University of St. Thomas Journal of Law and Public Policy

Volume 15 Issue 1 *Neuroscience and the Law*

Article 10

October 2021

A Model for Analyzing and Grading the Quality of Scientific Authorities Presented to State Legislative Committees

Rose Tempowski Maxine Lintern Jill Molloy Sarah L. Cooper

Follow this and additional works at: https://ir.stthomas.edu/ustjlpp

Part of the Health Law and Policy Commons, Human Rights Law Commons, Law and Philosophy Commons, Law and Psychology Commons, Law and Society Commons, Legislation Commons, Medical Jurisprudence Commons, Other Law Commons, and the Science and Technology Law Commons

Recommended Citation

Rose Tempowski, Maxine Lintern, Jill Molloy & Sarah L. Cooper, *A Model for Analyzing and Grading the Quality of Scientific Authorities Presented to State Legislative Committees*, 15 U. ST. THOMAS J.L. & PUB. POLY 356 (2021).

Available at: https://ir.stthomas.edu/ustjlpp/vol15/iss1/10

This Article is brought to you for free and open access by UST Research Online and the University of St. Thomas Journal of Law and Public Policy. For more information, please contact the Editor-in-Chief at jlpp@stthomas.edu.

A MODEL FOR ANALYZING AND GRADING THE QUALITY OF SCIENTIFIC AUTHORITIES PRESENTED TO STATE LEGISLATIVE COMMITTEES

ROSE TEMPOWSKI, MAXINE LINTERN, JILL MOLLOY & SARAH L. COOPER*

ABSTRACT

Longitudinal studies have confirmed that human brains continue to mature and restructure throughout adolescence, with the prefrontal cortex – responsible for executive functions – maturing into an individual's twenties.¹ Studies examining adolescent decision-making demonstrate that young people prioritize rewards when assessing risk,² take more risks in 'hot' contexts³ and are more likely to take risks when in the presence of their

^{*} Rose Tempowski is a doctoral candidate at the Centre for Law, Science and Policy, Birmingham City University, UK and a tutor at the University of Law, Nottingham, UK. Maxine Lintern is a Professor of Biomedical Science and Associate Dean for Research and Enterprise for the Faculty of Business, Law and Social Sciences at Birmingham City University, UK. Jill Molloy is a barrister and Senior Lecturer in Law at Birmingham City University, UK. Dr. Sarah L. Cooper is a Reader in Interdisciplinary Legal Studies and the Director of Research in the School of Law, Birmingham City University, UK. The model described in this paper was developed by Rose Tempowski and the associated research is being undertaken in partial fulfilment for the degree of Doctor of Philosophy at Birmingham City University, UK, supervised by Dr. Sarah Cooper, Prof. Maxine Lintern and Jill Molloy.

¹ Jay N. Giedd et al., Brain Development During Childhood and Adolescence: A Longitudinal MRI Study, 2 NAT. NEUROSCI. 861 (1999) [hereinafter Brain Development During Childhood and Adolescence]; Jay N. Giedd, Structural Magnetic Resonance Imaging of the Adolescent Brain, 1021 ANN. N.Y. ACAD. SCI. 77 (2004) [hereinafter Structural Magnetic Resonance Imaging of the Adolescent Brain].

² Margo Gardner & Laurence Steinberg, *Peer Influence on Risk Taking, Risk Preference, and Risky Decision Making in Adolescence and Adulthood: An Experimental Study,* 41 DEV. PSYCHOL. 625 (2005); L.H. Somerville, et al., *Frontostriatal Maturation Predicts Cognitive Control Failure to Appetitive Cues in Adolescents,* 23 J. COGN. NEUROSCI. 2123 (2011).

³ B. J. Casey, et al., *The Adolescent Brain*, 1124 ANN. N.Y. ACAD. SCI. 111 (2008).

peers.⁴ These findings have motivated arguments that the immaturity of an adolescent brain could impact on culpability for criminal offences; a point recognized by the US Supreme Court in 2005:

From a moral standpoint it would be misguided to equate the failings of a minor with those of an adult, for a greater possibility exists that a minor's character deficiencies will be reformed. Indeed, "[t]he relevance of youth as a mitigating factor derives from the fact that the signature qualities of youth are transient; as individuals mature, the impetuousness and recklessness that may dominate in younger years can subside."⁵

Since 2007, states have begun to '*Raise the* Age' and move towards a national consensus of 18 for the upper age limit of juvenile court jurisdiction. Vermont has even gone beyond this, raising the age limit to 20.⁶ Little is known, however, about the extent to which, one, the evidential body of adolescent brain science is informing this legislative movement, or, two, robust science is presented to legislative decision-makers and by whom.

This paper presents a model, developed by Tempowski, for analyzing and grading the quality of scientific arguments (related to adolescent developmental neuroscience) and authorities presented to legislative committees examining 'Raise the Age' legislation. It has been applied to four states between 2000 and 2019: Connecticut, Vermont, Michigan and Wisconsin. The former two were selected as states which had already, or were repeatedly attempting, to raise the age of juvenile jurisdiction above 18 and the latter two were states which, as of the beginning of the research in 2018, had not reached the national consensus of 18. Almost 700 pieces of evidence were analyzed. Using the model, each item was reviewed for, first, the quality of their scientific argument, by examining how a dominant theory was communicated, and second, the quality of the scientific authorities which underpinned their argument, by assessing criteria such as whether studies were peer-reviewed, performed in humans, randomized control trials or whether they were opinion-based. After grades were assigned for these two analyses, items were also categorized by author and a thematic analysis conducted.

⁴ Laurence Steinberg, A Social Neuroscience Perspective on Adolescent Risk Taking, 28 DEV. REV. 78 (2008).

⁵ Roper v. Simmons, 543 U.S. 551, 570 (2005).

⁶ 2018 Vt. Acts & Resolves No. 201 (increasing the age of juvenile court jurisdiction to 20 as of 2022).

The model tells us that overall, although detailed scientific arguments about brain science and culpability are made to the legislature, poor quality evidence is provided to support these and, most often, there is a lack of scientific evidence entirely. Our research shows that campaign organizations, academia, religious groups, police chiefs and parents regularly provide testimony in this public process and that the themes of funding, recidivism and serious offences are repeatedly referenced.

This paper provides a summary of the results from Connecticut, Michigan, Vermont and Wisconsin. Part I provides context through a discussion of the developing neuroscience and legal activity, Part II discusses the methodology of the analysis model and Part III offers conclusions about the quality of science referenced, who participates in the process of providing testimony to state legislative committees, and the themes discussed by these witnesses.

I. DEVELOPING NEUROSCIENCE AND LEGAL ACTIVITY

A. Developing Neuroscience and Juvenile Justice

It has been known for centuries that young people are not as thoughtful as adults. As far back as the 4th century BCE, Aristotle noted that, 'The young are heated by nature as drunken men by wine.'⁷ Centuries later, in 412 CE, St. Augustine opined that, '*All men have freedom [of will] but it is restrained in children, in fools, and in the witless who do not have reason whereby they can choose the good from the evil.*'⁸ These thoughts persisted throughout the Middle Ages and famously, in A Winter's Tale, Shakespeare wrote:

I would there were no age between ten and three-andtwenty, or that youth would sleep out the rest, for there is nothing in the between but getting wenches with child, wronging the ancientry, stealing, fighting-⁹

Since the advent of the first juvenile court in 1899, bright-line age limits have been used to separate young people from adults criminally, but questions can now be asked about how these limits are determined and whether what we now understand about the developing adolescent brain should play a role in informing them. A body of neuroscientific evidence has

⁷ ARISTOTLE, RHETORIC bk. II (c. 350 B.C.E.).

⁸ DAN MICHEL, AYENBITE OF INWYT (Richard Morris ed., N Trübner & Co 1866) (1340).

⁹ WILLIAM SHAKESPEARE, A WINTER'S TALE act 3, sc. 3.

built up from the middle of the 20^{th} century that demonstrates adolescent brains differ to those of adults.

In the 1960s and 70s, post-mortem studies allowed scientists to explore the developing brain. Rather than relying on anecdotal observations of the behavior of the young, science was now able to directly observe that there appeared to be a physical difference between the brain of young person and that of an adult. In 1967, Yakovlev and Lecours discovered that adolescence appeared to be a period where the human brain underwent a series of changes in structure and that the region of the brain which differed the most with the age of the subject was the prefrontal cortex.¹⁰ This was significant as the prefrontal cortex had been suggested as the localized region responsible for control.¹¹

Relying on donated brains, Peter Huttenlocher was able to use a microscope to count individual synapses.¹² When examining the prefrontal cortex, Huttenlocher found that synapses continue to increase until the age of three, and then a gradual reduction occurs which continues until the latter teenage years.¹³ The cause of this reduction is synaptic pruning, a process through which less used synapses are removed and actively used synapses are reinforced.¹⁴ The results of this study altered the belief that brain development halted in early childhood.

With the development of Magnetic Resonance Imaging ('MRI') came the ability to examine living subjects and to re-examine the same subject over time. In 1990, Terry Jernigan et al. used MRI to demonstrate that grey matter volume was lower in young adults compared to children and that this reduction began to occur after seven.¹⁵ They suggested this reduction

¹⁰ P.I. Yakovlev & A.R. Lecours, *The Myelogenetic Cycles of Regional Maturation of the Brain* in REGIONAL DEVELOPMENT OF THE BRAIN IN EARLY LIFE 3-70 (A Minkowski ed., 1967).

¹¹ See e.g., JM Harlow, Recovery from the Passage of an Iron Bar Through the Head, 2 PUBL. MASS. MED. Soc. 327 (1868); S. I. Franz, On the Functions of the Cerebrum. I. The Frontal Lobes in Relation to the Production and Retention of Simple Sensory-Motor Habits, 8 AM. J. PSYCHOL. 1 (1902); Brenda Milner, Effects of Different Brain Lesions on Card Sorting, 9 ARCH. NEUROL. 90 (1963).

¹² See Peter R. Huttenlocher, Synaptic Density in Human Frontal Cortex — Developmental Changes and Effects of Aging, 163 BRAIN RES. 195 (1979).

 $^{^{13}}$ *Id*.

¹⁴ See Peter R. Huttenlocher, *Synaptogenesis in Human Cerebral Cortex* in HUMAN BEHAVIOR AND THE DEVELOPING BRAIN 137 (G. Dawson & K. Fischer eds., 1994).

¹⁵ See Terry L. Jernigan & Paula Tallal, Late Childhood Changes in Brain Morphology Observable with MRI, 32 DEV. MED. CHILD NEUROL. 379 (1990); Terry

might have occurred due to myelination, an increase in white matter volume, and discovered that the frontal lobe was the last brain region to undergo this change.¹⁶

The first longitudinal study of brain development across ages was undertaken by Jay Giedd et al. in the 1990s and produced growth curves for white and grey matter.¹⁷ White matter was shown to uniformly increase through age 20, but changes in grey matter depended on the brain region.¹⁸ Subsequent studies have continued to support this finding.¹⁹

It is now understood that the brain undergoes a significant period of reorganization throughout adolescence and young adulthood.²⁰ Synaptic pruning results in the thinning, but increased efficiency, of grey matter and myelination results in an increase in volume of white matter.²¹ The prefrontal cortex, the region responsible for executive functions, is the last to mature.²² The brain of a young person is therefore in a period of constant flux.

In addition to research into the physical maturation of the brain, social scientists and neuroscientists have conducted studies into decision making whilst brain maturation is ongoing. In 2001, Beatriz Luna et al. conducted an inhibition study which showed that as regions of the brain matured, voluntary control of behavior increased.²³ Functional MRI scans, in

²⁰ Anatomical Brain Magnetic Resonance Imaging, supra note 19.

L. Jernigan, et al., *Maturation of Human Cerebrum Observed in Vivo During Adolescence*, 114 BRAIN 2037 (1991); Arthur W. Toga, et al., *Mapping Brain Maturation*, 29 TRENDS IN NEUROSCIENCES 148 (2006).

¹⁶ See Maturation of Human Cerebrum Observed in Vivo During Adolescence, supra note 15.

¹⁷Brain Development During Childhood and Adolescence, supra note 1; Toga, supra note 15.

¹⁸ Brain Development During Childhood and Adolescence, supra note 1.

¹⁹ See e.g., Jay N. Giedd et al., Anatomical Brain Magnetic Resonance Imaging of Typically Developing Children and Adolescents, 48 J. AM. ACAD. CHILD. ADOLESC. PSYCH. 465 (2009) [hereinafter Anatomical Brain Magnetic Resonance Imaging]; M.R. Asato, et al., White Matter Development in Adolescence: A DTI Study, 20 CEREB. CORTEX 2122 (2010); Sarah-Jayne Blakemore, Imaging Brain Development: The Adolescent Brain, 61 NEUROIMAGE 397 (2012); K.L. Mills, et al., Structural Brain Development Between Childhood and Adulthood: Convergence Across Four Longitudinal Samples, 141 NEUROIMAGE 273 (2016).

²¹ Anatomical Brain Magnetic Resonance Imaging, supra note 19; Sara B. Johnson, et al., Adolescent Maturity and the Brain: The Promise and Pitfalls of Neuroscience Research in Adolescent Health Policy, 45 J. ADOLESC. HEALTH 216 (2009).

²² Johnson, *supra* note 21.

²³ Beatriz Luna, et al., *Maturation of Widely Distributed Brain Function Subserves Cognitive Development*, 13 NEUROIMAGE 786 (2001).

partnership with an oculomotor response-suppression task, showed that executive regions which were responsible for focus, planning, performance monitoring and error spotting were used automatically by adults, but much less by the teenagers.²⁴

In 2005, Margo Gardner & Laurence Steinberg famously conducted a decision-making experiment using a driving game called "Chicken".²⁵ Participants in the study (adolescents, youths and adults from age 13 upwards) needed to weigh risk to decide whether to stop a car on an amber traffic light. The experiment found that teenagers and adults are capable of assessing risk in the same way, but that teenagers value the reward more highly than adults, which can lead to risky behavior.²⁶ Their results were supported again by Steinberg's 2008 study: when peers were present, teenagers took twice as many risks.²⁷

In 2008, BJ Casey et al. demonstrated that adolescents displayed elevated responses to incentives and socio-emotional events.²⁸ These circumstances have been labelled 'hot' contexts and there is evidence that young people make more risky decisions in these contexts than other age groups.²⁹ Functional MRI scans, obtained whilst subjects were undergoing such experiments, show that the ventral striatum, the reward center of the brain, was engaged in adolescents when making decisions.³⁰ These conclusions were explained further by neuroscientists who showed that the maturation of the prefrontal and parietal lobes which occurs in young people affects working memory, socio-emotional maturity and other higher-order processes like inhibition.³¹

By the late 2000s, there was now an established body of evidence in both neuroscience and social science that confirmed the centuries old observations that young people were less thoughtful than adults. In the same period, such arguments – in the context of young persons' criminal culpability - made their way to the US Supreme Court.

²⁴ Id.; Beatriz Luna, et al., *Development of Eye-Movement Control*, 68 BRAIN AND COGNITION 293 (2008).

²⁵ Gardner, *supra* note 2.

²⁶ Id.

²⁷ Steinberg, supra note 4.

²⁸ Casey, *supra* note 3.

²⁹ SARAH-JAYNE BLAKEMORE, INVENTING OURSELVES: THE SECRET LIFE OF THE TEENAGE BRAIN 143 (2018).

³⁰ Somerville, *supra* note 2.

³¹ E. A. Crone & R. E. Dahl, Understanding Adolescence as a Period of Social-Affective Engagement and Goal Flexibility, 13 NAT. REV. NEUROSCI. 636 (2012).

B. The US Supreme Court

In the new millennium, the US Supreme Court examined a series of related issues, from the constitutionality of the death penalty for under 18s to whether under 18s should receive sentences of life without parole for any crime. Arguments in these cases centered around the difference between being under 18 and an adult.

In 2002, in *Atkins v. Virginia*, the US Supreme Court determined that knowing right from wrong was not sufficient to sentence someone with an intellectual disability to death due to their compromised decision making processes.³² Following this, *In re Stanford* asked the US Supreme Court to re-examine the death sentence of Kevin Stanford – who had been under 18 at the time of his sentencing – which had been previously affirmed in 1989.³³ His petition was denied, but crucially, Justice Stevens, joined by Justices Souter, Ginsberg and Breyer, pointed to neuroscientific evidence in their dissent:

Neuroscientific evidence of the last few years has revealed that adolescent brains are not fully developed, which often leads to erratic behaviors and thought processes in that age group. ... Scientific advances such as the use of functional magnetic resonance imaging - MRI scans - have provided valuable data that serve to make the case even stronger that adolescents 'are more vulnerable, more impulsive, and less self-disciplined than adults.'³⁴

Three years later, the US Supreme Court ruled in *Roper v. Simmons* that use of the death penalty for those under 18 at the time of their offence violated the evolving standards of decency.³⁵ A study by Laurence Scott and Elizabeth Steinberg, referenced by the Court, summarized that adolescents suffered from poor future foresight, impulsivity and a vulnerability to peer pressure, which correlated with the neuroscientific evidence that regions in the brain involved in higher-order functioning, such as control and decision-making, continued to develop throughout adolescence.³⁶

³² Atkins v. Virginia, 536 U.S. 304 (2002).

³³ In re Stanford, 537 U.S. 968 (2002).

³⁴ *Id.* at 971.

³⁵ Roper v. Simmons, 543 U.S. 551 (2005).

³⁶ L. Steinberg & E. Scott, Less Guilty by Reason of Adolescence: Developmental Immaturity, Diminished Responsibility, and the Juvenile Death Penalty, 58 AM. PSYCHOL. 1009 (2003).

In 2010, the US Supreme Court held in *Graham v. Florida*, that sentencing a juvenile to life without parole for a non-homicide crime violated the US constitution.³⁷ Justice Kennedy, writing the Court's opinion, explicitly referenced neuroscience, stating:

[D]evelopments in psychology and brain science continue to show fundamental differences between juvenile and adult minds. For example, parts of the brain involved in behavior control continue to mature through late adolescence.³⁸

Two years later, in *Miller v. Alabama*, the Court would determine that mandatory life without parole sentences for homicide offenders were also unconstitutional for similar reasons.³⁹ The Court recognized that the juvenile qualities 'of transient rashness, proclivity for risk, and inability to assess consequences' reduced an offender's moral culpability whilst also increasing the likelihood of their rehabilitation, as these deficiencies are resolved once the brain maturation occurs.⁴⁰ In 2016, this decision was held to be retroactive.⁴¹

Scientific arguments surrounding brain maturity have not just been reserved for the US Supreme Court. In 2017, a series of cases in Kentucky saw scientific data that brain development continues into the 20s used as justification for labelling the state's death penalty statute unconstitutional in its application to 18 to 21 year olds.⁴² The American Bar Association supports extending the prohibitive age to 21 and in 2018, and passed a resolution, grounded in developmental neuroscience, calling for prohibition of capital punishment for defendants both 21 and under.⁴³ In March 2018, the US District Court for Connecticut used the same scientific principles and the specific testimony of Laurence Steinberg, to rule that the principle in *Miller* could apply to a defendant who had reached the age of 18 prior to the offence for which they were prosecuted.⁴⁴

C. The 'Tough on Crime' and 'Raise the Age' Eras

³⁷ Graham v. Florida, 560 U.S. 48 (2010).

³⁸ *Id.* at 68.

³⁹ Miller v. Alabama, 567 U.S. 460 (2012).

⁴⁰ *Id.* at 472.

⁴¹ Montgomery v. Louisiana, 577 US (2016).

⁴² Commonwealth v. Bredhold, 14-CR-161 (Fayette Cir. Ct. Aug. 1, 2017); Commonwealth v. Diaz, 15-CR-584-001 (Fayette Cir. Ct. Sep. 6, 2017).

⁴³ ABA House of Delegates Resolution 111 (2018).

⁴⁴ Cruz v. United States, 3:11-cv-00787-JCH (Dist. Ct., Mar. 29, 2018).

Between 1980 and 1995, there was a sharp increase in violent juvenile crime. In this period, arrests for the Violent Crimes Index of murder, forcible rape, robbery and aggravated assault grew by 94% involving children under 15 and 47% for older juveniles.⁴⁵ Media focus on juvenile crime increased and an ethos of *'if it bleeds, it leads'* developed in newsrooms, resulting in a barrage of crime related headlines.⁴⁶ The public became concerned at an impending wave of juvenile *'super-predators'*.⁴⁷ Politicians claimed the juvenile system was inadequate and that prioritizing rehabilitation did not work, with Representative Bill McCollum claiming, "*In America today, no population poses a greater threat to public safety than juvenile criminals*".⁴⁸

The period became one of significant change in juvenile criminal policy. The rhetoric of '*adult time for adult crime*' motivated increasingly punitive measures and firmly moved the system away from being offender focused to offence based.⁴⁹ States began to adjust their laws dealing with juvenile transfer, taking discretion away from juvenile court judges who were seen as too lenient,⁵⁰ and placing the transfer decision either in the hands of the prosecutors or the legislature.⁵¹ A host of legislation was developed or expanded which would sweep more young people into the jurisdiction of the adult criminal court, for example so-called 'Direct File' laws which handed

⁴⁵ Office of Juvenile Justice and Delinquency Prevention, The Youngest Delinquents: Offenders Under Age 15 (1997).

⁴⁶ Barry C. Feld, *Violent Youth and Public Policy: A Case Study of Juvenile Justice Law Reform*, 79 MINN. L. REV. 965 (1995); OFFICE OF JUVENILE JUSTICE AND DELINQUENCY PREVENTION, THE YOUNGEST DELINQUENTS: OFFENDERS UNDER AGE 15 (1997); Elizabeth S. Scott & Laurence Steinberg, Adolescent Development and the Regulation of Youth Crime, 18 THE FUTURE OF CHILDREN 15 (2008); John J. DiLuio, *The Coming of the Super-Predators*, THE WEEKLY STANDARD 1995.

⁴⁷ Id.

⁴⁸Richard Lacayo, *Teen Crime*, TIME (1997); John Cloud, *For They Know Not What They Do?*, TIME (1998); Elizabeth S. Scott & Laurence Steinberg, Adolescent Development and the Regulation of Youth Crime, 18 THE FUTURE OF CHILDREN 15 (2008); OFFICE OF JUVENILE JUSTICE AND DELINQUENCY PREVENTION, TRYING JUVENILES AS ADULTS: AN ANALYSIS OF STATE TRANSFER LAWS AND REPORTING (2011).

⁴⁹ Elizabeth S. Scott & Laurence Steinberg, *Adolescent Development and the Regulation of Youth Crime*, 18 THE FUTURE OF CHILDREN 15 (2008).

⁵⁰ OFFICE OF JUVENILE JUSTICE AND DELINQUENCY PREVENTION, STATE RESPONSES TO SERIOUS AND VIOLENT JUVENILE CRIME (1996); OFFICE OF JUVENILE JUSTICE AND DELINQUENCY PREVENTION, STATE RESPONSES TO VIOLENT JUVENILE CRIME: 1996-97 UPDATE (1996).

⁵¹ Id.

discretion to prosecutors, allowing them to directly file in adult court, or 'Statutory Exclusion' which meant if any of an exhaustive list of crimes was alleged then adult court automatically had jurisdiction. By 1998, every state and the District of Columbia had passed new legislation allowing more juveniles to be charged as adults⁵² and by 1997, the District of Columbia and 22 other states had at least one method of charging a child of any age as an adult.⁵³

When the first juvenile court was introduced in the United States in 1899 in Cook County, Illinois, the Illinois Juvenile Court Act 1899 granted jurisdiction over all youth below the age of sixteen.⁵⁴ Using an age-based rule is the easiest means of distinguishing between who should (and should not) be treated as an adult by the criminal justice system. The relevant age at which such a rule should sit, however, is debatable. Over the last two decades, US states have been engaged in such a debate either in the context of re-examining state transfer laws or age limit. This has led to an era of 'Raise the Age' legislation as states began to adjust their upper age limit for juvenile court jurisdiction.

This movement has been visualized for the purpose of this paper in the three charts that follow. Using the 'shiny', 'ggplot2' and 'usmap' libraries in coding language R, an interactive map displaying trends in movement of the upper age limit was produced.⁵⁵ Three screenshots have been reproduced here showing how this trend changes from 2007 at the start of the Raise the Age era, to 2014 in the middle and to 2019 which was this study's end point. The screenshots below show a color-coded map of the US according to the upper age of juvenile court jurisdiction in that state, and below this, a bar chart showing the frequency of each upper age limit across the US.

⁵² Id; Barry C. Feld, Violent Youth and Public Policy: A Case Study of Juvenile Justice Law Reform, 79 MINN. L. REV. 965 (1995).

⁵³ Christine Chamberlin, Not Kids Anymore: A Need for Punishment and Deterrence in the Juvenile Justice System Note, 42 B.C. L. REV. 391 (2000).

⁵⁴ LARRY SIEGEL & JOSEPH SENNA, JUVENILE DELINQUENCY: THEORY, PRACTICE AND LAW (7th ed. 2000).

⁵⁵ The 'usmap' library is reproduced under the General Public License Version 3.

2007⁵⁶



Figure 1: Chart showing the upper age of juvenile jurisdiction in the United States in 2007.

⁵⁶ Data on file with author. New York and North Carolina are the only two states with an upper limit of 16 for the jurisdiction of their juvenile justice system.



2014⁵⁷

Figure 2: Chart showing the upper age of juvenile jurisdiction in the United States in 2014.

⁵⁷ Data on file with author.





Figure 3: Chart showing the upper age of juvenile jurisdiction in the United States in 2019.

This 'Raise the Age' movement appears to coincide with the jurisprudence of the US Supreme Court discussed above. The Court recognized that scientific evidence was supporting the anecdotal observations that young people made decisions differently to adults;

⁵⁸ Data on file with author. New York and North Caroline have raised their upper limit to 18. Four states remain with an upper limit of 17: Georgia, Michigan, Texas and Wisconsin. Vermont has passed legislation (2018 Vt. Acts & Resolves No. 201) to increase the age of juvenile court jurisdiction to 20 as of 2022.

Supreme Court Justice Kennedy summed this up as being what '*any parent knows*':

First, as any parent knows and as the scientific and sociological studies respondent and his *amici* cite tend to confirm, [a] lack of maturity and an underdeveloped sense of responsibility are found in youth more often than in adults and are more understandable among the young. These qualities often result in impetuous and ill-considered actions and decisions. (Even the normal 16-year-old customarily lacks the maturity of an adult.) It has been noted that adolescents are overrepresented statistically in virtually every category of reckless behavior.⁵⁹ (Internal citations and quotations omitted.)

It was clear that US Supreme Court jurisprudence was being informed by the emerging body of neuroscience, but what is unclear is the extent to which the apparent legislative movement in individual states was being affected by adolescent brain development science.

II. METHODOLOGY

A. Study Design

In trying to determine whether adolescent brain development science was playing any role in the discourse surrounding these state legislative changes, it was necessary to consider at which points of the legislative process relevant science could interact with the legislature. Legislative committees were selected because they hold public hearings when considering a proposed bill, and invite testimony from interested stakeholders.

Four states were selected for review: Connecticut, Vermont, Michigan and Wisconsin. The former two were selected as states which had already, or were repeatedly attempting, to raise the age of juvenile jurisdiction above 18 and the latter two were states which, as of 2018, had not reached the national consensus of 18, retaining an upper age limit of 17 on their juvenile justice systems. All states had legislative committee public testimony which was freely available to download from the websites of the state legislature. A legislative review was conducted in each state for the period 2000-2019, which would fully encompass the 'Raise the Age' era. All

⁵⁹ Roper v. Simmons, 543 U.S. 551, 569-570 (2005).

bills that addressed attempts to raise the age of juvenile jurisdiction, or to adjust juvenile transfer or waiver laws, were collated. This resulted in the data shown in Figure 4, which details the status of bills collected from each relevant legislative session during the assessment. Pending bills are only shown in the 2019-2020 legislative session as that session was not complete when the data collection period ended in 2019.



371



Figure 5: Bar chart showing the number of pieces of evidence examined by state.

From the bills collated in Figure 4, all the publicly available witness testimony was collected. In total, this was 698 pieces of evidence, however this was not evenly distributed across the four states. Figure 5 above shows the number of pieces of evidence collected from each state.

B. Creating the Model

The 698 items of evidence needed to be analyzed to determine whether they contained any reference to adolescent brain development science. If it was found that they did reference brain science, then they needed to be further analyzed to grade the quality of this. Only then would any conclusion be possible regarding the quality of the science which interacted with the state legislature. To do this, a unique analysis model needed to be developed; this can be seen in Figures 6 and 7.

The model was inspired by the grading of undergraduate assessments, using set marking criteria on a sliding scale to provide consistent results across varying documentation. Upon exploring possible criteria for analyzing references to adolescent brain development science, it became clear that there were two categories of analysis occurring: one which dealt with the quality of the communication of a scientific argument to the legislature, and one which dealt with the quality of the underpinning scientific authorities on which the argument was based. Grading each of these categories separately would allow the final grades to be plotted on a 2-D axis and visualized. The model was therefore split into two. First, each piece of evidence would receive a grade for the communication for the scientific argument it contained and this would be recorded on the x-axis. Secondly, a grade would be awarded using the second half of the model and grading the quality of the underpinning scientific authorities referenced by the item of evidence; this grade would be recorded on the y-axis. Together, the grades could be plotted, as in Figure 11, to visualize the overall quality of scientific references contained in the evidence.

1.			_							_		-	_	-	_	
						science? Why?	development	adolescent brain	reference	Does the record	Communication	Science	Quality of			X-Axis
								science.	development	brain	reference to adolescent	makes no	The record	Science	Void of	•
						no context beyond the circumstances.	reference has	development science. The	brain	adolescent	generic reference to	contains	The record		Limited	
Figure 6. Creding and analyzing model v avis oritoria						The record makes links between adolescent brain development and decision-making in young people.	QR	justice system.	science are made in the context of the juvenile	References to adolescent brain development	AND	development science.	The record makes reference to adolescent brain		Some	2
						The record makes links between adolescent brain development and decision-making in young people.	CANY	context of the juvenile justice system.	development science are made in the	References to adolescent brain	AND	adolescent brain development science.	The record makes reference to		Good	
				The record makes explicit links between decision-making and criminal culpability.	AND	The record makes links between adolescent brain development and decision-making in young people.	ONV	context of the juvenile justice system.	development science are made in the	References to adolescent brain	CANY	adolescent brain development science.	The record makes reference to		Very Good	4
	ox The record explores the inherent uncertainty of scientific conclusions.	The record presents multiple viewpoints and provides a critical analysis by engaging with the existing evidence base and identifying the dominant theory.	CAN	The record makes explicit links between decision-making and criminal culpability.	AND	The record makes links between adolescent brain development and decision-making in young people.	CAVY	context of the juvenile justice system.	development science are made in the	References to adolescent brain	CAV	adolescent brain development science	The record makes reference to		Exceptional	~

Figure 6: Grading and analyzing model x-axis criteria.

						Quality of Authorities	Y-Axis
				development science.	authorities on adolescent brain	The record does not contain a	0 Void of Science
				but does not provide any citation.	adolescent brain development science <u>exist</u>	The record suggests authorities	1 Limited
1		Ava/on The primary authority is, or rel opinion or anecdotal evidence	AND/OR The record cites some non-aca published material from a sou a website, report or news jour	centre. [The reader cannot be sure wh research is being referenced. b specific point of contact to exp authority further.]	The record cites some general information for the authority, name of a university, scientist	The record cites a single autho adolescent brain development	2 Some
1		lies on,	idemic Irce such as rmal.	ich ut has a vore the	identifying such as the or research	rity on science.	
•	The primary authorities rely on animal studies on brain development over human studies.	Average The primary authorities are mostly observational studies. Average	AND/OR The record cites a non-peer reviewed academic journal, or professional equivalent.	The record cites to specific authorities in some non-standard form. [The reader can find the specific research cited with the use of a search engine.]	One authority dominates.	The record cites multiple authorities on adolescent brain development science.	Good
•	Awayow The primary authorities use randomised control trials (RTIs).	The primary authorities study brain development and/or decision-making performed in humans.	AND/OR The record cites a peer-reviewed journal in a non-scientific field, such as criminal justice, or professional equivalent.	The record provides full citations for authorities. [The reader can follow to the citation to locate the specific authority.]	Weight is given to different authorities.	The record cites multiple authorities on adolescent brain development science.	4 Very Good
	Avci/on Primary authorities linked to are systematic reviews or involve meta- analysis.	The record cites a peer-reviewed scientific journal, or professional equivalent.	[The reader can follow the citation to find the specific authority and the specific section which supports the statements mode.]	Authorities are critically discussed. avo The record provides <u>pincites</u> for authorities referenced.	Weight is given to different authorities.	The record cites multiple authorities on adolescent brain development science.	5 Exceptional

Figure 7: Grading and analyzing model y-axis criteria.

375

The grading and analysis model⁶⁰ was applied to the 698 pieces of witness testimony. The analytical framework for each piece of evidence was four-fold. For each piece of evidence (1) an x-axis grade was recorded; (2) a y-axis grade was recorded; (3) an analysis for recurring themes was undertaken (i.e., issues beyond brain science presented as relevant to the bill, such as resources and victims' rights etc.); and (4) a categorization by author was made (e.g., whether the evidenced was produced by, for example, academics, NGOs, law enforcement etc.).

III. **Results**

A. Results



This section summarizes key findings, namely: (1) adolescent brain development science was in fact a recurring theme in the evidence; (2)

⁶⁰ The model was beta tested by adapting the x-axis criteria to fit vaccination science. Public testimony was then collected from state legislative committees dealing with forced vaccination legislation to see whether the model could be used to analyze and grade these appropriately. The analyzing and grading model was adjusted based upon this beta testing. This led to the realization that not every piece of evidence would display all of the criteria in a selected grade boundary. Therefore, it was necessary to determine which of the criteria were fundamental to the grade and which, if present, would be suggestive of that grade. This resulted in the use of 'and' and 'or' being inserted into the grade boundaries.

evidence that was graded 'Good' on both axes of the analysis model rarely reached the legislature; (3) the most common theme discussed in the evidence was resources; and (4) the most common category of author was non-governmental organizations.

The most common (x,y) grade produced was (0,0); meaning most evidence was determined to be void of any reference to brain science. Figure 8, however, shows the percentage of witness testimony in each state which did reference brain science in some way. Across the four states, this figure sits at a comparable level.



Figure 9: Bar chart showing the total frequency of x-axis grades across all four states in the data set.

Figure 9 shows that the most common grade awarded to the evidence for the quality of scientific communication was zero. After this, Figure 9 shows that the second most common grade awarded was a three. This would equate to 'Good' on the grading model in Figure 6. This shows that of the witness testimony that references brain science, the majority do so by referencing brain science in the context of the juvenile justice system and making links between adolescent brain development science and decision

making in young people. Figure 9 also shows that it was very rare that a grade of five, or 'Exceptional', was awarded. In fact, out of all 698 pieces of evidence only three of these received a grade of five.

The above chart can be repeated for the total y-axis grades. These are the grades awarded for the quality of the underpinning scientific authorities referenced by the evidence in accordance with the model in Figure 7.



Figure 10: Bar chart showing the total frequency of y-axis grades across all four states in the data set.

Figure 10 shows that the most common grade awarded for the quality of scientific authorities was zero. Again, this is to be expected as if a piece of evidence was 'Void of Science' in accordance with the model in Figure 6, then it would also have to be 'Void of Science' in accordance with the model in Figure 7. After this, the most common grade awarded was that of one, or 'Limited'. As can be seen in Figure 7, this means that most of the witness testimony which made reference to adolescent brain development science in some way, did so without providing any authorities for the scientific argument it was making. Without citation, scientific claims and data cannot be checked by the legislature for their veracity.

These two sets of results can then be combined and produced on a 2-D axis to visualize the distribution of grades awarded to the data-set. For the purposes of this article, this distribution has been produced only for the evidence which contained reference to brain science, i.e., all evidence receiving a grade of (0,0) which was 'Void of Science' has been excluded.



Figure 11: Bubble graph - with quartiles marked - showing the frequency of grades on the x and y axes across all four states in the data set.

Figure 11 shows that the most common (x,y) grade awarded to evidence in the data set was (3,1), with 30.5% of the 236 pieces of evidence which referenced brain science receiving this grade. This equates to witness testimony which communicates a scientific argument that references adolescent brain development science, in the context of the juvenile justice system, and makes links to decision making in young people, however it does

not provide any scientific authority for this argument. This shows that scientific arguments relevant to *Raise the Age* legislation are commonly reaching state legislatures, but that these are not commonly backed up with robust scientific authority.

Figure 11 has red lines marked which divides the axis into quartiles. Looking at the results in the top right-hand corner shows the number of pieces of evidence which would be graded above a three, or 'Good' in both categories on the grading and analysis model. In total, this is only 37 pieces of testimony. This equates to 15.7% of the 236 pieces of evidence which referenced brain science, or 5.3% of the total data set of 698 pieces of evidence.

B. Alternate Themes

The third stage of the analysis involved each piece of evidence being examined for recurring key themes. The results of this analysis are shown in Figure 12.



Of the 15 themes identified,⁶¹ the most common theme referenced by the evidence was resources; this meant that there was discussion of the finances or manpower required to meet current or proposed obligations in juvenile justice policy. After resources, recidivism was the second most common theme; this meant there was discussion of reoffending by juvenile actors. A limitation of the chart in Figure 12, is that it does not record in which manner this discussion is held. For example, recidivism could have been mentioned as a theme by someone who believes the upper age limit for juvenile court jurisdiction needs to be lower, because they are concerned about young people repeatedly committing crime. Equally, recidivism could have been referenced as a theme by a witness who believes the upper age limit should be higher because young people often age out of crime and do not necessarily become adult offenders.⁶² Brain science is a relatively frequent theme; it was more common than nine other themes. Figure 12

shows that the least mentioned themes are concern for the rights of victims and compliance with the Juvenile Justice and Delinquency Prevention Act.⁶³

C. Categories of Author

⁶¹ The themes analyzed to produce Figure 12 were: bill language and exiting legislation (Discussion of suggested language to include in the proposed bill or existing statutes for comparison.); confidentiality (Discussion surrounding the confidentiality of juvenile/youth proceedings and the data which is produced as a result.); evidence-based practice (Discussion of the need to implement or invest in evidence-based programs relevant to criminal justice.); the Juvenile Justice and Delinquency Prevention Act (Discussion of compliance with the Juvenile Justice Delinquency Prevention Act.); other states' practice (Discussion, information or data regarding juvenile justice in other states within the US.); race (Discussion of the role of race in the justice system.); recidivism (Discussion of reoffending.); resources (Discussion of state resources, such as the cost of current or suggested approaches.); restorative justice (Discussion of restorative justice as a criminal justice approach.); risk assessment (Discussion of the state/county risk assessment process for offenders in the state in determining court placement.); serious offences (Commentary on or the highlighting of serious offences such as sexual offences and murder.); statistics (Use of relevant statistical evidence to support discussion.); substance abuse (Discussion of substance abuse and its role in the criminal justice system.); trauma (Discussion of the lived experience of youth entering the justice system, or of their trauma in experiencing the adult criminal justice system.); and victims' rights (Discussion surrounding the rights of victims of juvenile/youth crime.).

⁶² See e.g., Terrie E. Moffitt, Adolescence-Limited and Life-Course Persistent Anti-Social Behavior: A Developmental Taxonomy, 100 PSYCHOL. REV. 674 (1993).

⁶³ Juvenile Justice Delinquency Prevention Act, 42 U.S.C. § 5601 et seq. (1974).

In addition to categorizing alternate themes in the data set, the frequency of different categories of witness who authored the evidence can also be visualized. 14 different categories of author were recorded and the results are produced in Figure 13.⁶⁴



⁶⁴ The categories of author analyzed to produce Figure 13 were: state departments (Statements from different state offices/departments, for example the Department. for Children and Family Services.); county or local government bodies (Statements from county offices, departments or mayors.); non-governmental organizations (Statements from organizations, whether for-profit or non-profit, which do not come under a state or county umbrella. For example, the Campaign for Youth Justice and the ACLU.); law enforcement (Statements from police departments and law enforcement associations.); legislators (Testimony from state and federal representatives. This also includes legislative policy agencies, for example the Latino and Puerto Rican Affairs Commission.); scientists or medical professionals (Scientists or medical professionals, whether individual or affiliated with an association, who have written in this capacity.); lawyers (Testimony of individual lawyers or legal practice organizations, such as a bar association.); individuals (Statements or letters from individual members of the public who do not mention an affiliation.); interested individuals (Testimony of parents who have been affected by children in the criminal justice system, or of ex-offenders themselves.); news articles (Copies of items which have appeared in newsprint or online.); academia (Includes academic journal articles and testimony from those affiliated with higher education institutions, including university legal clinics.); reports (Published reports.); religious organizations (Organizations specifically affiliated with a religion or church.); and other (Testimony which does not fit into any of the above.).

Figure 13 visualizes the people and organizations who get involved with the public process of providing witness testimony to state legislative committees when they are deliberating over a proposed piece of legislation. It shows that the most common type of witness testimony was from a nongovernmental organization, either for, or non-profit. Examples of this type of author included organizations such as the Connecticut Juvenile Justice Alliance, the American Civil Liberties Union and the National Juvenile Justice Network. The second most common type of witness was a state department. This would include departments such as the Department of Corrections, the Department of Children and Families and the State Department of Education. Of the evidence in the data set, scientists and medical professionals were the least represented witnesses in this public process. This suggests, scientists and medical professionals are not engaging much with this process as a means of putting forward their scientific expertise to the legislature.

CONCLUSION

Since the first US juvenile court in Cook County, Illinois in 1899 set its upper age limit for original jurisdiction at 16, bright-line age limits have been used to separate young people from adults criminally across the United States. Questions are now being asked about how these limits are determined and whether what we now understand about the developing adolescent brain should play a role in informing them. Longitudinal studies have confirmed that human brains continue to mature and restructure throughout adolescence, with the prefrontal cortex – responsible for executive functions – maturing into an individual's twenties.⁶⁵ Studies examining adolescent decision-making have demonstrated that young people prioritize rewards when assessing risk,⁶⁶ take more risks in 'hot' contexts⁶⁷ and are more likely to take risks when in the presence of their peers.⁶⁸ Arguments that the immaturity of an adolescent brain could impact on culpability for criminal offences have repeatedly been introduced to the US Supreme Court over the last two decades.⁶⁹

⁶⁵ Brain Development During Childhood and Adolescence, supra note 1; Structural Magnetic Resonance Imaging of the Adolescent Brain, supra note 1.

⁶⁶ Gardner, *supra* note 2; Somerville, *supra* note 2.

⁶⁷ Casey, *supra* note 3.

⁶⁸ Steinberg, *supra* note 4.

⁶⁹ In re Stanford, 537 U.S. 968 (2002); Atkins v. Virginia, 536 US 304 (2002); Roper v. Simmons, 543 U.S. 551, (2005); Graham v. Florida, 560 U.S. 48 (2010);

Since 2007, states have begun to '*Raise the* Age' of their upper limit for juvenile court jurisdiction and move towards a national consensus of 18, with Vermont exceeding this and introducing legislation which will ultimately raise its limit to 20.⁷⁰ Little is known about the extent to which, one, the evidential body of adolescent brain science is informing this legislative movement, or, two, robust science is presented to legislative decision-makers and by whom. This study sought to develop a unique grading and analysis model to examine evidence presented to state legislative committees and grade the quality of the scientific references it contained.

The grading and analysis model was applied to the 698 pieces of evidence and the analysis for each was four-fold: (1) an x-axis grade was recorded, which analyzed the quality of the communication of a scientific argument related to the dominant theory of adolescent brain development science; (2) a y-axis grade was recorded, which analyzed the quality of the underpinning scientific authorities; (3) recurring themes were analyzed; and (4) the evidence was categorized by author.

The use of the grading and analysis model has been able to demonstrate that – for the data set – adolescent brain development science is a theme that is repeatedly being put before a legislature considering 'Raise the Age' legislation. The way in which this theme is expressed varies, but it is most commonly achieved by making reference to adolescent brain development science in the context of the juvenile justice system and making links to decision making in young people, but without providing any scientific authorities for the arguments made. The results of the grading and analysis model show that scientific testimony that would be wholly ranked 'Good' or above rarely reaches the legislature, with only 15.7% of the pieces of evidence in the data set which referenced brain science receiving a grade above 'Good' on both categories of the model.⁷¹

Additionally, the results show that although brain science is commonly mentioned, the most common theme discussed by testimony before the state legislative committees is resources. A wide range of people and organizations engage with the public process of providing testimony to the state legislature in this way, but the most commonly represented authorship group is a non-governmental organization.

Miller v. Alabama, 567 U.S. 460 (2012); Montgomery v. Louisiana, 577 US ____ (2016).

 $^{^{70}}$ 2018 Vt. Acts & Resolves No. 201 (increasing the age of juvenile court jurisdiction to 20 as of 2022).

 $^{^{71}}$ 5.3% of the total data set.

These results raise questions for future exploration. Two emerge as particularly important in the authors' view. First, in the data set, the group who were least commonly represented were scientists and medical professionals. It should be explored why scientists are the least represented group and what, if any, barriers exist to hinder their engagement in the legislative process. Second, whether a method for filtering scientific evidence into legislative committees could (or, indeed, should) be introduced. If, according to the model, only 15.7% of the evidence which referenced adolescent brain development science was graded 'Good' or above on both the x and y axis of the model, exploring ways to highlight the varying qualities of scientific evidence to legislative decision-makers would likely be useful.