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# The Developing Brain: New Directions in Science, Policy, and Law

## Introduction

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Scientific findings on brain development increasingly are influencing how we understand children’s social and emotional development and how we interpret their behavior. Such understandings and interpretations, in turn, can shape public policy and legal precedent. For example, brain imaging has complemented behavioral studies on cognitive development, with functional and structural imaging showing protracted maturation of the prefrontal cortex,<sup>1</sup> a region that strongly contributes to higher-order cognitive processing, often called “executive function.”<sup>2</sup> Findings on this

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1. See B.J. Casey, *Beyond Simple Models of Self-Control to Circuit-Based Accounts of Adolescent Behavior*, 66 ANN. REV. PSYCHOL. 295 (2015); Rina D. Eiden et al., *Developmental Cascade Model for Adolescent Substance Use from Infancy to Late Adolescence*, 52 DEV. PSYCHOL. 1619 (2010).

2. Executive function refers to higher-order processes (such as inhibitory control, working memory, and attentional flexibility) that govern goal-directed action and adaptive responses to novel, complex, or ambiguous situations. See C. Hughes, *Executive Function: Development, Individual Differences, and Clinical Insights*, in NEURAL CIRCUIT DEVELOPMENT AND FUNCTION IN THE BRAIN 429 (John Arthur Rubinstein ed., 2013). For a brief introduction to the relevant terminology to help law-trained readers without the scientific background, see Deborah W. Denno, *The Place for Neuroscience in Criminal Law*, in PHILOSOPHICAL FOUNDATIONS OF LAW AND NEUROSCIENCE 69 (Dennis Patterson and Michael S. Pardo eds., 2016). Professor Denno writes:

The term *neuroscience* was first used in 1963, and is defined quite broadly as “the branch of the life sciences that studies the brain and nervous system.” However, this area is developing so rapidly that much of my attention is on the even newer discipline of *cognitive neuroscience*. Cognitive neuroscience combines cognitive science, psychology, and neuroscience to examine the mechanisms of the mind, such as motor function, language, higher cognitive functions, emotions, and consciousness. Recent advances in brain imaging technology have given us new insight into how these brain mechanisms

delayed maturation provided the basis for three separate rulings by the United States Supreme Court, setting aside certain sentences for criminal offenses committed by juveniles as “cruel and unusual punishment” in violation of the Eighth and Fourteenth Amendments of the Constitution.<sup>3</sup> In each of these cases, a majority of the Justices determined that juvenile offenders must be treated differently from adults with respect to criminal sentencing for two reasons. First, based on the immature status of their brains, juveniles deserve more lenient sanctions than adult offenders.<sup>4</sup> Second, time itself will allow adolescent brains to mature, reducing the need for punitive interventions to accomplish rehabilitation and reform.<sup>5</sup>

Limitations on juvenile sentencing, in which neuroscience has had a decisive impact on legal doctrine and policy, can help pave the way for similar approaches on other topics. For example, in 2016, the American Law Institute began work on a *Restatement of the Law, Children and the Law*, which will attempt to clarify and simplify how law treats children in four main settings: in families, in schools, in the justice system, and in society more generally.<sup>6</sup> Recalling the juvenile sentencing cases, early drafts for this project recognize an important role for research from both neuroscience and social science in fashioning appropriate legal rules applicable to children.<sup>7</sup> In an additional illustration, legal scholars see promising ways to use neuroscience to enlighten criminal law’s reliance on the mental state (or mens rea) of the accused.<sup>8</sup>

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operate. The use of brain imaging technology has exploded in both clinical and commercial settings, and it has propelled an interest in the human brain and its relationship to disciplines outside of neuroscience, such as law. But this use in law has fueled fervent debates about the pros and cons of allowing neuroimaging and other kinds of neuroscience evidence to enter the criminal justice system.

*Id.* at 73 (footnotes omitted).

3. *Roper v. Simmons*, 543 U.S. 551 (2005) (death penalty); *Graham v. Florida*, 560 U.S. 48 (2010) (life imprisonment without parole for a juvenile who did not commit homicide); *Miller v. Alabama*, 567 U.S. 460 (2012) (mandatory life imprisonment without parole for capital murder committed by a juvenile). *See also* *Montgomery v. Louisiana*, 136 S. Ct. 718 (2016) (holding that *Miller* applies retroactively on state collateral review).

4. *See Roper*, 543 U.S. at 570; *Graham*, 560 U.S. at 68; *Miller*, 567 U.S. at 471-72.

5. *See Roper*, 543 U.S. at 570; *Graham*, 560 U.S. at 68; *Miller*, 567 at 472.

6. *See, e.g.*, RESTATEMENT OF THE LAW, CHILDREN AND LAW (AM. LAW INST., Preliminary Draft No. 1 2016).

7. *See id.* at 155-62 Appendix B (project proposal for American Law Institute Council).

8. *See Denno, supra* note 2, at 80-81.

This symposium and the conference from which it derives<sup>9</sup> explore new possibilities for bringing insights from our understanding of brain development and its relationship to cognitive, social, and emotional development into the arenas of law and policy. In particular, the papers in this volume provide a legal and policy context for examining recent studies that use neuroscientific tools and methods, including imaging and behavioral studies, to ask questions about how children’s brains are negatively affected by what we call “early stressors.”<sup>10</sup> These studies aim to understand the mechanisms that mediate the impact of socio-economic status (SES) on brain development, such as family adversity, inflammatory pathways, and/or the microbial environment, all of which themselves are influenced by SES. Among such efforts, brain imaging studies in children have shown that being raised in poverty is associated with thinning of the cortex, reduced hippocampal and amygdala volumes, and altered connections of these brain regions to the rest of the brain.<sup>11</sup> Significantly, these changes in brain function and structure are also associated with later health problems and behavioral changes in children, such as increased depression and learning difficulties.<sup>12</sup>

In emphasizing recent findings about early stressors in this symposium, we respond to legal scholars who have called for more conversations at the intersection of neuroscience, social work, and law and who have specifically proposed a “new field of early childhood development and the law.”<sup>13</sup> We also build on important work taking place at Washington University, where experts from diverse disciplines are investigating early experience and brain development, generating metrics for evaluating environmental effects on

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9. The conference, “The Developing Brain: New Directions in Science, Policy, and Law,” took place at Washington University School of Medicine, on Sept. 26, 2017. For additional information, see <https://neuroscienceandsociety.wustl.edu/>.

10. Here, we refer to psychosocial stressors experienced in the prenatal and early postnatal period, including poverty, psychiatric illness, and substance abuse. See Cynthia Rogers, *Addressing the Psychosocial Risk Factors Affecting the Developing Brain of the High Risk Infant*, 57 WASH. U. J.L. & POL’Y 117 (2018).

11. See Deanna Barch et al., *Effect of Hippocampal and Amygdala Connectivity on the Relationship Between Preschool Poverty and School-Age Depression*, 173 AM. J. PSYCHIATRY 625 (2016); Damien A. Fair, Alice M. Graham, & Brian Mills, *A Role of Early Life Stress on Subsequent Brain and Behavioral Development*, 57 WASH. U. J.L. & POL’Y 89 (2018).

12. See Barch et al., *supra* note 11; Fair, Graham, & Mills, *supra* note 11.

13. Clare Huntington, *Early Childhood Development and the Law*, 90 S. CAL. L. REV. 755, 759 (2017).

premature babies, assessing possible interventions, examining the effects of home instability on cognition, and analyzing the ways in which a child's early environment shapes brain development and behavior.

This symposium and the underlying conference exemplify a new initiative at Washington University, Neuroscience and Society, that is designed to promote interdisciplinary conversations on early brain development.<sup>14</sup> Taking advantage of particular strengths in neuroscience, social work, and law at our institution, this new initiative aims to 1) build meaningful bridges across disciplines to enable better-informed clinical and research programs; and 2) catalyze the flow of information to those who enact and implement policy in healthcare, education, housing, and other areas that directly affect children. These represent the first steps, bringing together such experts from Washington University with those from other institutions for wide-ranging consideration of children, families, and brain development to consider possible responses—as well as challenges—from law and public policy. We hope that, ultimately, this new initiative will lead to policy that best serves the goals of child and community health and welfare.

This symposium volume is organized as follows. We feature as the lead article *Brain Development, Social Context, and Justice Policy* by legal scholar Elizabeth Scott and her psychologist co-authors, Natasha Duell and Dr. Laurence Steinberg.<sup>15</sup> This piece, which builds on the extensive work of Professor Scott and Dr. Steinberg on the trio of Supreme Court cases imposing constitutional limits on the punishment of juvenile offenders,<sup>16</sup> provides a prototype for what we can expect once the relationship among neuroscience, law, and policy on a specific topic becomes well established,

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14. Washington University's Office of Neuroscience Research (ONR) drives this new initiative. Under the leadership of its Director, Dr. Anneliese Schaefer, the ONR gathered academics from the School of Medicine, School of Law, College of Arts & Sciences, and the Brown School of Social Work to plan the underlying conference. The Office of the Provost of Washington University supported these planning efforts with a grant from the "Cross-School 'Bring Your Own Idea' Program." See <https://provost.wustl.edu/wp-content/uploads/2016/05/2017-Bring-Your-Own-Idea-Application.pdf>.

15. Elizabeth Scott, Natasha Duell, & Laurence Steinberg, *Brain Development, Social Context, and Justice Policy*, 57 WASH. U. J.L. & POL'Y 13 (2018).

16. See *supra* note 3 and accompanying text. They have written extensively on this and related topics. See, e.g., ELIZABETH S. SCOTT & LAURENCE D. STEINBERG, *RETHINKING JUVENILE JUSTICE* (2008); Elizabeth S. Scott & Laurence Steinberg, *Social Welfare and Fairness in Juvenile Crime Regulation*, 71 LA. L. REV. 35 (2010).

allowing researchers and theorists to probe more deeply by considering, for example, how multiple variables might interact to influence human behavior.

Using as a point of departure precedents recognizing the immaturity of adolescent brains as a critical factor in setting the outer limits of criminal punishment, the authors squarely address skeptics' challenges based on the fact that many juveniles—despite the immaturity of their brains—do not commit serious criminal offenses. In other words, the authors ask, why do only a fraction of those with immature brains commit crimes and what are the implications for criminal justice policy? They posit a dynamic framework in which brain development and social context, including peer associations, interact. This framework, in turn, presents empirical and theoretical support for lenient sanctions for juvenile offenders,<sup>17</sup> offers new understandings of how correctional settings can affect young offenders' futures both for good and for ill,<sup>18</sup> and fine tunes arguments about the impact on criminal responsibility of growing up in a deprived environment.<sup>19</sup>

For purposes of this symposium, several attributes of the analysis of Professor Scott and her co-authors stand out. First, they reject an overly simplified causal hypothesis in favor of a close examination of risk-taking tendencies among adolescents, constructing a model that takes into account the critical role of parents throughout development, neural plasticity, the different timetables for maturation across brain regions, reward seeking, impulsivity, and the accessibility of risky activity, as well as the role of peers and social context.<sup>20</sup> Second, they bring to bear cross-cultural research on brain development, thereby testing their theories and identifying features of human development for their framework that transcend specific cultural and economic settings.<sup>21</sup> Third, they caution that their framework does not allow predictions about adult criminality,<sup>22</sup> or juvenile offending for that matter. Finally, they provide a concrete example of a policy change consistent with our understanding of brain development: a model of correctional housing for juvenile offenders based on small facilities located closer to offenders'

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17. Scott, Duell, & Steinberg, *supra* note 15, at 20.

18. *Id.* at 56.

19. *Id.* at 66.

20. *Id.*

21. *Id.* at 30.

22. *Id.* at 53.

homes and families, thus showing how scientific findings can help promote the goals of decreased recidivism and the eventual integration of these adolescents as productive members of society.

These features and the other strengths of the analysis by Professor Scott and her co-authors offer a glimpse of the sort of robust and nuanced integration of neuroscience, law, and policy that we envision might eventually emerge concerning early stressors. Put differently, we might think of Professor Scott and her co-authors' article as a "second generation" analysis that becomes possible once the "first generation"—the initial acceptance in law and policy of particular neuroscientific findings—has taken root. The other papers in the symposium represent various entry points into an expansive conversation about early stressors and presage the critical role of the parent (or caregiver) and child at the earliest stages of development, complementing the importance of parental influence on adolescents' behavior underscored by Professor Scott and her co-authors.<sup>23</sup> We hope some of the ideas will take root and that the conversation will continue, ultimately producing several generations of legal and policy responses.

Two contributions to the symposium introduce readers to what neuroscientists have learned about early stressors. First, in *The Ingredients of Health Brain and Child Development*, Dr. Pat Levitt and co-author Dr. Kathie Eagleson summarize foundational principles of brain development, debunk several popular misconceptions, and identify critical periods and drivers in the processes of building circuits and pruning synapses.<sup>24</sup> The authors emphasize how cognitive development, social development, and emotional development intertwine so that early experiences, both positive and negative, have significant life-long consequences because of the impact on the developing brain. Thus, "serve and return" interactions between adults and infants help propel healthy brain development, while toxic stress poses risks, and each can play a critical role in appropriate development of executive function. The authors also emphasize that, in addition to infancy, adolescence is a crucial period for brain development, echoing the work discussed in Scott et al.

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23. *Id.* at 38.

24. Pat Levitt & Kathie A. Eagleson, *The Ingredients of Healthy Brain and Child Development*, 57 WASH. U. J.L. & POL'Y 75 (2018).

Second, in *A Role of Early Life Stress on Subsequent Brain and Behavioral Development*, Dr. Damien A. Fair, with co-authors Dr. Alice M. Graham and Brian Mills, elaborates on brain scientists' key discoveries about the negative impact of early stressors.<sup>25</sup> Using a theory called Developmental Origins of Health and Disease, Dr. Fair and his co-authors consider how early brain programming might help explain the rising rates of developmental disabilities, criminal activity, substance use disorders, and psychopathologies in early adolescence and young adulthood. In particular, the authors highlight that neuroscientists find correlations of the maternal stress response of inflammation during pregnancy (as measured by the biological marker of cytokines in the blood) with sensitivity of the amygdala to prenatal exposure to inflammation, consistent with the increased risk to offspring of neuropsychiatric disorders and physical health problems.

As Dr. Levitt and his co-author note at the end of their article, the challenge for neuroscientists now lies in experimenting with and fashioning next steps, with a view to determining the most productive interventions for particular families. Three of the contributions to the symposium engage with such questions.

In *Early Life Impacts on Later Life Health and Economic Outcomes*, Dr. Diane Whitmore Schanzenbach joins other prominent economists<sup>26</sup> in making the case for investments in young children at the earliest stages of development as an effective, even necessary, means of improving our country's long-term economic well-being.<sup>27</sup> Dr. Schanzenbach describes her research on the impact, both short-term and long-term, of access to the food stamp program, which she has found enhances nutrition and reduces stress for children, in turn resulting in better adult health and increased economic self-sufficiency. Significantly, the research compares long-term health and education outcomes with children's ages at the time of intervention, showing the importance of the in utero period and providing empirical support for measures designed to address poverty and food insecurity among pregnant women for the purpose of improving outcomes

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25. Fair, Graham, & Mills, *supra* note 11.

26. See, e.g., JAMES J. HECKMAN, *GIVING KIDS A FAIR CHANCE (A STRATEGY THAT WORKS)* (2013).

27. Diane Whitmore Schanzenbach, *Early Life Impacts on Later Life Health and Economic Outcomes*, 57 WASH. U. J.L. & POL'Y 103 (2018).



for their offspring.

Complementing Dr. Schanzenbach's observations, Dr. Cynthia Rogers also emphasizes the very earliest stages of brain development in her article, *Addressing the Psychosocial Risk Factors Affecting the Developing Brain of the High Risk Infant*.<sup>28</sup> Dr. Rogers and her colleagues have focused on preterm delivery, an important phenomenon for two reasons. First, preterm delivery constitutes one of the most significant outcomes associated with maternal depression and anxiety. Second, preterm infants face an elevated risk of exposure to high parenting stress and unsupportive maternal-child interactions during a key period when the neonatal brain undergoes rapid growth and therefore is highly vulnerable. Based on studies of a cohort of children who were born preterm and also experienced social disadvantage,<sup>29</sup> Dr. Rogers and colleagues have developed the Perinatal Behavioral Health Service, a clinical program at Washington University School of Medicine designed to improve maternal mental health and thus optimize outcomes for children. This service provides maternal mental health screenings pre- and post-partum, on-site treatment for mothers at the neonatal intensive care unit, and access to mental health education.<sup>30</sup> The program currently helps a small fraction of those at risk,<sup>31</sup> but has the potential to reach many more.

Looking beyond the prenatal and infancy stages, Dean Mary McKay and co-author Dr. Mary Acri outline promising evidence-based interventions that rely on collaborative research methods designed specifically to address child mental health and strengthen protective family processes, with the goal of enhancing positive development for low-income children of color. Their contribution to the symposium, *A Conversation on Building Resilience and Protecting Children: An Evidence-based Family Strengthening Approach*,<sup>32</sup> acquaints readers with the "4Rs and 2Ss Family Strengthening Program," an NIH-funded program in collaboration with the New York State Office of Mental Health. The authors emphasize the importance of meeting the demands of families and the systems that attempt to serve them, reflected in their organization of the hundreds of families in

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28. Rogers, *supra* note 10.

29. *Id.* at 125.

30. *Id.*

31. *Id.* at 126.

32. Mary M. McKay & Mary Acri, *A Conversation on Building Resilience and Protecting Children: An Evidence-based Family Strengthening Approach*, 57 WASH. U. J.L. & POL'Y 133 (2018).

this study into multi-family groups, thereby serving a greater number of families and facilitating a support network of family-to-family interactions. Noting significant outcomes in child behavioral functioning and family protective processes, they explain the value of shifting the focus from personal and community deficits to context, in turn, promoting “a search for conditions that can be addressed by community-level, structural interventions.”<sup>33</sup>

The final piece of the symposium presents a conversation among panelists whom we invited to offer their diverse perspectives on how law and policy should and might change, based on our current understanding of brain development, and also on how neuroscientists can undertake research that would prove most useful in influencing law and policy.<sup>34</sup> The participants include clinicians and investigators as well as those with “on the ground” implementation expertise: a pediatric neurologist trained in cognitive neuroscience; a healthcare and service provider for adolescents; a former judge now engaged in the private practice of family law; a health economist who works with policymakers on topics of medical insurance and Medicare; and a state legislator. This important culmination of the symposium attempts to grapple with just some of the difficulties of turning theory into practice.

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As the basis of a law reform project, the findings on early stressors present a number of challenges that the legal innovations on juvenile sentencing had no need to confront. These are problems grounded in American jurisprudence, far more than in the strength or weakness of the neuroscience or the data. The Supreme Court’s juvenile sentencing cases—the point of departure for Professor Scott and her co-authors—relied on the Eighth Amendment’s prohibition on cruel and unusual punishment and the Fourteenth Amendment’s Due Process Clause, both of which impose limits on government action, consistent with what some call our “negative

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33. *Id.*

34. Panel Discussion, *Bringing Science to Law and Policy*, 57 WASH. U. J.L. & POL’Y 147 (2018).

Constitution.”<sup>35</sup> By contrast, the Supreme Court has rejected the claims to affirmative government support or “positive rights,” even if such “entitlements” are needed in order for one to realize the negative rights guaranteed by the Constitution.<sup>36</sup> What we have learned about early stressors, as described by several contributions to this symposium, calls for government action—support for interventions—for which we have no constitutional guarantee, no matter how critical to child health and wellbeing such support might be.<sup>37</sup>

We see a similar reluctance to embrace affirmative rights as a legislative matter. The United Nations Convention on the Rights of the Child, which entered into force in 1990, recognizes a number of positive rights for children, including, for example, “the right of the child to the enjoyment of the highest attainable standard of health and to facilities for the treatment of illness and rehabilitation of health,” and it requires state parties to “strive to ensure that no child is deprived of his or her right of access to such health care services.”<sup>38</sup> Yet, the United States stands alone among U.N. member states for failure to ratify this treaty,<sup>39</sup> which requires a favorable vote by two-thirds of the U.S. Senate. This failure to act stems in part from perceived threats to parental rights and American sovereignty,<sup>40</sup> but likely also reflects resistance to the positive rights that this treaty grants to children and the corresponding affirmative duties that it imposes on government.<sup>41</sup>

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35. Susan Bandes, *The Negative Constitution: A Critique*, 88 MICH. L. REV. 2271 (1990).

36. See *Harris v. McRae*, 448 U.S. 297 (1980); *DeShaney v. Winnebago Cty. Dep’t of Soc. Servs.*, 489 U.S. 189 (1989); *Town of Castle Rock v. Gonzales*, 545 U.S. 748 (2005). For an examination of these cases, see, e.g., Susan Frelich Appleton, *Obergefell’s Liberties: All in the Family*, 77 OHIO ST. L.J. 919, 933-39 (2017).

37. See, e.g., Anne L. Alstott, *Is the Family at Odds with Equality? The Legal Implications of Equality for Children*, 82 S. CAL. L. REV. 1, 4 (2008); see also JAMES S. FISHKIN, JUSTICE, EQUAL OPPORTUNITY, AND THE FAMILY 4 (1983) (“Once the role of the family is taken into account, the apparently moderate aspiration of equal opportunity produces conflicts with the private sphere of liberty—with autonomous family relations—that are nothing short of intractable.”).

38. United Nations Convention on the Rights of the Child art. 24 (1990), available at <http://www.ohchr.org/Documents/ProfessionalInterest/crc.pdf>.

39. See *Hailing Somalia’s Ratification, UN Renews Call for Universalization of Child Rights Treaty*, UN NEWS CENTRE (Oct. 2, 2015), <http://www.un.org/apps/news/story.asp?NewsID=52129#.Wcew3kyZNE4> [http://perma.cc/ZRJ8-RJJ5].

40. See Karen Attiah, *Why Won’t the U.S. Ratify the U.N.’s Child Rights Treaty?*, WASH. POST (Nov. 21, 2014), [https://www.washingtonpost.com/blogs/post-partisan/wp/2014/11/21/why-wont-the-u-s-ratify-the-u-n-s-child-rights-treaty/?utm\\_term=.98043dbe19d4](https://www.washingtonpost.com/blogs/post-partisan/wp/2014/11/21/why-wont-the-u-s-ratify-the-u-n-s-child-rights-treaty/?utm_term=.98043dbe19d4).

41. See Anne C. Dailey & Laura A. Rosenbury, *The New Law of the Child*, 127 YALE L.J. 1448

Even states that assert strong “pro-life” positions in efforts to restrict abortion routinely ignore life after birth, eschewing opportunities to invest in measures that can help pregnant women bear healthy children or that can enhance child wellbeing.<sup>42</sup> Similarly, in the wake of the Affordable Care Act, eighteen states failed to adopt Medicaid expansion, despite a coverage gap that left many residents of those states, including numerous children, without affordable health insurance. As these examples show, sound data about benefits will not alone persuade lawmakers to support at-risk families.

Of course, sometimes legislatures undertake to support health and wellbeing even in the absence of a constitutional command to do so. The federal Food Stamp Program (or Supplemental Nutritional Assistance Program or SNAP)<sup>43</sup> that underlies Dr. Schanzenbach’s analysis is a prominent example. The Affordable Care Act itself, which imposes insurance coverage duties on many employers for their employees,<sup>44</sup> and the Title X program, which provides birth control for poor women with government dollars,<sup>45</sup> provide two additional illustrations. Yet, these illustrations also expose the vulnerability of such programs, based on changing political winds. All have encountered fierce resistance with the advent of the Trump administration and a Republican Congress.<sup>46</sup> In other words, legislative and administrative actions, especially those that call for affirmative government support, lack the staying power of the constitutional rights on which the juvenile sentencing cases rest.

The challenge, then, for making law and policy based on what we know about early stressors and their impact on brain development may well entail working hard to implement reforms, even while knowing that government support for interventions might be temporary, and reinforcing such efforts

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(2018).

42. See generally Reva B. Siegel, *ProChoiceLife: Asking Who Protects Life and How—and Why It Matters in Law and Politics*, 93 IND. L.J. 207 (2018).

43. 7 U.S.C. §§ 2011-2036 (2012).

44. Patient Protection and Affordable Care Act of 2010 (ACA), Pub. L. No 111-148, 124 Stat. 119.

45. 42 U.S.C. §§ 300 et seq.

46. See, e.g., Associated Press, *House Panel Moves to Curb Food Stamps, Renew Farm Subsidies*, N.Y. TIMES (Apr. 18, 2018), <https://www.nytimes.com/aponline/2018/04/18/us/politics/ap-us-congress-farm-bill.html>; Robert Pear, *Trump, Shouting “Death Spiral,” Has Nudged Affordable Care Act Downward*, N.Y. TIMES (May 20, 2017), <https://www.nytimes.com/2017/05/20/us/politics/trump-death-spiral-affordable-care-act.html>; Editorial Board, *The Trump Administration’s Backward Attitude Toward Birth Control*, N.Y. TIMES (Mar. 8, 2018), <https://www.nytimes.com/2018/03/08/opinion/trump-birth-control-backward.html>.

by seeking private sources of funding, which also may be time-limited. Indeed, sometimes research undertaken with private funding can provide initial evidence that legislators will find sufficiently compelling to persuade them to continue a program with public funds, as the Colorado legislature recently did in extending a program that offers long-acting reversible contraceptive devices to reduce teen pregnancy.<sup>47</sup>

Research findings examined here, carried out with significant financial support from private as well as public sources, reveal critical windows of brain development and, importantly, opportunities to intervene with demonstrated benefit not only for those at risk but also for society at large, through positive health and economic outcomes. By introducing such findings and their promise to a wider audience, we hope that this volume will inspire further conversation about how contemporary neuroscientific learning can inform reforms in law and policy.

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47. See COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT, TAKING THE UNINTENDED OUT OF PREGNANCY: COLORADO'S SUCCESS WITH LONG-ACTING REVERSIBLE CONTRACEPTION vi (Jan. 2017), [https://www.colorado.gov/pacific/sites/default/files/PSD\\_TitleX3\\_CFPI-Report.pdf](https://www.colorado.gov/pacific/sites/default/files/PSD_TitleX3_CFPI-Report.pdf).