval of, the preceding line from the Ninth Circuit's opinion seems to imply that the Court also disagreed with the Ninth Circuit's subsequent logic that Fourteenth Amendment protections do not apply to differences in students created in part by differing social, economic, and cultural backgrounds, [94] or would have had it reached the Equal Protection argument.

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[89] Id. at 223.
[90] Id.
[91] Lau v. Nichols, 414 U.S. 563, 568 (1974).
[92] Id. at 566.
[93] Id.
[94] The Ninth Circuit's opinion, immediately following the text quoted by the Supreme Court, goes on to state, "[t]hat some of these may be impediments which can be overcome does not amount to a 'denial' by the Board of educational opportunities within the meaning of the Fourteenth Amendment should the Board fail to give them special attention." Lau v. Nichols, 483 F.2d 791, 797 (9th Cir. 1973), *rev'd*, 414 U.S. 563 (1974).

Education is not a federal right, but it has been the benefit of Fourteenth Amendment equal protection litigation in the past. Language in decisions such as Plyler and Lau suggests there is reason to believe that the Supreme Court would be receptive to future Fourteenth Amendment based education litigation in the future.

B. State Courts and Equality in Educational Opportunities

Claims based on federal equal protection largely came to an end after the Supreme Court's decision in Rodriguez,[95] and state courts became the primary avenues for litigants to argue for the advancement of equal educational opportunities for all students. Education rights advocates advanced arguments similar to those rejected in Rodriguez, that inequalities in school finance resulted in equal protection violations, though these arguments were based on education and equal protection clauses found in state constitutions. Where these arguments failed in the Supreme Court, they found success in the highest courts of many states. California[96] and New Jersey[97] were among the first states to recognize the application of equal protection clauses to education finance schemes. After these states recognized such educational rights, other states began to follow suit.[98]

Favorable post-Rodriguez state court decisions typically recognized a fundamental right to education emanating from state constitutions, employing both education and equal protection clauses to make such determinations.[99] Many states that found their education "financing systems unconstitutional" also found "their state's equal protection clause to be applicable and to require equal educational opportunities."[100] While these decisions were the sought-after results, their translation from the courtroom to the classroom often left much to be desired. Some state legislatures responded to court-ordered fiscal equalization by decreasing funding in well-funded districts, as opposed to increasing funding in poorer districts.[101] Even when funding equality was achieved without reduction of

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[95] Black, supra note 63, at 1359.

[96] Serrano v. Priest (Serrano II), 557 P.2d 929, 952 (Cal. 1976).

[97] Robinson v. Cahill (Robinson I), 303 A.2d 273, 281 (N.J. 1973).

[98] Dupree v. Alma Sch. Dist. No. 30, 651 S.W.2d 90, 93 (Ark. 1983); Washakie Cnty. Sch. Dist. No. One v. Herschler, 606 P.2d 310, 315 (Wyo. 1980); Pauley v. Kelly, 255 S.E.2d 859, 878 (W. Va. 1979); Horton v. Meskill, 376 A.2d 359, 373 (Conn. 1977).

[99] See Herschler, 606 P.2d 310; Pauley, 255 S.E.2d 859; Serrano, 557 P.2d 929.

[100] DuPree, 651 S.W.2d at 92 (citing Herschler, 606 P.2d 310; Pauley, 255 S.E.2d 859; Serrano, 557 P.2d 929; Horton, 376 A.2d 359).

[101] Black, supra note 63, at 1362–63 ("[P]ublic opposition to an equity based shifting of funds arose in

funds, it was still possible for districts with concentrations of poor students to actually lose money under fiscally neutral remedies.[102] Furthermore, it has been observed that equal funding by itself does not necessarily mean all students will have equal access to educational opportunities,[103] and that funding disparities by themselves do not necessarily offend uniformity clauses of state constitutions. [104]

In light of these results, many education advocates embraced the standardized testing movement to make standards-based state constitutional arguments,[105] leading to further interpretation and expansion of the right to education as protected and guaranteed under state constitutions.[106] This standards-based litigation made use of language included in state constitutions modifying the right to an education; phrases such as "sound basic education,"[107] "thorough and efficient"[108] education, and "minimally adequate education"[109] all have been construed by state courts. The Supreme Court of South Dakota, for instance, held that students' constitutional right to an adequate education is a right "that provides them with the opportunity to prepare for their future roles as citizens, participants in the political system, and competitors both economically and intellectually."[110] Connecticut's Supreme Court found that in order "[t]o satisfy this standard, the state, through the local school districts, must provide students with an objectively 'meaningful opportunity' to receive the benefits of this constitutional right."[111]

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some states and frustrated progress. This opposition led states to equalize funds by driving down overall spending across the state rather than leveling up those school districts at the bottom").

[102] William H. Clune, New Answers to Hard Questions Posed by Rodriguez: Ending the Separation of School Finance and Educational Policy by Bridging the Gap Between Wrong and Remedy, 24 CONN. L. REV. 721, 730 (1992) (citing Mark G. Yudof, School Finance Reform: Don't Worry, Be Happy, 10 REV. LITIG. 585, 595–96 (1991)).

[103] Julie Zwibelman, Broadening the Scope of School Finance and Resource Comparability Litigation, 36 HARV. C.R.-C.L. L. REV. 527, 530 (2001) (arguing that "[b]ecause different children have different needs, equal funding will often fail to provide truly equal educational opportunities").

[104] Roosevelt Elementary Sch. Dist. No. 66 v. Bishop, 877 P.2d 806, 816 (Ariz. 1994). The Arizona Supreme Court observed that "a general and uniform school system does not require perfect equality or identity," and further noted that "a system that acknowledges special needs would not run afoul of the [State's] uniformity clause."

[105] Black, supra note 63, at 1363–64.

[106] Id. at 1364.

[107] Bd. of Educ. v. Nyquist, 439 N.E.2d 359, 369 (N.Y. 1982); Leandro v. North Carolina, 488 S.E.2d 249, 254 (N.C. 1997).

[108] Abbott v. Burke, 575 A.2d 359, 363 (N.J. 1990).

[109] Abbeville Cnty. Sch. Dist. v. South Carolina, 515 S.E.2d 535, 540 (S.C. 1999).

[110] Davis v. North Dakota, 804 N.W.2d 618, 627 (S.D. 2011).

[111] Conn. Coal. for Justice in Educ. Funding, Inc. v. Rell, 990 A.2d 206, 253–54 (Conn. 2010).

The progression of these cases and the accompanying legal commentary suggests that "society has become more aware that not all children are equal in terms of their task of learning. They have differing abilities and challenges."[112] In fact, some courts have observed that "'output' measurements may be more reliable than measurements of 'input' such as per-pupil funding or general educational funding provided by the state"[113] when it comes to determining whether states are providing students with constitutionally adequate educations. In other words, under current standards in many states, if the system of public instruction is able to produce students who are all, at minimum, prepared to participate at a recognized acceptable level politically, economically, and intellectually in our society, then unequal funding will not be viewed as denial of equal educational opportunity.

The Connecticut Supreme Court's recognition that students must be afforded an objectively meaningful opportunity to receive the benefits of an equal education moves the standard of equality even farther beyond simple equalization of spending than previous standards-based litigation.[114] This line of thought suggests that equal access to facilities and instruction by itself does not guarantee students will have an equal opportunity to fully benefit from the education provided. If, when they gain access to the education, students are at different stages of mental development, and the education is geared toward those students at the higher end of the development scale, then students who begin school with a developmental delay will be denied their right to an equal opportunity to benefit from the education provided.

Many state courts have recognized a fundamental right to an education emanating from state constitutions.[115] In these states, equity litigation can rely on equal protection provisions built into state constitutions. In states that do not have equal protection provisions in their constitutions, or states that recognize education only as a statutory, not a fundamental, right, there is reason to believe courts would be willing to apply Fourteenth Amendment equal protection standards to ensure all students are afforded an objectively meaningful opportunity to receive the full benefits of the education provided.[116]

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[112] Julie K. Underwood, School Finance Adequacy as Vertical Equity, 28 U. MICH. J.L. REFORM 493, 516–17 (1995).
[113] Leandro v. North Carolina, 488 S.E.2d 249, 260 (N.C. 1997).
[114] Roosevelt Elementary Sch. Dist. No. 66 v. Bishop, 877 P.2d 806, 816 (Ariz. 1994).
[115] Susan Neilson, Right to Shelter Under the Connecticut Constitution, 67 CONN. B. J. 441, 441 (1993).
[116] See 20 U.S.C. § 1221-1 (2006).

C. Effectiveness of Court-Ordered Remedies

Education litigation has led to the implementation of a variety of different remedies, including busing students to different districts, creating magnet schools to attract a diverse student body, and increasing funding in low-wealth districts. These interventions have been met with different results in different districts, ranging from noticeable positive impacts in student achievement, school integration, and social outcomes such as youth crime rate, to little or no impact at all in these areas. The gap in educational outcome between the Missouri v. Jenkins[117] and *Sheff v. O'Neill*[118] litigation provides a good example of how different the results of similarly targeted educational interventions can be.

Missouri v. Jenkins, a federal case concerning the Kansas City, Missouri School District ("KCMSD"), demonstrates the limits of what even extremely well funded educational interventions can achieve if they are not properly designed. In 1977, KCMSD was on the brink of collapse, underfunded, segregated, and low-achieving; however, between 1984 and 1996 the district saw an influx of approximately $1.7 billion as a result of a 1984 Court Order emanating from the Missouri v. Jenkins lawsuit, for the purpose of creating magnet schools to attract white students from the suburbs to the KCMSD schools.[119] While this money allowed for improvements to physical infrastructure, the anticipated achievement gains did not materialize, and the intervention has been viewed as a failure.[120] In 1996, the Supreme Court ruled 5-4 that "the district court had had no authority to order expenditures for the purpose of attracting suburban whites."[121] Chief Justice Rehnquist authored an opinion that the district court exceeded its authority in trying to transform the school district into a magnet school district drawing white students from surrounding areas, because there was no evidence that suburban districts had done anything to cause the segregation within KCMSD.[122]

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[117] Missouri v. Jenkins, 515 U.S. 70 (1995).

[118] Sheff v. O'Neill, 678 A.2d 1267, 1290 (Conn. 1996).

[119] Kevin Fox Gotham, Missed Opportunities, Enduring Legacies: School Segregation and Desegregation in Kansas City, Missouri, 43 AM. STUDIES 5, 27 (2002).

[120] Paul Ciotti, Money and School Performance: Lessons from the Kansas City Desegregation Experiment, 298 CATO POLICY ANALYSIS 1, 19 (1998), http://www.cato.org/sites/cato.org/files/pubs/pdf/pa-298.pdf.

[121] Gotham, supra note 119, at 27.

[122] Id. at 27.

The educational intervention that grew out of the Sheff litigation, which was state-based, resulted in the creation of a successful voluntary two-way school integration system in the Hartford, Connecticut, area, illustrating that interdistrict magnet schools can be successful in raising student achievement. Under the Sheff model, high-quality magnet schools located in and around the fairly segregated city of Hartford attract suburban students, while an Open Choice program creates the option for Hartford students to attend suburban schools.[123] As a result of this intervention, students attending the interdistrict high schools have increased scores in math and reading, while students attending the interdistrict magnet middle schools have seen reading scores increase.[124] The fact that the interdistrict magnet schools are more integrated, and have higher achieving peer environments, combined with the positive effect on student achievement, suggests that this could be a useful model for addressing some of the ills resulting from racial and socioeconomic isolation.[125] The results of the Sheff intervention illustrate that a well-executed interdistrict magnet schools can function effectively to increase student performance and diversity.

Court-ordered busing of students is another, albeit a politically unpopular, educational intervention, and was a primary result of the Swann v. Charlotte-Mecklenburg Board of Education litigation.[126] While the busing plan was politically unpopular, it appears to have been effective in integrating schools; researchers found that students were more likely to attend school with peers of their own race after the busing program was stopped and the school district re-zoned.[127] This reorganization led to a decline in educational achievement for minorities attending heavily minority schools, which in turn led to a widening of the racial achievement gap. More importantly, however, this change in student distribution led to an increase in minority crime rates.[128] Researchers found that a combination of race and income segregation leads to increases in crime, referencing data that shows "[m]inority males have significantly more

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[123] SHEFF MOVEMENT, A PARENT'S GUIDE: TO THE VOLUNTARY TWO-WAY SCHOOL INTEGRATION SYSTEM IN THE HARTFORD AREA, 2 (2012), http://www.sheffmovement.org/pdf/SheffMovement-ParentsGuide2012.pdf.

[124] Robert Bifulco et al., Can Interdistrict Choice Boost Student Achievement? The Case of *Connecticut's Interdistrict Magnet* School Program, 31 EDUC. EVALUATION & POLICY ANALYSIS 323, 323 (2009), available at http://ncspe.org/publications_files/OP167.pdf.

[125] Id. at 341.

[126] Swann v. Charlotte-Mecklenburg Bd. of Educ., 402 U.S. 1, 91 (1971).

[127] Stephen B. Billings et al., School Segregation, Educational Attainment and Crime: Evidence From the End of Busing in Charlotte-Mecklenburg 20 (Nat'l Bureau of Econ. Research, Working Paper No. 18487, 2012), available at http://www.nber.org/papers/w18487.pdf?new_window=1.

[128] Id. at 25.

arrests and days incarcerated when they are assigned to schools with more poor minorities," but finding "no impact on crime [when minority males are] assigned to schools with more non-poor minorities or poor non-minorities."[129] The researchers further concluded that while compensatory resource allocation policies probably played a role in mitigating segregation's impact on educational achievement, such policies had no discernible impact on youth crime rates.[130] The experience with busing in Charlotte-Mecklenburg shows that, while mixing students through busing may decrease the racial achievement gap, such court-ordered interventions are not likely to create lasting gains once the orders have been lifted.

Educational interventions in Montgomery County, Maryland, provide excellent data regarding the effectiveness of educational remedies focused on school funding versus educational remedies focused on the importance of place. In "Housing Policy is School Policy," described by some as one of the most important and least discussed pieces of education research in recent years,[131] Heather Schwartz's research confirms what the Coleman Report first stated in 1966: that the socioeconomic characteristics of a student and the student's classmates are perhaps the most important factors in academic achievement.[132] Interventions in Montgomery County took two different approaches; first, an inclusive zoning plan first implemented in 1976 which allowed low-income families chosen by lottery to live in affluent neighborhoods throughout the county, and second, an education policy adopted in 2000 focused on providing greater resources to students in the neediest schools.[133] Although the education intervention significantly increased money provided to needy schools and embraced many of the most championed school-based reforms – full-day kindergarten, smaller class sizes in early grades, a balanced literacy curriculum, and increased professional development – and increased academic achievement,[134] low-

[129] Id.

[130] Id. at 26.

[131] Robert C. Embry, Jr., *"Housing Policy is School Policy": A Modest Proposal?*, in FINDING COMMON GROUND: COORDINATING HOUSING AND EDUCATION POLICY TO PROMOTE INTEGRATION 31, 31 (Philip Tegeler ed., 2011), available at http://www.prrac.org/pdf/HousingEducationReport-October2011.pdf.

[132] David Rusk, *"Housing Policy is School Policy": A Commentary*, in FINDING COMMON GROUND: COORDINATING HOUSING AND EDUCATION POLICY TO PROMOTE INTEGRATION, supra note 131, at 21, 21.

[133] Heather Schwartz, Housing Policy is School Policy — Recent Research in Montgomery County, in FINDING COMMON GROUND: COORDINATING HOUSING AND EDUCATION POLICY TO PROMOTE INTEGRATION, supra note 131, at 15–18.

[134] Richard D. Kahlenberg, From all Walks of Life: New Hope for School Integration, AM. EDUCATOR, Winter 2012–2013, at 2, 4 available at https://www.aft.org/pdfs/americaneducator/winter1213/ae_winter2012.pdf.

income students living in low-poverty public housing and attending more affluent schools as a result of the inclusive zoning program still exhibited significantly better achievement results.[135]

While court-ordered educational remedies have been extremely helpful in pursuing an equal educational opportunity for all students, the life of court-ordered remedies is inherently limited by the court's provision of oversight. Once a district is declared unitary and the court ceases oversight, many districts slip back into older, damaging patterns of racial and socioeconomic isolation.

Educational interventions that focus exclusively on school-based remedies, while politically popular, are not necessarily adequate to protect the rights of children from impoverished communities to have an equal opportunity to receive a sound basic education. The federal government, the States, and local educational agencies need to consider more holistic, integrated programs that incorporate housing policy alongside traditional school-based educational interventions. The strong educational successes stemming from Montgomery County's inclusive zoning policy suggest that housing policies can and should serve as educational remedies, which could have broader, longer lasting impacts than court-ordered, school-based remedies, which tend to end after the court relinquishes oversight.

IV. EMERGING NEUROSCIENCE

Several avenues exist for advocates to use the courts to address the problem of widespread functional illiteracy in this country's next generation of adults. One underutilized, potentially effective, and increasingly discussed remedy may be to invest in early education programs for children from low socioeconomic backgrounds.[136] Unfortunately, equity litigation in federal and state courts advocating early childhood programs for those children most at risk of remaining functionally illiterate throughout their lives (i.e., children grow up in areas of concentrated disadvantage) was made much more difficult after Rodriguez, in which the Supreme Court

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[135] See Schwartz supra note 133, at 17–19. It should be noted that significant achievement gains did not begin to materialize until low-wealth students spent approximately four years in the wealthier school districts. Schwartz supra note 133, at 17–19. Additionally, the precise levels of economic integration needed for gains to begin accruing are still the subject of debate.

[136] See Orla Doyle et al., Investing in Early Human Development: Timing and Economic Efficiency, 7 ECON. HUM. BIOL. 1, 1 (2009), available at http://www.sciencedirect.com/science/journal/157067-7X/7/1; Press Release, Office of the Press Secretary, Fact Sheet President Obama's Plan for Early Education for all Americans (Feb. 13, 2013), available at http://www.whitehouse.gov/the-press-office/2013/02/13/fact-sheet-president-obama-s-plan-early-education-all-americans.

determined socioeconomic status was not immutable, discrete and insular enough to warrant being treated as a suspect class.[137] However, new scientific research on brain development suggests that the experience of growing up in an area of concentrated poverty, with all the attendant social and environmental factors that entails, may alter the architecture of the developing brain,[138] a fact which may be useful in advocating for new educational remedies.

In recent years, behavioral, neurocognitive, and neuroimaging studies have revealed a correlation between socioeconomic status and cognitive function. While more research is needed in these areas, the studies already conducted have produced results which indicate a correlation between socioeconomic background, typically determined by taking into account parental education and occupation, and several different brain systems which govern acquisition of information in school settings, such as executive control, memory, and language systems.[139] Essentially, socioeconomic background seems to have an effect on how the brain processes and stores information.[140] This observed correlation between socioeconomic background and brain activity creates a new distinction between students from middle or high socioeconomic backgrounds versus students from low socioeconomic backgrounds, a distinction not grounded in money or privilege, but actual observed differences in cognitive function and brain development.[141] Furthermore, the Supreme Court has recently indicated a willingness to treat differences in age, which could be viewed as a proxy for differences in cognitive function, as cause for differential treatment in determining whether a student had been afforded access to his constitutional rights.[142]

It is my hope that this emerging scientific research can be combined with the right to an education existing in state constitutions, alongside equal protection theories, to incorporate housing policies into educational remedies. If the neuroscience proves a causal link between living in concentrated poverty and brain developments that in fact impair students'

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[137] San Antonio Indep. Sch. Dist. v. Rodriguez, 411 U.S. 1, 24–25 (1973).

[138] E.g., Bruce S. McEwen & Peter J. Gianaros, Central Role of the Brain in Stress and Adaptation: Links to Socioeconomic Status, Health, and Disease, 1186 ANNALS N.Y. ACAD. SCI. 190, 191, 197, 210 (2010).

[139] SEBASTIÁN J. LIPINA & JORGE A. COLOMBO, POVERTY AND BRAIN DEVELOPMENT DURING CHILDHOOD: AN APPROACH FROM COGNITIVE PSYCHOLOGY AND NEUROSCIENCE 79–80 (2009).

[140] Daniel A. Hackman et al., Socioeconomic Status and the Brain: Mechanistic Insights from Human and Animal Research, 11 NATURE REVS. NEUROSCIENCE 651, 651–53 (2010).

[141] See, e.g., Kimberly G. Noble, M. Frank Norman & Martha J. Farah, Neurocognitive Correlates of Socioeconomic Status in Kindergarten Children, 8 DEV. SCI. 74, 76, 83 (2005).

[142] J.D.B. v. North Carolina, 131 S. Ct. 2394, 2402–03, 2408 (2011).

ability to take advantage of the educational opportunities provided, and a state is held to have an affirmative obligation to provide student with an objectively meaningful opportunity to receive the full benefits of the education provided, then it may be argued that a state has an affirmative obligation to prevent students from growing up in areas of concentrated poverty to avoid such detriments to brain development and afford them a truly equal educational opportunity.

A. Socioeconomic Status and Cognitive Development

Over the last decade a number of studies have examined the effects of socioeconomic status, measured generally with reference to parental education and employment, on student performance and cognitive function.[143] In addition to multiple behavioral studies, there have been a small but growing number of neurocognitive and neuroimaging studies examining the relationships between socioeconomic status and cognitive function. These studies have revealed that "[g]rowing up in a family with low SES is associated with substantially worse health and impaired psychological well-being, and impaired cognitive and emotional development throughout the lifespan."[144] The results produced by new neurocognitive and neuroimaging studies have the potential to prove extremely useful in understanding and combating the effects of low socioeconomic status on student performance.

Many studies have focused on behavior instead of neurocognitive systems, and so only indirectly relate findings to brain function. However, these behavior studies have resulted in significant contributions to the evolving understanding of how socioeconomic status influences the basic processes of cognitive functioning. Behavioral studies have, for instance, shown the impact of home environment quality on children's inhibitory control, planning, and the ability to sustain attention.[145] Behavioral studies

[143] LIPINA & COLOMBO, supra note 139, at 79–80; see also Rajeev D.S. Raizada & Mark M. Kishiyama, Effects of Socioeconomic Status on Brain Development, and How Cognitive Neuroscience May Contribute to Leveling the Playing Field, 4 FRONTIERS HUM. NEUROSCIENCE 1, 4 (2010).

[144] Hackman et al., supra note 140, at 651 & nn.1–6 (citing Nancy E. Adler & David H. Rehkopf, U.S. Disparities in Health: Descriptions, Causes, and Mechanisms, 29 ANN. REV. PUB. HEALTH 235 (2008); Robert H. Bradley & Robert F. Corwyn, Socioeconomic Status and Child Development, 53 ANN. REV. PSYCHOL. 371 (2002); Jeanne Brooks-Gunn & Greg J. Duncan, The Effects of Poverty on Children, FUTURE CHILD., Summer/Fall 1997, at 55; Rand D. Conger & M. Brent Donnellan, An Interactionist Perspective on the Socioeconomic Context of Human Development, 58 ANN. REV. PSYCHOL. 175 (2007); Gary W. Evans, The Environment of Childhood Poverty, 59 AM. PSYCHOL. 77 (2004); Vonnie C. McLoyd, Socioeconomic Disadvantage and Child Development, 53 AM. PSYCHOL. 185 (1998)).

[145] NICHD Early Child Care Research Network, *Do Children's Attention Processes Mediate the Link*

have also evaluated the effects of toxin exposure on cognitive function. Studies found that lower socioeconomic status results in greater risk of exposure to environmental toxins associated with neurocognitive defects, such as lead in building materials.[146]

While the examination of socioeconomic status and cognitive function is still an emerging field, results from several computed studies provide enough information to indicate that socioeconomic status correlates with brain function in several areas, namely memory, language, and executive function. Neurocognitive studies generally involve tests, derived from neurocognitive literature, designed to tax specific neurocognitive systems such as language, spatial cognition, and declarative memory.[147] There is a shared concern among researchers that while "cognitive neuroscience of SES has the potential to enable more appropriately targeted, and hence more effective, programs to protect and foster the neurocognitive development of low SES children, it can also be misused or misunderstood as a rationalization of the status quo or 'blaming the victim'."[148] Perhaps partially for this reason, many researchers warn against the interpretation of biological differences related to socioeconomic status as essential or immutable, stressing that there is "little evidence for such a claim."[149]

1. The Use and Limitations of Neuroimaging

The use of neuroimages in drawing conclusions from neurological studies is itself the subject of considerable scholarship, with the overall message being one of caution. Functional brain imaging is subject to a number of "methodological difficulties that must be navigated successfully before the technique can be used to provide a testing ground for neuropsychological and neurophysiological theories of higher cognitive function."[150] Additionally, "studies have shown that the presentation of a

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Between Family Predictors and School Readiness?, 39 DEV. PSYCHOL. 581, 582 (2003); NICHD Early Child Care Research Network, Predicting Individual Differences in Attention, Memory, and Planning in First Graders From Experiences at Home, Child Care, and School, 41 DEV. PSYCHOL. 99, 100 (2005).

[146] Laura Hubbs-Tait et al., Neurotoxicants, Micronutrients, and Social Environments: Individual and *Combined Effects on Children's Development*, 6 PSYCHOL. SCI. IN PUB. INTEREST 57, 63–65, 73–74 (2005).

[147] LIPINA & COLOMBO, supra note 139, at 80–83.

[148] Daniel A. Hackman & Martha J. Farah, Socioeconomic Status and the Developing Brain, 13 TRENDS IN COGNITIVE SCIENCES 65, 71 (2008), available at http://www.psych.upenn.edu/~mfarah/pdfs/TICS-SESauthor.pdf.

[149] Id.

[150] Daniel N Bub, Methodological Issues Confronting PET and fMRI Studies of Cognitive Function, 17 COGNITIVE NEUROPSYCHOLOGY 467, 482 (2000).

brain image can increase the reader's judgment of the quality of the reasoning" of the attendant argument.[151] While this aspect of neurological imaging is attractive for purposes of creating a convincing argument in the litigation context, it is the subject of considerable caution among researchers, who caution that "[c]autious interpretation and reporting of findings in the peer reviewed literature is critical if the field is to maintain respectability."[152]

Evidence of heated debate between researchers regarding the accuracy of reported results, and the conclusions drawn from such results, in the areas of emotion, personality, and social cognition highlights some of the difficulties facing researchers in both research methodologies and information synthesis.[153] While there may be limits on the use of neuroimaging research in delineating the effects of socioeconomic status on brain development, correlations revealed should "reflect meaningful relationships between psychological and neural variables to the extent that valid multiple comparisons procedures are used."[154] While existing research may still be deficient, in time more studies should provide enough information for researchers to begin drawing stronger conclusions as to the effects of socioeconomic status on brain development and function.

2. Neuroimaging Studies Focused on Socioeconomic Status and Brain Development

A series of studies has revealed correlation between socioeconomic status and performance in several neurocognitive systems.[155] The studies examined neurocognitive systems in preschool, school-aged, and preadolescent children from different socioeconomic backgrounds, and the studies generally conceptualize socioeconomic status in terms of parental

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[151] Poldrack, R. A., The Role of fMRI in Cognitive Neuroscience: Where Do We Stand?, 18 CURRENT OPINION IN NEUROBIOLOGY 223, 225 (2008); see McCabe D. P., Castel, A. D., Seeing is Believing: The Effect of Brain Images on Judgments of Scientific Reasoning, 18 COGNITION 223, 225 (2007).

[152] Horn, J. D. V., Poldrack, R. A., Functional MRI at the crossroads, 73 INT'L J. OF PSYCHOPHYSIOLOGY 3, 8 (2009).

[153] See Edward Vul et al., Puzzlingly High Correlations in fMRI Studies of Emotion, Personality, and Social Cognition, 4 PERSPECTIVES ON PSYCHOLOGICAL SCI. 274 (2009). But see Mathew D. Lieberman et al., *Correlations in Social Neuroscience Aren't Voodoo*, 4(3) PERSPECTIVES ON PSYCHOLOGICAL SCIENCE 299 (2009).

[154] Matthew D. Lieberman et al., Correlation in Social Neuroscie*nce Aren't Voodoo: A R*eply to Vul et al. (submitted to PERSPECTIVES ON PSYCHOLOGICAL SCIENCES).

[155] Kimberly G. Noble, M. Frank Norman, Martha J. Farah, Neurocognitive Correlates of Socioeconomic Status in Kindergarten Children, 8 DEVELOPMENTAL SCIENCE 74 (2005).

education, occupation, and income-to-need ratios.[156] The neurocognitive systems assessed were the left perisylvian language system, which deals with language processes like grammar reception and phonological awareness; the medial temporal declarative memory system, which relates to memory formation in the absence of any directed effort to commit the information to memory; and the lateral-orbital-medial prefrontal system, which relates to attention, spatial working memory, and inhibitory control.[157]

An initial study in 2005 focused on a group of 60 kindergarteners, half from low socioeconomic backgrounds, and half from mid-socioeconomic backgrounds.[158] The results of the study suggest that socioeconomic differences are related to disparities in the functioning of both the language and executive function systems.[159] The researchers believed that socioeconomic background may exhibit an effect on the cognitive functions associated with language and executive systems because the mechanisms underlying the language and executive systems have a longer period of development, making them more vulnerable to environmental factors.[160] The study found that socioeconomic background and executive function are both related to language ability, but that socioeconomic background and executive function are independent of one another.[161] The authors also suggest that differences in home literacy environment, which are associated with differences in socioeconomic status, may account for some of the differences in language skill development.[162]

The second study in 2006 examined neurocognitive processes in 60 African American children between 10 and 13 years old.[163] The children were from low and middle socioeconomic backgrounds, determined by parental education and occupation, and had been screened for health conditions that could influence cognitive performance.[164] This study focused on creating a neurocognitive profile of children from different socioeconomic backgrounds, focusing on the prefrontal system, in order to

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[156] Id. at 80 ("authors have conceptualized poverty as a composite based on an SES that includes . . . parental education").
[157] Id.
[158] Id. at 76.
[159] Id. at 83.
[160] Id. at 84.
[161] Id. at 83.
[162] Id. at 84.
[163] Martha J. Farah et al., Childhood Poverty: Specific Associations with Neurocognitive Development, 1110 BRAIN RES. 166, 170 (2006).
[164] Id.

further explore the relationship between socioeconomic status and cognitive development.[165] The researchers used a variety of tasks designed to expose correlation between socioeconomic status and working memory, cognitive control, reward processing, and memory systems.[166] The study's results show differences between socioeconomic groups in the areas of working memory, and cognitive control, as well as significant differences in both language and memory.[167] In particular, working memory and cognitive control, both reliant on the prefrontal system, seemed more developed in children from middle socioeconomic backgrounds.[168] Neither reward processing nor visual cognition exhibited significant differences along socioeconomic lines.[169]

In the third study researchers analyzed 168 first grade children from nine New York City public schools, covering a wide range of socioeconomic backgrounds.[170] The study used a battery of focused tests to examine neurocognitive systems related to reward processing, cognitive control, working memory, declarative memory, spatial cognition, and language.[171] The results of the study show that socioeconomic status statistically accounts for differences in performance of neurocognitive systems.[172] The researchers also found that language ability is of primary importance in neurocognitive functionality; controlling for language ability erases the relationship between socioeconomic background and cognitive control, and reduces the correlation between socioeconomic background and other neurocognitive systems tested.[173] This result suggests that a focus on improving language skills and functionality in associated neurocognitive systems would reduce the impact of socioeconomic background on the overall cognitive function of children from low socioeconomic backgrounds, which could in turn reduce barriers to success in the classroom.

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[165] Id. at 167.
[166] Id. at 170—72.
[167] Id. at 169
[168] Id.
[169] Id., at 169.
[170] Kimberly Noble, et al., Socioeconomic Gradients Predict Individual Differences in Neurocognitive Abilities, 10 DEVELOPMENTAL SCIENCE 464, 465 (2007).
[171] Id. at 466.
[172] Id. at 470 (concluding that Socioeconomic background differences were reported to account for 32.0% of the variance in the language composite score, 16.7% of the variance in the visuospatial composite score, 10.2% of the variance in memory composite score, and 5.5% of the variance in both work working memory and cognitive control composite scores).
[173] Id. at 476.

"Brain imaging can provide insights into the neurobiological basis of [learning to read], and can now be used to understand the neural bases of individual differences in children's literacy acquisition."[174] A brain imaging study in 2006 further explored the relationship between socioeconomic status ("SES") and phonological awareness ("PA"), the understanding of sound structure of language, using functional magnetic resonance imaging (fMRI) in conjunction with tasks designed to tax specific neurocognitive systems.[175] The study focused on the left perisylvian region, which is related to language, and the occipitotemporal system, which is associated with pattern vision.[176] The "study suggests that the locus of the neural correlates of the observed interaction between PA and SES in reading skill lies primarily in the left fusiform gyrus," an area of the brain associated with reading skill level in children.[177] In children from lower socioeconomic backgrounds, "phonological skill level is positively predictive of activation in the left fusiform region."[178] However, phonological skill level was less predictive of activation in the left fusiform region as the socioeconomic background of the children improved. Instead, in children from higher socioeconomic backgrounds, phonological awareness is positively related to activity in different neural regions, specifically the right superior temporal gyrus and the bilateral superior frontal gyri.[179] These results, which show that the region of the brain in which activity exhibits a positive association with phonological awareness is different depending on a child's socioeconomic background, seem to indicate a real difference in the brain's function, which correlates with socioeconomic status. The authors theorize that if "access to literacy resources … stimulates the use and development of reading-related brain regions," then "low-achieving readers would demonstrate neurobiologically typical brain responses to print, and that improved access to resources would lead to greater achievement."[180]

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[174] Noble et al., Brain-behavior Relationships in Reading Acquisition are Modulated by Socioeconomic Factors, 9 DEVELOPMENTAL SCIENCE 642, 642 (2006).
[175] Id.
[176] Id. at 643.
[177] Id. at 651.
[178] Id. at 651; see also Larry R. Squire, Memory and the Hippocampus: A Synthesis from Findings with Rats, Monkeys, and Humans, 99:2 PSYCHOL. REV. 195 (1992).
[179] Noble et al., supra note 174, at 651.
[180] Id. at 651.

3. Stress and Brain Development

Studies suggest stress may have an especially profound impact on brain development. The functional plasticity, or capacity for changes in neural pathways, of the young and developing brain makes it particularly sensitive to chemical influences.[181] Children growing up in neighborhoods of lower socioeconomic status, especially areas of concentrated poverty, are more likely to be exposed to stressful events, maltreatment, conflict-laden familial relationships, and adverse physical and social conditions,[182] and a significant body of research establishes that poverty adversely impacts many aspects of development in children.[183] The economic hardships associated with living in concentrated poverty can increase conflicts between adults, so children in poor households are especially likely to experience disruption of social relationships with the key adults in their lives.[184] When parents continually deal with elevated stress, there is an increased probability of parents exhibiting depressive symptoms, emotional distress, and expressing anger and aggression, which can have a cascading effect on children's psychological development.[185]

Elementary school children from low socioeconomic backgrounds exhibit significantly higher levels of salivary cortisol than children from higher socioeconomic backgrounds, with cortisol being considered to be one of the best markers of an altered physiological state produced in response to stress, as tested for in saliva.[186] Growing evidence suggests that chronic stress, resulting in persistently elevated levels of stress hormones,

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[181] Jack P. Shonkoff et al., The Lifelong Effects of Early Childhood Adversity and Toxic Stress, 129 PEDIATRICS e232, e236 (2012).

[182] Bruce S. McEwen & Peter J. Gianaros, Central Role of the Brain in Stress and Adaptation: Links to Socioeconomic Status, Health, and Disease, 1186 ANNALS N.Y ACAD. SCI. 190, 191 (2010).

[183] Clancy Blair & C. Cybele Raver, Child Development in the Context of Adversity: Experiential Canalization of Brain and Behavior, 67 AM. PSYCHOLOGIST 309, 310 (2012) (citing Bradley & Corwyn, supra note 143, at 374; Greg J. Duncan & Jeanne Brooks-Gunn, Family Poverty, Welfare Reform, and Child Development, 71:1 CHILD DEV. 188, 188 (2000); Noble et al., supra note 169, at 464).

[184] Blair & Raver, supra note 183, at 310 (citing Tara Watson & Sara McLanahan, Marriage Meets the Joneses: Relative Income, Identity, and Marital Status, 43:3 J. HUM. RESOURCES, 482 (2011)).

[185] Id. at 310 (citing Brian P Ackerman & Eleanor D. Brown, Physical and Psychosocial Turmoil in the Home and Cognitive Development, in CHAOS AND ITS INFLUENCE ON CHILDREN'S DEVELOPMENT: AN ECOLOGICAL PERSPECTIVE 35, 35-36 (Gary W. Evans & Theodore D. Wachs ed., 2010); Holly Foster & Jeanne Brooks Gunn, *Toward a Stress Process Model of Children's Exposure to Physical Family and* Community Violence, 12 CLINICAL CHILD FAM. PSYCHOL. REV. 71, 71 (2009); Beth E. Molnar et al., A Multilevel Study of Neighborhoods and Parent-to-Child Physical Aggression: Results from the Project on Human Development in Chicago Neighborhoods, 8 CHILD MALTREATMENT 84, 95 (2003)).

[186] S. J. Lupien et al., Can Poverty Get Under Your Skin? Basal Cortisol Levels and Cognitive Function in Children from Low and High Socioeconomic Status, 13 DEV. & PSYCHOPATHOLOGY 653, 657 (2001).

can disrupt the developing architecture of the brain. [187] For example, the amygdala, hippocampus, and the prefrontal cortex all have abundant glucocorticoid receptors, which are compatible with the stress hormone cortisol, and "exposure to stressful experiences has been shown to alter the size and neuronal architecture of these areas as well as lead to functional differences in learning, memory, and aspects of executive functioning."[188]

Chronic stress is associated with many negative aspects of brain development, such as hypertrophy (increase in volume of an organ or tissue) and over-activity in both the amygdala (which performs a primary role in processing memory and emotional reactions) and the orbitofrontal cortex (involved in decision-making).[189] Additionally, prolonged adversity can lead to loss of neurons and neural connections in the hippocampus and medial prefrontal cortex, which governs executive function.[190] These structural changes can result in increased anxiety related to both hyper-activation of the amygdala and less top-down control as a result of atrophy of the prefrontal cortex, as well as impaired memory and mood control as a consequence of hippocampal reduction.[191] "Thus, the developing architecture of the brain can be impaired in numerous ways that create a weak foundation for later learning, behavior, and health."[192]

> It is in this way that a child's environment and early experiences get under the skin. Although the hippocampus can turn off elevated cortisol, chronic stress diminishes its capacity to do so and can lead to impairments in memory and mood-related functions that are located in this brain region. Exposure to chronic stress and high levels of cortisol also inhibit neurogenesis [, the generation of new neurons,] in the hippocampus, which is believed to play an important role in the encoding of memory and other functions. Furthermore, toxic stress limits the ability of the hippocampus to promote contextual learning, making it more difficult to discriminate conditions for which there may be danger versus safety, as is common in posttraumatic stress disorder. Hence, altered brain architecture in response to toxic stress in early childhood could explain, at least in part, the strong association between early adverse experiences and subsequent problems

[187] Shonkoff, supra note 181, at e236 (citing NAT'L SCIENTIFIC COUNCIL ON THE DEVELOPING CHILD, Excessive Stress Disrupts the Architecture of the Developing Brain 1 (June 2009) (Working Paper) (on file with Center on the Developing Child at Harvard University)).
[188] Id. at e236.
[189] Id. at e236.
[190] Id. at e236. Executive function is an over-arching term that relates to the cognitive processes that regulate other cognitive processes like planning, working memory, attention, problem solving, verbal reasoning, inhibition, and mental flexibility among others, Campbell, supra note 187(b), at 357.
[191] Id. at e236.
[192] Id. at e236.

> in the development of linguistic, cognitive, and social-emotional skills, all of which are inextricably intertwined in the wiring of the developing brain.[193]

In addition to negative aspects of brain development like hypertrophy, chronic stress may also have an effect on the expression of genes, providing further connection between areas of concentrated poverty and brain developments that may impact students' ability to learn in normal classroom settings.

Researchers have noted that low-SES backgrounds exhibit a correlation with the increased expression of genes related to adrenergic function (the adrenaline system), and decreased expression of genes related to the regulation of the hypothalamic-pituitary-adrenal axis (a grouping of organs key in controlling reactions to stress, as well as regulating digestion, the immune system, mood and emotions, and energy storage and expenditure).[194] The authors further explain that:

> [i]ncreased adrenergic and glucocorticoid responses to stimulation would enable a more reactive and faster response to threats, both physical and psychosocial, and as such would confer an advantage in unsafe environments. Such a trade-off, however, would come with short- and long-term costs to health and well-being that would preferentially shape physical and psychological development along particular trajectories while limiting the likelihood of development along others.[195]

The authors theorize that, while developmental adaptations such as hypervigilance to environmental clues and altered hypothalamic-pituitary-adrenal axis may provide "for more rapid learning and response to conditions of threat"[196] in the context of a low-wealth, unpredictable environments, such developments may result in increased negative interpersonal interactions and lead to difficulty in social settings like classrooms.[197]

Finally, a recent neurological study found "highly significant SES differences in regional brain volume … in the hippocampus and the amygdala," as well as interaction between socioeconomic status and age in the left superior temporal gyrus and the left inferior frontal gyrus, regions of the brain associated with language development.[198] The authors, like many others, theorize that "differences in the home linguistic environment and

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[193] Id. at e236.
[194] Blair & Raver, supra note 183, at 312.
[195] Id. at 312.
[196] Id. at 313.
[197] Id. at 313.
[198] Noble et al., Neural Correlates of Socioeconomic Status in the Developing Human Brain, DEVELOPMENTAL SCI. 1, 1 (2012).

exposure to stress" may at least partially explain the observed differences, and emphasize "the fact that there are neural correlates of SES in no way connotes 'immutability', or rules out a plastic response to different environmental factors."[199] Indeed, researchers in this area generally agree that "environments and experiences of childhood in different socioeconomic strata are at least in part responsible for different neurocognitive outcomes for these children,"[200] and that such changes in neuronal circuitry are reversible in a healthy, resilient brain.[201]

As illustrated by the behavioral, neurocognitive, and neuroimaging studies above, there is a correlation between socioeconomic status and cognitive function. Behavioral studies show that individuals from lower socioeconomic backgrounds have a higher risk of exposure to environmental toxins known to have a detrimental effect on cognitive function. Additionally, neurocognitive studies show a positive correlation between students' socioeconomic background and performance of neurocognitive systems related to memory, cognitive control, and language. Neuroimaging studies have revealed that areas of brain activity related to language differ depending on an individual's socioeconomic background, and that high levels of stress, which negatively correlate with socioeconomic status, can cause changes in several regions of the brain related to learning, language, and behavior regulation.

B. Applying Neuroscience to Policy

The Obama White House has recently proposed a $100 million initiative to develop new neuroscience technologies and map the human brain, meaning scientists and researchers should have access to increasingly better information and techniques.[202] As information and techniques improve, it

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[199] Id. at 9.

[200] See Hackman & Farah, supra note 148, at 71, noting that "[e]arly poverty is a better predictor of later cognitive achievement than poverty in middle- or late-childhood, an effect that is difficult to explain by genetics. SES modifies the heritability of IQ, such that in the highest SES families, genes account for most of the variance in IQ because environmental influences are in effect 'at ceiling' in this group, whereas in the lowest SES families, variance in IQ is overwhelmingly dominated by environmental influences because these are in effect the limiting factor in this group." Id. at 69.

[201] Bruce S. McEwen, Effects of Stress on the Developing Brain, CEREBRUM 1, 2 (Sep. 2011), available at http://dana.org/news/cerebrum/detail.aspx?id=34202.

[202] Francis Collins & Arati Prabhakar, BRAIN Initiative Challenges Researchers to Unlock Mysteries of Human Mind, THE WHITE HOUSE BLOG (Apr. 2, 2013, 10:15 AM), http://www.whitehouse.gov/blog/2013/04/02/brain-initiative-challenges-researchers-unlock-mysteries-human-mind; see also NAT'L INST. OF HEALTH, Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative (2013), http://www.nih.gov/science/brain/.

stands to reason that a concrete, causal connection between socioeconomic status and brain development may be confirmed in the relatively near future. If a causal connection between maturing in conditions of concentrated disadvantage and brain development is found, that connection may be very useful in advocating for education policy and remedies to take housing policy into account when considering new interventions.

Results from Heather Schwartz's study in Montgomery County, Maryland, suggest that providing low-wealth students in high-poverty schools with compensatory resources in the form of school-based interventions is not as effective at raising student achievement as housing policy changes that encourage economic integration. In Dr. Schwartz's findings, the economic integration of students, as a result of inclusive zoning practices, produces better long-term educational results than providing low-wealth students with compensatory recourses, despite the fact that Montgomery County Public Schools have instituted most of the highly touted reforms emphasized by the well-funded Race to the Top program.[203] If even these championed school-based reforms fail to raise achievement levels for disadvantaged students, then other, more radical options should be considered.

A housing program targeting areas of concentrated disadvantage and working toward resettling resident families in more affluent neighborhoods could have a potentially game-changing impact. A change in locale could not only provide low-wealth students with a more nurturing, lower-stress environment in which to mature, which could have significant positive impacts on brain development and thus academic achievement, but also place low-wealth students in schools with higher-wealth peers, which has also been observed to strongly raise student achievement.[204] Considering the high priority Congress has placed on bringing about each student's full academic potential without regard for financial barriers,[205] and the President's emphasis on preparing children for academic achievement,[206] it

[203] Schwartz, supra note 133, at 18; see also Rusk, supra note 132, at 22 (noting that "[i]n short, in Dr. Schwartz's findings, the Green Zone strategy – economic integration – isn't just 'even more powerful' than the Red Zone school approach – compensatory resources. The Red Zone strategy is failing despite the fact that Montgomery County Public Schools are implementing most of the reforms championed by *the current U. S. Department of Education's much praised $4.35 billion Race to the Top program.*" (emphasis in original)).

[204] Schwartz, supra note 133, at 18; see also THE FUTURE OF SCHOOL INTEGRATION: SOCIOECONOMIC DIVERSITY AS AN EDUCATION REFORM STRATEGY 1, 3 (Richard D. Kahlenberg ed., 2012).

[205] See generally 20 U.S.C. § 6361 (2006).

[206] THE WHITE HOUSE, Early Learning, http://www.whitehouse.gov/issues/education/early-childhood.

seems that the federal government should act to encourage the break-up of concentrated poverty.

The federal government could encourage states to address the problem of concentrated poverty by creating a competitive funding scheme similar to the Department of Education's popular Race to the Top program, which has been very successful in encouraging states to change educational approaches. Some aspects of his theoretical plan that should be considered include a focus on families with young children and new families likely to have children, since these families represent the largest expected return on investment. Though it would a very difficult task to design and implement a housing competition, the results of a well-executed program could be greater than any previous educational intervention. Both Montgomery County's inclusive zoning program and Oak Park, a stably integrated, low-poverty suburb of Chicago, hold lessons that could potentially be useful in creating a national competition.[207]

V. CONCLUSION

Learning does not start at age five, and it does not start when a student first reports to kindergarten; learning is a lifelong experience. Students born into an impoverished situation have, from the very beginning, a less than equal opportunity to succeed in a society such as ours where literacy is of fundamental importance. The groups most at risk of remaining functionally illiterate are children living in concentrated poverty whose parents did not graduate high school. Increasing functional literacy in the United States would likely result in greater tax revenue, as well as savings on government expenditures related to crime, health and welfare.

The status of education as a state right is still in flux. Some states recognize the right to an education as a fundamental right, emanating from the education clause of the state constitution, and therefore the proper subject of state constitution based equity challenges. Other states do not recognize education as a fundamental right for the purposes of equal protection litigation, but as a statutory right provided by the state, and recognize that the state is required to provide students with an education of a certain quality. The highest courts in some states have gone so far as to recognize that students' rights are not satisfied with mere equal access to an

[207] Evan McKenzie & Jay Ruby, Reconsidering the Oak Park Strategy: The Conundrums of Integration 32, available at http://astro.temple.edu/~ruby/opp/3qrpt02/finalversion.pdf (noting "[a]lthough such programs are rare, description and analysis of the Oak Park strategy may serve to expand the perceived options open to other communities considering similar measures.").

education, and have ruled that all students must be afforded an objectively meaningful opportunity to receive the benefits of an equal education.

Recent neurocognitive studies have shown correlations between socioeconomic status and cognitive performance in the areas of language and memory formation, while neuroimaging studies have revealed that different areas of the brain are active when responding to similar stimuli, with socioeconomic status correlating with the change in activity. The prevalence of stress associated with high-poverty environments seems to be one of the primary ways in which impoverished conditions impact brain development. The results of these studies suggest that the brains of children from lower socioeconomic backgrounds may develop and function differently from children from middle or high socioeconomic backgrounds, and so these students may not be able to take advantage of the same educational opportunities as students from a higher-wealth background and environment.

In states where the law commands all students must be afforded an objectively meaningful opportunity to receive the benefits of an equal education, emerging neuroscience could be used alongside equal protection principles to advocate for a new kind of educational intervention using housing policy to focus on students who mature in concentrated poverty. Ensuring that low-wealth students mature outside areas of concentrated poverty and chronic stress will increase the likelihood of normal neurocognitive development, making it more likely such students will be able to take advantage of the educational opportunities provided. Given the federal government's stated interest in educational achievement, as well as its vast funding power, the federal government should create a Race to the Top style competitive grant program focused on reducing areas of concentrated poverty. In this way, through a combination of education and housing policy, the federal government could assist states in meeting their constitutional equal education obligations while improving the quality of life for some of our most disadvantaged citizens.

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