The Intersection Between Adolescent Brain Science and Juvenile Justice

Katie Jerstad

June 2024

Also published as Chapter 3 of
NDAA's *Handbook for Juvenile Court Prosecutors*

NDAA
National District Attorneys Association
JUVENILE JUSTICE

The Intersection Between Adolescent Brain Science and Juvenile Justice

Katie Jerstad

Introduction

Society has known for a long time that child and adolescent brains are different than those of adults. This difference was the reason for the creation of the juvenile justice system in Chicago in the late 1890s.[1] Even before advances in brain science explained these behavioral differences between teens and adults, states legislated an 18-year-old threshold for "adulthood"—the right to vote, the right to join the military, the right to marry without parental consent, etc. On the one hand, some laws are designed to protect the young and society from youth's immaturity, such as setting the legal age for alcohol consumption at 21. On the other hand, many states' juvenile court jurisdiction has no floor and children ten years of age or younger can be brought before a juvenile court judge. Most states allow for youth as young as fourteen to be prosecuted as adults for the most serious crimes. During this period of brain growth, American adolescents live in a "precarious middle ground" and legal status between innocence and immaturity and responsibility and accountability.[2]

With the advancements in brain science, society has come to accept that, while most young adults may stop growing vertically by age 17 and 18, their brains continue to develop into their mid-to-late 20s. Advancements in science in the last 20 years, particularly research involving MRIs and then functional MRIs, enhanced our knowledge about the differences not only in the architecture between adolescents' and adults' brains but the functional pathways.

Some of these differences, such as lack of maturity, undeveloped sense of responsibility, and higher levels of risk-taking, were the basis for legislative changes as well as expansion of Eighth Amendment protections for juveniles by the United States Supreme Court. Some state legislatures have determined 17-year-olds are adults for criminal proceedings while other states are raising the age to 19 or 20 for adult prosecution to enable emerging adults the benefits of the juvenile justice system for certain types of offenses. Some jurisdictions have already enacted legislation or are considering legislation that would raise the floor of juvenile justice prosecution to 12 or 13 so as to prevent younger children from becoming "system involved." The U.S. Supreme Court, in a series of cases, considered the appropriate sentences and sentencing procedure for crimes committed by youth in light of brain science advancements (*Roper*, *Graham*, *Montgomery*, and *Jones*, discussed below). Adolescent brain science is influencing these changes to some degree, but prosecutors must be cautious about what assumptions are being made about brain science in Court.

---

[1] *In re. Gault*, 387 U.S. 1, 15, 87 S. Ct. 1428, 1437 (1967). "The Juvenile Court movement began in this country at the end of the last century. From the juvenile court statute adopted in Illinois in 1899, the system has spread to every State in the Union, the District of Columbia, and Puerto Rico." However, it was lacking in expertise and legal resources. As the *Gault* Court included in a footnote, *see Harvard Law Review* Note, 809; and McCune, *Profile of the Nation's Juvenile Court Judges* (monograph, George Washington University, Center for the Behavioral Sciences, 1965).

[2] ACT4JuvenileJustice, *Adolescent Brain Development & Juvenile Justice Fact Sheet*, JJDPA Fact Book, accessed August 7, 2023, www.gvsu.edu/cms4/asset/903124DF-BD7F-3286-FE3330AA44F994DE/ad._brain_development__jj_fact_sheet.pdf.

Part One of this article aims to cover what prosecutors need to know about adolescent brain science and Part Two will cover how the Courts have incorporated it into their reasoning in various cases. Since the U.S. Supreme Court decided *Miller v. Alabama* in 2012, study of the brain's development throughout late adolescence has appeared in more than one hundred new publications.[3] Of over 1,000 legal cases referencing the same or similar neuroscience discussed in *Miller*, roughly half concerned individuals who were 18 years old or older at the time of the offense for which they are charged.[4] Almost 40% of those serving the longest prison sentences in the U.S. were incarcerated before the age of 25.[5] The implications of brain science research could alter the U.S. judicial and correctional systems significantly and some vocal proponents are advocating for that.

Within the adolescent brain science field, neuroscientists have learned through their studies that complex interactions between biology and environment influence brain development. Neuroscientists recognize that both positive and negative experiences and environments affect child and adolescent development and life outcomes. Advanced research has helped us better understand the parts of the adolescent brain that control or influence youth decision-making, impulsivity, and risk-taking. The research has led to changes in laws, policies, and juvenile justice systems across the country that embrace a youth's ability to correct criminal behavior as compared to an adult whose brain is no longer growing. This article aims to discuss that research and what has been learned as well as how the courts have taken that research into consideration in reaching decisions on specific youth cases.

How this general population research is applied to specific case facts is a matter of significant importance to the Youth Court and Adult Court Prosecutors. Juvenile court prosecutors have the dual task of advocating for community safety while also considering the rehabilitative needs of the juvenile involved, taking into account the emotional and psychological development of the youth. To some degree, adolescent brain science and the Adverse Childhood Experiences (ACEs) study (discussed below) will inform that dual task.

Part One: Brain Science

Areas of the Brain

The central nervous system is made up of the brain and spinal cord, which are interconnected with nearly every other part of your body with the help of **nerves**.[6] The brain can be divided into three basic units: the forebrain, the midbrain, and the hindbrain.

The **forebrain** is the largest part of the brain and consists primarily of the cerebrum and the structures hidden beneath it (the "inner brain"). The **cerebrum** holds memories, allows you to plan, imagine, think, recognize friends, read books, and play games. The cerebrum is split into two halves by deep fissures. The ability to form words seems to lie primarily in the left hemisphere, while the right hemisphere seems to control many abstract reasoning skills. These hemispheres communicate with each other through a thick

[3] Center for Law, Brain & Behavior at Massachusetts General Hospital, *White Paper on the Science of Late Adolescence: A Guide for Judges, Attorneys, and Policy Makers* (January 27, 2022), 7, clbb.mgh.harvard.edu/white-paper-on-the-science-of-late-adolescence/.

[4] *Id.*

[5] *Id.,* 8.

[6] JoAnn Deak and Terrence Deak, *The Owner's Manual for Driving Your Adolescent Brain* (San Francisco: Little Pickle Press, 2013), 13.

tract of nerve fibers called the **corpus callasum**. *During adolescence, the corpus callosum begins to thicken, "making stronger connections between different parts of your brain, so suddenly things like abstract math start to click."* [7]

The **midbrain** contains the uppermost part of the brain stem, which controls reflect actions and circuitry controlling eye movement and other voluntary movements.[8]

The **hindbrain** includes the upper part of the spinal cord, the brain stem and the cerebellum. The hindbrain controls respiration and heart rate.[9] The **cerebellum** coordinates movement and motor control.[10] This includes balance, coordination, fine motor learning upon repetition, integration of muscle groups to provide smooth body movements and posture.[11] *Recent testing shows this area is also responsible for some cognitive functions relating to emotional processing, language, attention, fear, and pleasure.*[12]

The **cerebral cortex** is a vital layer of tissue, like bark, that surrounds or coats the cerebrum and the cerebellum.[13] Often referred to as "**gray matter**" in the brain, the nerves in this area have less insulation causing a slightly darker appearance than other whiter parts of the brain.[14]

The term "gray matter" is also used to describe the unmyelinated (insulated) neurons in the brain, the density of which appear to increase as a child develops into early adulthood.[15]

Each of the two hemispheres of the cerebrum contain lobes each specializing in a distinct function: the occipital, temporal, parietal, and frontal lobes.

The **occipital lobes** are two areas at the back of the brain that are primarily responsible for image and visual processing, linking what we see with images stored in memory.

The **temporal lobes** process sensory input for hearing and assists with language and sound recognition. It is located just above the spinal cord. At the top of the temporal lobes is an area responsible for receiving information from the ears.[16] In the left temporal lobe, a region important for memory and language, gray matter density continues to grow until age 30, according to MRI studies.[17]

---

[7] *Id.*

[8] National Institute of Neurological Disorders and Stroke, "Brain Basics: Know Your Brain," accessed March 17, 2023, www.ninds.nih.gov/health-information/public-education/brain-basics/brain-basics-know-your-brain.

[9] *Id.*

[10] *Id.*

[11] *Id.*; Olivia Guy Evans, "Cerebellum: Functions, Structure, and Location," Simply Psychology, last updated July 3, 2023, www.simplypsychology.org/what-is-the-cerebellum.html#Functions.

[12] Jill Seladi-Schulman, "What Is the Cerebellum and What Does It Do?", Healthline, last reviewed February 11, 2020, www.healthline.com/health/cerebellum#function.

[13] *Id.*

[14] *Id.*

[15] Efstathios D. Gennatas et al., "Age-Related Effects and Sex Differences in Gray Matter Density, Volume, Mass, and Cortical Thickness from Childhood to Young Adulthood," *Journal of Neuroscience* 37, no. 20 (May 17, 2017): 5065–5073, doi.org/10.1523/JNEUROSCI.3550-16.2017.

[16] *Id.*

[17] Lindzi Wessel, "The Teen Years," BrainFacts.org, September 26, 2019, www.brainfacts.org/thinking-sensing-and-behaving/childhood-and-adolescence/2019/the-teen-years-092619.

The temporal lobes contain a **limbic system** which handle emotions, instincts, goal-directed behavior such as thirst, appetite for food, and other things like social interaction.[18] The limbic system activates when one experiences survival instincts and reward/pleasure. The limbic system is a powerful brain region responsible for motivation, fear, fight or flight, anger, and pleasure. *The limbic system can overtake the frontal lobes' executive functions in a teen, especially when stressors are involved. It can cause teens to experience higher "highs" and lower "lows" and makes a teen especially sensitive to emotional cues, information, and rewards.*[19]

The **amygdala** is a crucial part of the limbic system connected to the **ventral anterior cingulate cortex** (vACC). It is activated when we experience basic emotions like fear, anger and pleasure.[20] It is also involved in binding individual memories with particular emotions.[21] It "becomes activated when you feel a very strong emotion, especially in response to a fearful situation, and files that intense emotion in your memory bank."[22]

The **parietal lobes** are on the top of the brain and integrates information from sensory input like touch, taste, aroma, pain, and temperature. Reading and arithmetic are also functions of each parietal lobe.[23] Rewards circuits to the parietal cortex help with attention.[24]

The **somatosensory cortex** is the front part of the parietal lobes and receives information about "temperature, taste, touch, and movement from the rest of the body."[25]

The **frontal lobes** are at the front of your brain behind the forehead. The frontal lobe contains the prefrontal cortex (PFC), thought of as the seat of executive functioning. Functions of the frontal lobe include short-term storage site for ideas, attention, abstract thinking, emotional and behavioral control, long term planning, motivation, goal directed behavior, and understanding and evaluating consequences. *The frontal lobes are the last area of the brain to fully develop. This late maturation of the frontal lobe might explain some of the characteristics of a "typical teenager" such as short attention span, impulsive behavior, and forgetting homework.*[26]

---

[18] Deak, *The Owner's Manual,* 15.

[19] Harvard Health Publishing, "The adolescent brain: Beyond raging hormones," March 7, 2011, www.health.harvard.edu/mind-and-mood/the-adolescent-brain-beyond-raging-hormones.

[20] PracticalPie, "Anterior Cingulate Cortex," August 9, 2022, practicalpie.com/anterior-cingulate-cortex/.

[21] *Id.*

[22] Deak, *The Owner's Manual,* 43.

[23] National Institute of Neurological Disorders and Stroke, "Brain Basics: Know Your Brain."

[24] Emily Underwood, "Teens can have excellent executive function—just not all the time," *Knowable Magazine,* April 20, 2023, knowablemagazine.org/article/mind/2023/executive-function-in-teen-brains.

[25] National Institute of Neurological Disorders and Stroke, "Brain Basics: Know Your Brain."

[26] Lindzi Wessel, "The Teen Years."

Special areas within the frontal lobe are the **motor cortex** (which helps plan, control and execute voluntary body movement, like moving your arm or kicking a ball), the **prefrontal cortex** (the "conductor"[27] for "executive functions" such as thinking, problem-solving, reasoning, impulse-control) and **Broca's area** (involved in speech production). *The prefrontal cortex also supervises and directs other areas of the brain.*[28] *The prefrontal cortex is also the final area of the human brain to mature.*[29]

Disruption of functions associated with the frontal lobe may lead to impairments of foresight, strategic thinking, and risk management.[30] One "hallmark of frontal lobe dysfunction is difficulty in making decisions that are in the long-term best interests of the individual."[31] How do disruptions or dysfunction of the frontal lobe occur? As discussed below, disruptions or dysfunction may result from traumatic events (both physical or emotional trauma, chronic toxic stress, discussed in more depth below) or substance use.

Deep in the "**inner brain**" are the parts of the brain that act as gatekeepers between the spinal cord and cerebral hemispheres. Like lobes, these come in pairs, duplicated in the other cerebral hemisphere. These parts are the hypothalamus, thalamus, hippocampus, and basal ganglia.

The **hypothalamus**, part of the limbic system, mediates between the endocrine and central nervous systems[32] (wakes you up in the morning, gets adrenaline flowing, important emotional center, controlling molecules that make you feel exhilarated, angry or unhappy). According to a 1972 study by psychologist Donald Hebb, the hypothalamus contains from the time of birth "the anatomical circuitry of instinctual violence."[33] It contains a section called the **nucleus accumbens** which is part of reward system and is associated with motivation and behavioral reinforcement.[34]

The **thalamus** is the center of communication between the spinal cord and cerebrum.

The **hippocampus** is part of the limbic system and acts as a memory indexer—sending memories out to appropriate parts of the brain for long term storage and retrieval when necessary. Working with the amygdala, the hippocampus ensures that you remember where and how you were previously hurt or injured and other important environmental cues to predict where danger might be lying in wait and effectively protect you.[35]

---

[27] Underwood, "Teens can have excellent executive function."

[28] Cleveland Clinic, "Cerebral Cortex," last reviewed May 23, 2022, my.clevelandclinic.org/health/articles/23073-cerebral-cortex.

[29] ACT4JuvenileJustice, *Adolescent Brain Development & Juvenile Justice*, citing Paul Thompson, "Time-Lapse Imaging Tracks Brain Maturation From Ages 5 to 20," National Institutes of Mental Health and the University of California Los Angeles, May 2004; also author interview with Robin Jenkins, June 2006.

Coalition for Juvenile Justice, *What Are the Implications of Adolescent Brain Development for Juvenile Justice?* (Washington, DC: Coalition for Juvenile Justice, 2006), 3, accessed January 13, 2016, www.juvjustice.org/sites/default/files/resource-files/resource_134.pdf.

[30] *See* M.-Marsel Mesulam, "Behavioral Neuroanatomy," in *Principles of Behavioral and Cognitive Neurology*, 2nd ed., ed. M.-Marsel Mesulam (Oxford University Press, 2000), 47–48.

[31] *See* Antonio R. Damasio and Steven W. Anderson, "The Frontal Lobes," in *Clinical Neuropsychology*, 4th ed., ed. Kenneth M. Heilman and Edward Valenstein (Oxford University Press, 2003), 404, 434.

[32] PracticalPie, "Anterior Cingulate Cortex."

[33] Chris Murphy, *The Violence Inside Us: A Brief History of an Ongoing American Tragedy* (New York: Random House, 2020), 38.

[34] PracticalPie, "Anterior Cingulate Cortex."

[35] Deak, *The Owner's Manual,* 43.

The **basal ganglia** is a cluster of nerve cells surrounding the thalamus. It is responsible for initiating and integrating movements.[36]

No parts of the brain would work without many different cell types doing their job, but the primary functional cell in the brain is called the **neuron**.[37] Neurons are different from other cells in the body because they are electrically charged and process electrical information.[38] "Groups of neurons in one brain structure send their **axons** together to other brain structures, forming a **neural pathway**."[39] "Specialized sensory neurons translate messages from the environment into **electrical impulses**—the language of the brain to form a **sensation**."[40]

Neurons require the support of glial cells, or **glia**, which provide nourishment by releasing proteins that act like fertilizer to help neurons thrive and remove waste material from neurons.

All sensations, movements, thoughts, memories, and feelings are the results of signals passed through neurons.[41] This activation takes place with the help of **vesicles** that release **neurotransmitters** from the end of its axon (which can be up to a meter long) that carry a signal through the **synapse** (the place where a signal passes from the neuron to another cell) to a receptor on a neighboring cell.[42]

Different types of neurotransmitters can activate or dampen a cell's activity level. "There are two types of neurotransmitters: **inhibitory** neurotransmitters send a STOP signal to the next neuron (like hitting the brakes) and **excitatory neurotransmitters** send a signal for the next neuron to GO (like stepping on the gas)."[43] Scientists have learned that certain diseases stem from over-production or under-production of certain types of neurotransmitters.[44]

Dopamine, a neurotransmitter (and hormone) that influences memory, concentration, problem-solving and other mental functions, *is not at its most effective level in adolescence*.[45] "Dopamine is critical to the brain's reward system—creating a neurochemical loop that links a stimulus with pleasure and satisfaction."[46] One theory on the bio-chemistry of violence posits that when dopamine levels are off-kilter, the brain may offer higher reward signals to violence and aggression than in brains where the levels are more stable.[47]

---

[36] National Institute of Neurological Disorders and Stroke, "Brain Basics: Know Your Brain."

[37] Deak, *The Owner's Manual,* 16.

[38] *Id.*, 17.

[39] *Id.*, 17.

[40] *Id.*, 20.

[41] *Id.*, 18.

[42] *Id.*, 19.

[43] *Id.*, 18.

[44] National Institute of Neurological Disorders and Stroke, "Brain Basics: Know Your Brain."

[45] ACT4JuvenileJustice, *Adolescent Brain Development & Juvenile Justice*, citing Linda Patia Spear, "Neurodevelopment During Adolescence," in *Neurodevelopmental Mechanisms in Psychopathology,* ed. Dante Cicchetti and Elaine F. Walker (Cambridge University Press, 2003); Coalition for Juvenile Justice, *What Are the Implications of Adolescent Brain Development.*

[46] Murphy, *The Violence Inside Us*, 40.

[47] *Id.*

Much knowledge of brain development and many of the studies rely on the use of MRIs and functional MRIs (fMRI). A fMRI uses the same equipment as an MRI, however, in a fMRI a task or stimulus is introduced. The fMRI measures blood flow that results from or is indicative of an increase in neuronal connectivity, i.e., brain activity, resulting from the stimuli.[48] Researchers infer that the part of the brain with increased blood flow resulted from the stimulus or was used in the task. Where an MRI provides a static structural view of the brain, the fMRI can show how those structures react to a stimulus.

Past studies have guided newer neuroimaging studies to look at:

> the role of a relatively small number of brain regions in mediating social-affective behavior. Specifically, much attention has been given to the **amygdala**, **striatum**, **insula**, and **anterior cingulate cortex** (ACC), and a number of regions within the **prefrontal cortex** (PFC). These regions work together to assign salience, promote learning, monitor conflict, compute relative valence of social stimuli, and integrate this information to generate and guide affective behaviors toward wider goals and within the contexts in which they occur.[49]

Where there was once a focus on the "regional activation" with certain stimuli, more recent studies are looking at the "functional interconnection" between and among these brain regions and areas by looking at neural substrates and networks.[50]

How the Brain Develops and Why that Leads to Risky and Other Behavior

The brain develops through a combination of our genes, environment, experiences, and interpersonal relations. By age three, the brain has grown to almost ninety percent of its adult size.[51] "During adolescence the brain gets larger and heavier overall, ridges (**gyri**) and folds (**sulci**) in the cortex become more pronounced and the brain takes on a more cauliflower-like shape."[52] Aside from its physical appearance or growth in size, the brain becomes more complex and efficient during adolescence in part because of the strengthening of neural pathways and increased effectiveness of glia protecting and nourishing of neurons.[53]

Adolescence is a tricky time because of this variable rate of growth across different regions of the brain. The growth period referred to as "adolescent brain development" *typically begins at puberty and is roughly defined as lasting from age 10 to 25*.[54] The functions of the brain continue to develop into the mid-20s and for some parts, the early 30s.[55] Development of each area of the brain is generally completed at different

---

[48] John C. Gore, "Principles and practice of functional MRI of the human brain," *The Journal of Clinical Investigation* 112, no. 1 (July 2003): 4–9, doi.org/10.1172/JCI19010.

[49] Amanda E. Guyer, Jennifer S. Silk, and Eric E Nelson, "The neurobiology of the emotional adolescent: From the inside out," *Neuroscience & Biobehavioral Reviews* 70 (November 2016): 74–85, doi.org/10.1016/j.neubiorev.2016.07.037.

[50] *Id.*

[51] Child Welfare Information Gateway, *Child Maltreatment and Brain Development: A Primer for Child Welfare Professionals* (U.S. Department of Health and Human Services, Administration for Children and Families, Children's Bureau, 2023), www.childwelfare.gov/pubs/issue-briefs/brain-development/.

[52] Deak, *The Owner's Manual,* 25.

[53] *Id.*

[54] ACT4JuvenileJustice, *Adolescent Brain Development & Juvenile Justice.*

[55] National Juvenile Justice Prosecution Center in partnership with NDAA, OJJDP, DOJ, Juvenile Prosecutor Training Curriculum, Instructor Manual, Module 2, Child and Adolescent Development, 28, citing Coalition for Juvenile Justice, *What Are the Implications of Adolescent Brain Development.*

rates and times[56] rather than linearly like height. "The hindbrain structures are more mature at birth than structures of the forebrain."[57] The forebrain structures, like the cerebral cortex, are not fully developed until adulthood.[58]

There are **critical periods** for developing certain abilities. The critical period for learning a language, for example, is from birth to age eight. Once a critical period passes, the brain begins to fossilize. At that point, you could still learn a language, but it will take more time and effort.[59]

This doesn't mean that the brain stops growing at age eight—the brain will continue to produce new neurons throughout a lifetime in a process called **neurogenesis**.[60] "This happens mostly in brain structures that help with **plasticity**, or learning." Regular exercise has been shown to increase neurogenesis. The more a teen stimulates, challenges, and stretches their mind, the more **neurotrophins** the brain will produce. Neurotrophins are proteins produced by glial cells that act like fertilizer for the brain, stimulating neurogenesis and increasing resiliency to stress and capability of handling new experiences.[61]

Three processes occur simultaneously in the brain of a teen at a greater rate than at any other time of brain development. These are cell proliferation, pruning and myelination.

Cell proliferation is a growth spurt of neurons and connections, mainly in the frontal lobe, which generally begins at the onset of puberty.

Synaptic pruning of neuronal connections eliminate those connections that are not being used as often. Pruning is a fine tuning of the brain through one's environment and experiences. By pruning away irrelevant synapses, neural signals can travel and transmit information more efficiently.

Finally, **myelination** is the insulation of axons of the neurons to enable fast and efficient transmission of electrical and chemical impulses.[62] Myelination takes place from birth through late adolescence, but different brain structures achieve a fully myelinated state at different ages. "As myelination becomes more extensive, the brain becomes more capable of complex skills."[63]

With the three processes working at their busiest rate, adolescence is a distinct, transient period of tremendous neuroplasticity. "Because many of the brain circuits involved in social information processing continue to develop throughout the teenage years, adolescence may represent a sensitive period for the long-term organization of social behavior."[64]

---

[56] Deak, *The Owner's Manual,* 25.

[57] *Id.*

[58] *Id.*

[59] *Id.*, 27.

[60] *Id.*

[61] *Id.*, 41.

[62] Child Welfare Information Gateway, *Child Maltreatment and Brain Development*.

[63] Deak, *The Owner's Manual,* 29.

[64] Guyer, "The neurobiology of the emotional adolescent," 2.1.

One component of social behavior that makes humans unique is **empathy**. Scientists believe that the **right temporal parietal junction** (RTPJ) is particularly important for developing empathy and that a critical period of its development happens during adolescence. The **medial prefrontal cortex** is strongly engaged when you think about yourself and others as well, but is more active in adolescents than in adults.[65] The **temporoparietal junction** becomes active when you switch your perspective between yourself and others. *Some research on adolescents with a history of delinquent behavior found that the temporoparietal junction showed less variation in activity across different social situations in adolescents with a history of delinquency, compared with others.*[66] One potential explanation is that they are not as successful in switching from their own perspective to others', but other explanations are possible.

Researchers have concluded that *face to face human interaction activates this part of the brain and the more activation, the more positive social interactions one will have (suggesting more empathy)*. Researchers are concerned, however, about decreased use of this area of the brain by adolescents today who are communicating mostly electronically and certainly did so during the Covid 19 pandemic. Rodent studies have shown that when contact with other rodents was restricted, the rodents failed to develop normal social interactions. "These effects are particularly pronounced when social interaction is restricted during adolescent, suggesting that this is a critical/sensitive period for social interaction."[67]

On the other side of the spectrum from empathy is **rage**, **aggression**, **hate**, **violence**, or **antipathy**. Young children often exhibit violent tendencies—and studies of twin toddlers supported this observation. "The children generally were able to unlearn violence, suggesting that while violence may be part of our nature, nurture plays an increasingly influential role as children gain more exposure to alternative methods of conflict and rage resolution."[68] The study suggests that "[v]iolence may be a part of human biology, but it is not destiny."[69] "As children grow, they learn to manage their emotions, communicate with others and deal with conflict."[70]

Kent Kiehl, a neuroscience professor at the University of New Mexico, is developing a database of brains of hardened criminals and found that they have, in adulthood, different brains. There is less gray matter; the amygdala is smaller; and there are defects in limbic and paralimbic cortex.[71] This study is backed up by other studies that show brain scans of those prone to violence look different from those who are not.[72] Scientists are trying to understand the role that not only genetics but also brain chemicals play in the brain architecture of this one percent of the population (brain chemicals/neurotransmitters such as norepinephrine, dopamine, and serotonin for instance).[73]

---

[65] Tim Vernimmen, "Inside the adolescent brain," *Knowable Magazine,* June 30, 2022, knowablemagazine.org/article/mind/2022/inside-adolescent-brain.

[66] Wouter van den Bos et al., "Neural correlates of social decision-making in severely antisocial adolescents," *Social Cognitive and Affective Neuroscience* 9, no. 11 (December 2014): 2059–2066, doi.org/10.1093/scan/nsu003.

[67] Deak, *The Owner's Manual,* 44–45.

[68] Murphy, *The Violence Inside Us*, 38, referencing a 2014 University of Montreal study.

[69] *Id.*

[70] *Id.*

[71] Murphy, *The Violence Inside Us*, 40.

[72] *Id.*

[73] *Id.*

It would be an oversight to not mention **puberty** also taking place during adolescence and causing rapid growth and maturation of body parts. Puberty starts in the brain when a small group of neurons in the hypothalamus begin to produce a protein called **kisspeptin**.[74] When sufficient kisspeptin is produced, a specific hormone called **gonadotropin-releasing hormone** (GnRH) is released, which stimulates the release of **testosterone** (in males) and **estrogen** (in females) that surge around the body during puberty.[75] Animal studies have contributed to our knowledge of the influence of puberty and specific hormones on adolescent behavior, brain development and emotionality.[76]

Unlike popular belief, hormones and sex drive are not the only source of **risky behavior** for this age group. Adolescent brains' cognitive processes are mature by mid-teens, but self-regulation and other socio-emotional processes are not complete until early adulthood. The neural circuitry needed to produce an executive response is already there in adolescence, but an adolescent's ability to access these systems in a sustained and reliable way is variable.[77] Without consistent access to that system, teens use a different area of the brain to assist in making decisions than adults.[78] This is a time when synaptic pruning in the PFC is occurring.[79] Studies have shown that adolescents' greater involvement than adults in risk taking does *not* stem from ignorance, irrationality, delusions of invulnerability, or faulty calculations but from use of the emotional center of their brain.[80] *Because the frontal cortex is the last to develop, teens rely heavily on parts of the brain that house their emotional centers (the limbic system of the temporal lobe) when making decisions.*[81]

Perhaps this is the reason one author and scientist described adolescence as "like driving a car with a sensitive gas pedal and bad brakes."[82] More recent research indicates that adolescence is more like driving a car that is generally smooth and well-functioning, except, in highly emotionally charged situations, the gas pedal becomes more sensitive and the brakes go bad temporarily. Studies have shown that adolescents can make well-reasoned decisions when things are calm but struggle with activating their PFC when emotions are high.[83]

---

[74] Deak, *The Owner's Manual,* 33–34.

[75] *Id.*

[76] National Juvenile Justice Prosecution Center in partnership with NDAA, OJJDP, DOJ, Juvenile Prosecutor Training Curriculum, Instructor Manual, Module 2, Child and Adolescent Development, 28, citing Coalition for Juvenile Justice, *What Are the Implications of Adolescent Brain Development*.

[77] Underwood, "Teens can have excellent executive function."

[78] ACT4JuvenileJustice, *Adolescent Brain Development & Juvenile Justice*; Coalition for Juvenile Justice, *What Are the Implications of Adolescent Brain Development.*

[79] Underwood, "Teens can have excellent executive function."

[80] Valerie Reyna and Frank Farley, "Risk and Rationality in Adolescent Decision Making," *Psychological Science in the Public Interest* 7, no. 1 (2006): 1–44, doi.org/10.1111/j.1529-1006.2006.00026.x; Valerie Reyna and Frank Farley, "Is the Teen Brain Too Rational?" *Scientific American Mind* 17, no. 6 (June 2007), www.scientificamerican.com/article/is-the-teen-brain-too-rational/.

[81] Child Welfare Information Gateway, *Child Maltreatment and Brain Development*.

[82] Juvenile Prosecutor Training Curriculum, Instructor Manual, Module 2, Child and Adolescent Development, National Juvenile Justice Prosecution Center in partnership with NDAA, OJJDP, DOJ, 28, citing *Age of Opportunity*, Laurence Steinberg.

[83] B. J. Casey, "Beyond Simple Models of Self-Control to Circuit-Based Accounts of Adolescent Behavior," *Annual Review of Psychology* 66, no. 1 (2015): 295–319, doi.org/10.1146/annurev-psych-010814-015156.

"Recent research has shown that adolescents often act impulsively or engage in risky behaviors in part because the PFC is not yet fully mature, and not yet capable of effectively reigning in impulsive actions. This may be because adolescents don't have as much GABA, a key inhibitory neurotransmitter, in their PFC as adults."[84] A small percentage of youth engage in extremely risky behavior, which is a problem for juvenile justice systems, but according to researchers, "a side effect of the helpful, adaptive function of risk-taking that propels teens into adulthood."[85]

When compared to adults' cognitive control, adolescents' is not as good unless there is a **short-term reward** involved. Kids with higher levels of dopamine, the neurotransmitter involved in reward, in neurons in the basal ganglia exhibited cognitive control at levels of an adult when a short-term reward was offered for following the rule ("don't look at the light").[86]

This is consistent with another study looking at adolescents' lack of impulse control and their lower level of dopamine than adults. In one study, adolescents with higher dopamine levels could control their impulsive responses better than those with less dopamine when there was a reward involved.[87]

Due to fluctuating dopamine levels in adolescents and the reality that short-term rewards are not always available, cognitive control is inconsistent for this age group. Due to teens' excitement to pursue short-term rewards, some think that teens are naturally and chemically geared to seek greater risks for social, emotional, and physical reasons.[88] Some think that, at this point in their brain development, teens are naturally attracted to risky activities.[89]

Some theorize that adolescents experience "reward-deficiency syndrome" that occurs when youth are no longer stimulated by activities that thrilled them when they were younger, and they engage in activities involving greater risk and higher stimulation in order to achieve similar level of excitement.[90] These theories contemplate the adolescent actor choosing risk or reward over reason as purposeful or volitional behavior when the biological explanation (though perhaps not a justification) makes it more complicated than that.

As an example, in one study it was determined, through imaging, that two networks in the frontal lobe of the brain impact adolescent behavior and choices. In this study exploring contraceptive use and pregnancy prevention, it was found that the emotional network dominates the cognitive network and impacts planning and risk assessment.

---

84 Deak, *The Owner's Manual,* 50.

85 Vernimmen, "Inside the adolescent brain."

86 Underwood, "Teens can have excellent executive function."

87 Daniel Siegel, "Dopamine and Teenage Logic," *The Atlantic*, January 24, 2014, www.theatlantic.com/health/archive/2014/01/dopamine-and-teenage-logic/282895/. Also discussed in National Juvenile Justice Prosecution Center in partnership with NDAA, OJJDP, DOJ, Juvenile Prosecutor Training Curriculum, Instructor Manual, Module 2, Child and Adolescent Development, 28, citing Coalition for Juvenile Justice, *What Are the Implications of Adolescent Brain Development.*

88 National Juvenile Justice Prosecution Center in partnership with NDAA, OJJDP, DOJ, Juvenile Prosecutor Training Curriculum, Instructor Manual, Module 2, Child and Adolescent Development, 28, citing Coalition for Juvenile Justice, *What Are the Implications of Adolescent Brain Development.*

89 *Id.*

90 ACT4JuvenileJustice, *Adolescent Brain Development & Juvenile Justice*, citing Linda Patia Spear, "Neurodevelopment During Adolescence," in *Neurodevelopmental Mechanisms in Psychopathology,* ed. Dante Cicchetti and Elaine F. Walker (Cambridge University Press, 2003); Coalition for Juvenile Justice, *What Are the Implications of Adolescent Brain Development.*

Under normal conditions, the cognitive network can regulate the social/emotional network. However, when the social/emotional network is highly activated, they do not work together. The emotional network dominates the cognitive network. The result is that emotion, rather than reason, often influences adolescent decision-making.[91]

It is probably not a surprise to anyone that a teenager could be emotionally overwhelmed by sexual activity to the point of losing cognitive control. What might come as a surprise is the extent to which not just paramours but **peers** can cause the emotional network to dominate over the PFC.[92] Peers act like a form of reward that can overwhelm cognitive control.[93] *Peer acceptance is extremely important to an adolescent.*[94] This makes sense from an evolution standpoint—at a time when humans are getting ready to leave the safety of their family, they want to ensure safety and protection provided by the peer group, find a partner and reproduce.[95] **Peer rejection**, **pressure**, and **influence** greatly impact teens emotions and therefore decision-making but even the mere **presence** of peers can greatly influence an adolescent's decision-making.[96] On the other hand, a calm atmosphere helps teens brains focus on frontal lobe functions when making decisions instead of only reacting to limbic system impulses.[97]

There are numerous studies in the area of peer rejection, acceptance, presence, but one take away from some studies is that **anxious and depressed adolescents** may have less access to the parts of the brain that can reduce distress from peer rejection, creating a never-ending cycle of negative feelings.[98] Many major mental illnesses emerge during adolescence—that is why psychiatrists and neurologists have been using these studies to map typical trajectories in a pediatric growth chart to identify risk and fortify weaknesses in certain brain functions.[99] **Cognitive behavioral therapy** (CBT) trains the brain to start to observe emotional reactions and activate the PFC executive system with the goal that overtime the cognitive control will get stronger, and neural pathways that reinforced the illness will grow weaker due to infrequent use.[100]

---

[91] Youth.gov, "Adolescent Decision-Making Research," August 7, 2023, youth.gov/youth-topics/adolescent-health/adolescent-decision-making.

[92] *See* Kerry E. Bolger and Charlotte J. Patterson, "Developmental Pathways from Child Maltreatment to Peer Rejection," *Child Development* 72, no. 2 (March/April 2001): 549–568, doi.org/10.1111/1467-8624.00296; Laura R. Stroud et al., "Sex differences in biological response to peer rejection and performance challenge across development: A pilot study," *Physiology & Behavior* 169 (February 2017): 224–233, doi.org/10.1016/j.physbeh.2016.12.005.

[93] Underwood, "Teens can have excellent executive function."

[94] Berna Güroğlu, "Adolescent brain in a social world: Unravelling the positive power of peers from a neurobehavioral perspective," *European Journal of Developmental Psychology* 18, no. 4 (2021): 471–493, doi.org/10.1080/17405629.2020.1813101.

[95] Underwood, "Teens can have excellent executive function."

[96] Guyer, "The neurobiology of the emotional adolescent."

[97] Ken Ginsburg, "How Teens Make Decisions: The Developing Adolescent Brain," Center for Parent and Teen Communication, September 4, 2018, parentandteen.com/how-teens-make-decisions/; Jay N. Giedd, "The Amazing Teen Brain," *Scientific American,* May 1, 2016, www.scientificamerican.com/article/the-amazing-teen-brain/.

[98] Carrie L. Masten et al., "Neural correlates of social exclusion during adolescence: understanding the distress of peer rejection," *Social Cognitive and Affective Neuroscience* 4, no. 2 (June 2009): 143–157, doi.org/10.1093/scan/nsp007.

[99] Underwood, "Teens can have excellent executive function."

[100] *Id.*

In addition to anxiety and depression, other illnesses like **substance use** can threaten brain responses, executive functioning and development during adolescence. A neural pathway activated by natural rewards such as social interaction, tasty food, and sexual activity, becomes even more activated when a teen consumes **alcohol or drugs**, causing the teen to seek out those substances over and over again.[101] If this behavior becomes pathological, it can result in **addiction**, which takes over your life's priorities and can lead to devastating consequences. Alcohol use reduces neurogenesis and reduces how much a teen can learn later in life. Adolescents metabolize alcohol faster than adults so they can consume more without showing signs of impairment and are less likely to suffer hangover effects.

While the adolescent brain is developing, it is a time of great emotional, social, and moral development. Often the intensity of a teen's emotions can be overwhelming. Pursuing important passions, like pastimes such as music, sports, or writing, can hold a teen steady when they are feeling overwhelmed. These activities or pursuits are sometimes referred to as **North Star**.[102]

Stress

Stress is the internal response the mind-body system creates when experiencing something that the survival brain **perceives** as pressure, a challenge, or a threat. The perception starts in the brain with eyes and ears sending information to the amygdala, which send a distress signal to the hypothalamus, which sends signals to the adrenal glands, which pumps adrenaline into the bloodstream, which raises heart rate, pulse and blood pressure and releases blood sugar (energy) into the body.[103]

Although normally thought of in negative terms, stress is simply our system mobilizing energy to respond to the challenge or threat. A stress response temporarily disrupts our internal equilibrium so we can successfully respond. When our inner equilibrium is perturbed and comes back to baseline, this is called **allostasis** (the return to homeostasis after acute stress with the help of stress hormones).[104] Our bodies are wired for this response as a means of survival. A certain level of stress is necessary for brain development while certain types of stress or prolonged periods of stress can interrupt it.[105]

The effect of stress mainly depends on an individual's tolerance to stress, not the actual event causing the stress. Where a person finds themselves on the stress continuum has everything to do with how their system (conscious and unconscious) perceives the situation. Although stress can influence the brain and brain development, it largely depends on several factors including what type of stress an adolescent is experiencing.

The three types of stress are positive stress, tolerable stress, and toxic stress. How these types of stress affect an adolescent's brain development depend on the child's resilience.[106]

---

[101] Deak, *The Owner's Manual,* 48.

[102] *Id.*, 37.

[103] Harvard Health Publishing, "Understanding the stress response," July 6, 2020, www.health.harvard.edu/staying-healthy/understanding-the-stress-response.

[104] Bruce S. McEwen, "Allostasis and Allostatic Load: Implications for Neuropsychopharmacology," *Neuropsychopharmacology* 22 (2000): 108–124, doi.org/10.1016/S0893-133X(99)00129-3.

[105] Harvard University Center on the Developing Child, "Toxic Stress," accessed August 7, 2023, developingchild.harvard.edu/science/key-concepts/toxic-stress/.

[106] National Scientific Council on the Developing Child, *Excessive Stress Disrupts the Architecture of the Developing Brain*: *Working Paper #3*, updated ed. (2005/2014), developingchild.harvard.edu/resources/wp3/.

Positive stress briefly increases the heart rate and causes mild elevations in stress hormones. Positive stress is a normal and essential part of health and human development.

Tolerable stress causes serious but temporary stress responses. This causes a body's alert systems to be activated and it is usually a result of a more severe and/or longer-lasting difficulty such as loss of a loved one or a natural disaster. When tolerable stress activation is for a limited time and buffered by caring adults the brain and organs can recover.[107]

Toxic stress, on the other hand, causes prolonged activation of stress response systems in the absence of protective relationships. *Toxic stress occurs with strong, frequent and/or prolonged adversity such as physical or emotional abuse, chronic neglect, and addiction.* Prolonged activation of the body's natural stress response can rewire parts of the brain, altering activity and influence over emotions and the body.[108] The issue with chronic or prolonged stress is that the brain does not completely recovery and remains in an activated state—it can "disrupt the development of brain architecture and other organ systems, and increase the risk for stress-related disease and cognitive impairment, well into adult years."[109] The good news is that it is possible to develop and build tolerance to stress.[110]

A growing body of science and respected research supports the belief that children are both vulnerable and resilient. Even youth and families who face extraordinary stresses, as detailed above, have the capacity for **resilience**. Research shows that supportive, responsive relationships with caring adults as early in life as possible can prevent or reverse the damaging effects of the toxic stress response. Family conflict and cohesion affected resilience far more than the length or type of abuse people had suffered. The faith community, when assisting in building stronger family dynamics, is trying to build resilience.[111]

ACEs—Adverse Childhood Experiences Study[112]

This discussion of brain development and stress naturally leads us to a discussion of the Adverse Childhood Experiences Study (ACEs). ACEs was conducted by Kaiser Permanente where they examined health and social effects of adverse childhood experiences on approximately 17,000 of their members. They asked participants to answer a series of questions about 10 types of adverse childhood experiences falling into three categories (abuse, neglect and household dysfunction). Participants are asked about three forms

[107] Harvard University Center on the Developing Child, "Key Concepts," accessed August 7, 2023, developingchild.harvard.edu/science/key-concepts/.

[108] Brainfacts.org, "Wired for Danger: The Effects of Childhood Trauma on the Brain," video created by Jasmine Purnomo, October 19, 2020, www.brainfacts.org/thinking-sensing-and-behaving/childhood-and-adolescence/2020/wired-for-danger-the-effects-of-childhood-trauma-on-the-brain-101920; Hillary A. Franke, "Toxic Stress: Effects, Prevention and Treatment," *Children* 1, no. 3 (November 2014): 390–402, doi.org/10.3390/children1030390.

[109] Harvard University Center on the Developing Child, "Toxic Stress."

[110] Harvard University Center on the Developing Child, "Key Concepts"; Celina M. Joos, Ashley McDonald, and Martha E. Wadsworth, "Extending the toxic stress model into adolescence: Profiles of cortisol reactivity," *Psychoneuroendocrinology* 107 (September 2019): 46–58, doi.org/10.1016/j.psyneuen.2019.05.002.

[111] Ann S. Masten, "2019 Keynote: Ordinary Magic: Advances in Developmental Resilience Science," recorded February 22, 2019 at Miami International Child & Adolescent Mental Health Conference, video, 1:02:20, www.youtube.com/watch?v=YcfWZU2cfp8].

[112] National Center for Injury Prevention and Control, Division of Violence Prevention, "Adverse Childhood Experiences (ACEs)," last reviewed June 29, 2023, www.cdc.gov/violenceprevention/aces/; ACE Interface, Master Trainer Education, www.aceinterface.com.

of abuse: physical, emotional or sexual abuse; two types of neglect: physical or emotional neglect; and five types of "household dysfunction": witnessing DV, growing up with substance using or mentally ill household members, parental separation or divorce, or having a household member sentenced to prison. What they found was that the higher the ACE score, the more likely the person would suffer negative health and social connections (smoking, chronic lung and kidney disease, shorter lifetime/premature mortality, alcoholism and drug addiction, teenage pregnancy and fertility complications, likelihood to be raped). Health consequences were found to include obesity, diabetes, depression, suicide attempts, STDs, heart disease, cancer, stroke, COPD, and broken bones. Higher ACEs scores led to behaviors like smoking, alcoholism, and drug use. Furthermore, high ACE scores correlated with low graduation rates, low academic achievement, and lost time from work. In summation, ACEs are a pathway to negative neuro-developmental consequences and social problems.

It is important not to conflate terms such as stress and trauma[113] and ACEs, while recognizing the overlap and interconnectedness of these events on brain function. Stress and trauma are not the same thing and don't affect the brain the same way unless and until the stress becomes toxic and chronic; once that happens, it can affect the region of the brain that helps with safe decision-making, making the person more prone to subsequent health and social problems, similar to a trauma response. Consider this statement from an article in the American Academy of Pediatrics:

> [T]oxic 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 in the development of linguistic, cognitive, and social-emotional skills, all of which are inextricably intertwined in the wiring of the developing brain.[114]

Why is ACEs important and what can we learn from ACEs?

The first lesson learned is the importance of preventing ACEs from happening. Dr. Robert Anda summed it up best: "what is predictive is preventable."[115] If we prevent some or most adverse childhood experiences, we can prevent numerous adult health conditions and social problems.

Another lesson is that risky decision-making and lack of discrimination between danger and safety is not always a "bad choice" by a youth exercising free will but a neurological predisposition due to adverse childhood experiences, trauma, or chronic toxic stress.

---

[113] American Psychiatric Association, *Diagnostic and Statistical Manual of Mental Disorders*, 5th ed. (2013), psycnet.apa.org/record/2013-14907-000. The *Diagnostic and Statistical Manual of Mental Disorders* provides the following threshold definition of trauma as Criteria A of post-traumatic stress disorder: "The person was exposed to: death, threatened death, actual or threatened serious injury, or actual or threatened sexual violence, in the following way(s): direct exposure; witnessing the trauma; learning that a relative or close friend was exposed to trauma; indirect exposure to aversive details of the trauma, usually in the course of professional duties (e.g., first responders such as police or medics)."

[114] Jack P. Shonkoff et al., "The Lifelong Effects of Early Childhood Adversity and Toxic Stress," *Pediatrics* 129, no. 1 (2012): e232–e246, doi.org/10.1542/peds.2011-2663, citing National Scientific Council on the Developing Child, *Excessive Stress Disrupts the Architecture of the Developing Brain*.

[115] Tian Dayton, "ACE's Adverse Childhood Experiences: A Message from Dr. Robert Anda and Oprah Winfrey," Thrive Global, March 28, 2018, medium.com/thrive-global/aces-adverse-childhood-experiences-a-message-from-dr-robert-anda-and-oprah-winfrey-26654844ddc9.

A third lesson learned, and a positive finding in research, is that risk factors can be offset by protective factors. Safe, stable nurturing relationships are an example of a protective factor. The ABCD study conducted during the pandemic showed regular mealtime or family time and open communication with parents were two buffers or protective factors reducing anxiety in adolescents.[116] The presence of one dependable and caring adult can make a difference.[117] This can include trauma-informed professionals working with youth crime victims or justice-involved youth. Safe, stable, and nurturing relationships and environments can have a positive impact on a broad range of health problems and on development of skills that help children reach their full potential.

Conclusion

If you read this article hoping to know when precisely a teenager's brain was sufficiently mature: I'm sorry. That answer is not available . . . yet. According to researcher Leah Somerville,

> "[t]here is little agreement among basic scientists on what properties of a brain should be evaluated when judging whether a brain is mature. This lack of consensus could reflect the fact that most neuroscientists are typically focused on the "journey"—the temporal unfolding of a particular development process—more than when a brain reaches a particular "destination."

It will not come as a surprise to learn that nurturing and other experiences play a critical role in brain development.[118] Since brain development is strongly affected by interplay between the brain and the environment, teens are strongly affected by interactions with parents, peers, teachers, and community members. Juvenile Justice partners, including prosecutors, can and must look for ways in which their communities can build and expand opportunities for teens to engage in activities that will positively impact their growing brains, and re-examine each point of contact or interaction with adolescents to ensure that developmentally appropriate responses are in place.[119]

Part Two: U.S. Supreme Court Cases that Have Considered Brain Development

The U.S. Supreme Court precedence—and how the high court has treated or considered brain development in specific cases—forms the invisible backdrop in a youth or juvenile court proceeding.

When the U.S. Supreme Court considered the history of the juvenile court system in its 1967 decision *In re. Gault*,[120] it determined that the informal, *parens patriae* style of juvenile proceedings were unconstitutional in their lack of due process and procedural safeguards for the youth but could still retain

[116] ABCD Research Consortium, "About the [Adolescent Brain Cognitive Development (ABCD)] Study," abcdstudy.org/about/.

[117] Dayton, "ACE's Adverse Childhood Experiences."

[118] Thumbs Down. Speak Up., "The Adolescent Brain, Neuroplasticity, and Social Media," September 15, 2022, tdsu.org/news/the-adolescent-brain-neuroplasticity-and-social-media/.

[119] ACT4JuvenileJustice, *Adolescent Brain Development & Juvenile Justice.*

[120] *In re. Application of Gault*, 387 U.S. 1, 87 S. Ct. 1428, 18 L. Ed. 2d 527 (1967).

their rehabilitative focus. As a result of *Gault*, juvenile court systems have the procedural safeguards and due process rights given to adults as well as the rehabilitative focus originally intended. The Court noted,

> [o]f course, it is not suggested that juvenile court judges should fail appropriately to take account, in their demeanor and conduct, **of the emotional and psychological attitude of the juveniles with whom they are confronted**. While due process requirements will, in some instances, introduce a degree of order and regularity to juvenile court proceedings to determine delinquency, and in contested cases will introduce some elements of the adversary system, nothing will require that the conception of the kindly juvenile judge be replaced by its opposite.[121]

This assumes the juvenile will understand the proceedings.

Our history is replete with laws and judicial recognition that minors, especially in their earlier years, generally are less mature and responsible than adults. As Justice Frankfurter stated, "[c]hildren have a very special place in life which law should reflect."[122] And indeed the law does reflect this special place. Every state in the country makes some separate provision for minors.[123]

Viewing adult and juvenile systems together, the cases show that although children are generally protected by the same constitutional guarantees against governmental deprivations as are adults, *the state is entitled to adjust its legal system to account for children's vulnerability and their needs for "concern, . . . sympathy, and . . . paternal attention."*[124]

As the *Eddings v. Oklahoma* case later showed, courts must also take those characteristics into account as mitigating factors at sentencing, even in a case involving the murder of a police officer by a 16-year-old youth who shot the officer at point-blank range.[125] Historically, courts recognized *youth* as a mitigating factor but also the background of the youth, if that background stunted growth or interfered with the youth's development. *Eddings* was one such case.

> Even the normal 16-year-old customarily lacks the maturity of an adult. In this case, Eddings was not a normal 16-year-old; he had been deprived of the care, concern, and paternal attention that children deserve. On the contrary, it is not disputed that he was a juvenile with serious emotional problems, and had been raised in a neglectful, sometimes even violent, family background. In addition, there was testimony that Eddings' mental and emotional development were at a level several years below his chronological age. All of this does not suggest an absence of responsibility for the crime of murder, deliberately committed in this case. Rather, it is to say that *just as the chronological age of a minor is itself a relevant mitigating factor of great weight, so must the background and mental and emotional development of a youthful defendant be duly considered in sentencing*.[126]

---

[121] *Gault* at 26–27, at 1443 (emphasis added).

[122] *May v. Anderson*, 345 U.S. 528, 536, 73 S. Ct. 840, 844, 97 L.Ed. 1221 (1953) (concurring opinion).

[123] *Eddings v. Oklahoma*, 455 U.S. 104, 115–16, 102 S. Ct. 869, 877 (1982), citing *In re Gault*, 387 U.S., 14, 87 S. Ct., 1436 (1967).

[124] *McKeiver v. Pennsylvania*, 403 U.S. 528, 550, 91 S. Ct. 1976, 1989, 29 L.Ed.2d 647 (1971) (plurality opinion), followed by *Bellotti v. Baird*, 443 U.S. 622, 635, 99 S. Ct. 3035, 3044, 61 L. Ed. 2d 797 (1979).

[125] *Eddings* at 115–16, 877.

[126] *Eddings*, 455 U.S. at 116, 102 S. Ct. at 877 (1982) (emphasis added).

Roper v. Simmons and Preceding Cases

The intersection between law and adolescent mental and emotional development was further brought to the forefront in *Roper v. Simmons*[127], in which the U.S. Supreme Court ruled that it was unconstitutional to sentence a juvenile (16 or 17 years of age at the time of the crime) to death pursuant to the Eighth and Fourteenth Amendments. Although the opinion does not give a lot of weight to specific scientific studies, there is a nod to some research referenced in an amicus brief field by the American Psychological Association (APA).

Of all the factual scenarios for the U.S. Supreme Court to consider when weighing the constitutionality of the death penalty, the facts of the *Roper* case shock the conscience and make it a hard case. 17-year-old Christopher Simmons discussed with two friends a plan to burglar and murder a particular victim whom Simmons knew from a recent car accident. One of the two friends ended up assisting him on the night of the murder. They broke into the victim's home when her husband was out of town, covered her eyes and mouth and bound her hands with duct tape, then put her in her minivan and drove to a state park where they reinforced the bindings, covered her head with a towel, and walked her to a railroad trestle spanning a river. They tied her hands and feet with electrical wire, wrapped her whole face in duct tape, and threw her from the bridge, drowning her. Simmons reportedly told his friends before the murder that they would "get away with it" because they were minors. After the murder, he was heard bragging about the murder and why he did it.

Simmons was charged as an adult with numerous offenses (burglary, kidnapping, stealing, and murder in the 1st) and tried by a jury as an adult. The jury's verdict was guilty on murder, the jury recommended the death penalty, and the Court followed the jury's recommendation.[128]

After the U.S. Supreme Court issued its opinion in *Atkins v. Virginia*, 536 U.S. 304 (2002), that the Constitution prohibited the execution of a mentally retarded defendant, Simmons filed a petition for state post-conviction relief, arguing that the reasoning of *Atkins* applied to juveniles as well. The Missouri Supreme Court agreed. The State appealed to the U.S. Supreme Court, which affirmed the ruling.[129]

The premeditated nature of Simmons' offense, the depravity of his actions, and his pride in his actions all point towards his unsuitability for society and the appropriateness of the death penalty as punishment under Missouri law and capital case jurisprudence. The possibility for a court to remain free of passion or prejudice against Simmons was slim. For that reason, it is largely accepted as fact that Simmons' age and the recent discoveries in adolescent brain science were influential on the Court's reasoning.

---

[127] *Roper v. Simmons*, 543 U. S. 551 (2005).

[128] Simmons pursued writs of habeas corpus which were denied by the federal courts. Then the U.S. Supreme Court decided the case of *Atkins c. Virginia*, 536 U.S. 304 (2002), holding that the Eighth and Fourteenth amendments prohibit the execution of a mentally retarded person. The *Atkins* ruling was a departure from *Penry v. Lynbaugh*, 492 U.S. 302 (1989), which held that the constitution did not prohibit the execution of a mentally retarded person because there was not sufficient evidence of a national consensus on the issue (with just two states enacting laws specifically prohibiting their execution, and 14 states rejecting capital punishment completely). The *Atkin*s Court held that standards of decency had evolved since *Penry* and now demonstrate the execution of the mental retarded as cruel and unusual punishment.

[129] By affirming the Missouri Supreme Court's decision in *Roper*, the U.S. Supreme Court reversed its ruling in *Stanford v. Kentucky*, 492 U.S. 361 (1989) which held that imposition of capital punishment on an individual for a crime committed at 16 or 17 years of age did not violate the Eighth Amendment, noting, like in *Penry*, that standards of decency have not evolved to that point yet, as evidenced by state laws in part.

Brain science was not the only rationale, however. Prior cases considered national standards of decency, not according to the medical community, but according to state legislatures. Rather than just brain science or IQ leading to the decision, the Court built its decision off the decision in not only *Atkins*, but also *Thompson v. Oklahoma*, 487 U.S. 815, 108 S. Ct. 2687 (1988). In *Thompson*, the Court determined that the national standards of decency do not permit the execution of any person under the age of 16 at the time of the crime. *Thompson*, at 818–838, 108 S. Ct. at 2687. The Court was guided by relevant legislative enactments and jury determinations and the reasons why a civilized society may accept or reject the death penalty for a person of a certain age at the time of the crime. The *Thompson* Court also considered the lack of juries supporting the death penalty for children under 16 and the low number of those under 16 who had been sentenced to death for murder.

The *Thompson* Court's reasoning included the view or conclusion that continues to be repeated in case after case, that juveniles have **reduced culpability** and imposing the death penalty on this age group with reduced culpability "does not measurably **contribute to the essential purpose of the penalty**." The Court already recognized juveniles, when compared to adults, as having *less experience, less education, and less intelligence making a teen less able to evaluate consequences of his or her conduct and* **more apt to act on emotion or peer pressure**.[130]

The year after the *Thompson* decision, the Court decided *Stanford v. Kentucky*, a 5–4 decision, which again considered contemporary standards of decency in this country and concluded the 8th and 14th amendments did *not* prohibit the execution of juveniles over 15 but under 18. The Court, in weighing the meaning of cruel and unusual punishment, considered the fact that 22 out of 37 death penalty states permitted 16-year-olds to be sentenced to death and 25 permit it for 17-year-olds. In 1989, these numbers were not sufficient to convince the majority to label the particular punishment "cruel and unusual."[131]

The *Atkins* Court considered many items to be objective indicia of consensus significant in determining the national standard of decency in wading through the vague meaning of "cruel and unusual" punishment. The Court also applied the Court's independent judgment, though the dissent disagreed with this approach. The Court found that *mental retardation diminishes personal culpability even if the person can distinguish right from wrong*. The Court concluded that the death penalty for a mentally retarded person *does not meet the sentencing purposes of retribution or deterrence* and is therefore an excessive sanction.

The *Roper* Court, in following those cases before it, considered many items to be the objective indicia of consensus in weighing the national standard of decency. It considered the following:

1. The *number of states* that prohibited the death penalty overall, or the death penalty for all juveniles, through legislation or court decision;

2. The increase in the number of states that had prohibited the death penalty for juveniles, both at the time of *Stanford* and at the time of their consideration of *Roper*;

3. The *frequency* that states allowing juvenile death penalty had carried it out;

---

[130] *Bellotti v. Baird*, 443 U.S. 622, 99 S. Ct. 3035, 61 L.Ed.2d 797 (1979) (regarding the constitutionality of requiring parental notification and consent to their unmarried pregnant child's abortion; requiring the Court to make factual findings regarding the "maturity" of the youth and if she's well enough "informed"); *Eddings v. Oklahoma*, 455 U.S. 104, 102 S. Ct. 869, 71 L.Ed.2d 1.

[131] *Stanford*, 492 U.S. at 370–371, 109 S. Ct. at 2969.

4. The *rate* at which these legislative enactments took place between the last case, noting that the rate of change was faster to abolish the death penalty for those with mental retardation than for minors, but the *climate or collective change in attitude* towards minors was still significant; and

5. The *lack of states reimposing the death penalty* since the Court's decision to not prohibit it (*Stanford* and Penry).

After considering all those, the *Roper* Court referenced three general differences between youth under 18 and adults:

1. **A lack of maturity and an underdeveloped sense of responsibility**, often resulting in impetuous and ill-considered actions and decisions, citing *Johnson* and *Eddings* as well as an article on adolescent development.[132] "Adolescents are overrepresented statistically in virtually every category of reckless behavior."[133] The Court notes that states recognize this immaturity and irresponsibility in juveniles as almost every state prohibits those under 18 from voting, serving on juries, or marrying without parental consent.

2. Juveniles are more **vulnerable or susceptible to negative influences and outside pressures**, including peer pressure (again citing *Eddings*, 455 U.S. at 115). The Court noted juveniles have less control, and less experience with control, over their own environment.[134]

3. The third difference is that a juvenile's **character is less well-formed than an adult**. Juveniles have more transitory, less fixed personality traits. This matters to the Court who impose sentences and ask themselves, what are the chances that this person could actually change and stop committing offenses? For adolescents whose brains and characters are not done forming, **there is the potential for change**.

This is referred to by Court watchers as the "diminished culpability/enhanced potential theory" later broadened by the *Graham* decision.[135]

In summary, the *Roper* Court says juveniles have

> qualities that often result in impetuous and **ill-considered actions and decisions**; juveniles are **more vulnerable or susceptible to negative influences** and outside pressures, including peer pressure; and the **character** of a juvenile is **not as well formed** as that of an adult.[136]

[132] *Johnson v. Texas*, 509 U.S. 350, 359–362 (1993); *Eddings v. Oklahoma*, 455 U.S. 104, 115–116 (1982).

[133] *Roper* at 568, citing Jeffrey Arnett, "Reckless behavior in adolescence: A developmental perspective," *Developmental Review* 12, no. 4 (December 1992): 339–373, doi.org/10.1016/0273-2297(92)90013-R.

[134] *See* L. Steinberg and E. S. Scott, "Less Guilty by Reason of Adolescence: Developmental Immaturity, Diminished Responsibility, and the Juvenile Death Penalty," *American Psychologist* 58, no. 12 (2003): 1009, 1014, doi.org/10.1037/0003-066X.58.12.1009. "[A]s legal minors, [juveniles] lack the freedom that adults have to extricate themselves from a criminogenic setting."

[135] Terry A. Maroney, "Adolescent Brain Science after Graham v. Florida," *Notre Dame Law Review* 86, no. 2 (2013): 765, 782, scholarship.law.nd.edu/ndlr/vol86/iss2/6/.

[136] *Roper*, 569–570.

Due to these general traits, the Court concludes that "their irresponsible conduct is **not as morally reprehensible as that of an adult**."[137] Because their identities and personalities are still developing, there is some chance of rehabilitation and the youth's *depraved character causing the offense may be retrievable*. Quoting an adolescent brain science article, "[o]nly a relatively small proportion of adolescents who experiment in risky or illegal activities develop entrenched patterns of problem behavior that persist into adulthood."[138] The Court concludes that juveniles overall are less culpable than adults and expands the holding in *Thompson* to apply to juveniles not just under 16 but also under 18.

The *Roper* Court considered the argument that general characteristics of juveniles still leaves the possibility that a particular youth who has attained psychological maturity commits a crime demonstrative of sufficient depravity to merit a death sentence. The *Roper* Court pointed out that even in those cases, the APA manual does not allow psychiatrists to diagnose a juvenile with antisocial personality disorder (one of the most, if not the most, condemning of diagnoses), and concluded that if the psychiatrists cannot diagnose a juvenile with that diagnosis, states should not be allowed to ask juries and the Courts to issue the most condemning of punishments.

Graham v. Florida

Five years after *Roper* came *Graham v. Florida*[139], in which the Court held that the Eighth Amendment prohibits a sentence of life without possibility of parole for a nonhomicide crime committedby a juvenile, the majority opinion goes further than *Roper* by citing to amicus briefs from the APA and American Medical Association (AMA) regarding developments in psychology and brain science, specifically regarding the part of the brain linked to behavior control and how it continues to mature through late adolescence.[140]

The Court further explained differences between the juvenile and adult brain and the greater opportunity for reform with juveniles:

> [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. See Brief for American Medical Association et al. as *Amici Curiae* 16–24; Brief for APA et al. as *Amici Curiae* 22–27. Juveniles are more capable of change than adults, and their actions are less likely to be evidence of "irretrievably depraved character" than are the actions of adults. *Roper*, 543 U. S., at 570. It remains true that "[f]rom 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."[141]

[137] *Roper*, 570, citing *Thompson*, 835.

[138] L. Steinberg and E. S. Scott, "Less Guilty by Reason of Adolescence."

[139] *Graham v. Florida*, 560 U.S. 48, 130 S. Ct. 2011 (2010).

[140] *Graham*, 68, 2026.

[141] *Graham*, 68, 2026.

The Court's decision "likened life without parole for juvenile to the death penalty, thereby evoking a second line of cases"[142] requiring sentencing authorities to consider the characteristics of a defendant and the details of his offense before sentencing him to death.[143]

Miller v. Alabama

Then in 2012 came *Miller v. Alabama*, 567 U.S. 460, the confluence of the two lines of cases, in which the Court held that a *mandatory* sentence of life without parole for a juvenile convicted of homicide violated the Eighth amendment. "Such mandatory penalties, by their nature, preclude a sentencer from taking account of … age and the wealth of characteristics and circumstances attendant to it."[144]

The *Miller* case considered two Petitioners' cases, Evan Miller (in Alabama) and Kuntrell Jackson (in Arkansas), each of whom was 14 years old when convicted of murder and sentenced to a mandatory term of life imprisonment without the possibility of parole.

Jackson accompanied two other boys to rob a video store, learned one of the other two boys had a shotgun on the way to the store, and stayed outside the store for most of the robbery. Jackson eventually entered the store and soon after his co-conspirator shot and killed the store clerk. Jackson was charged as an adult with capital felony murder and aggravated robbery, and a jury convicted him of both crimes.

After an evening of drinking and using drugs with an adult neighbor who earlier had sold drugs to Miller's mother, Miller, along with a friend, beat the neighbor and set fire to his trailer, causing the neighbor to die. Initially charged as a juvenile, his case was transferred to adult court where he was charged with murder in the course of arson and a jury found him guilty.

As the *Roper* and *Graham* decisions were being decided, Jackson and Miller's cases made their way to the U.S. Supreme Court. By the time the two cases were heard by the Court, *Roper* and *Graham* laid the groundwork.

The Court stated:

> Mandatory life without parole for a juvenile precludes consideration of his chronological age and its hallmark features—among them, immaturity, impetuosity, and failure to appreciate risks and consequences. It prevents taking into account *the family and home environment that surrounds him—and from which he cannot usually extricate himself*—no matter how brutal or dysfunctional. It neglects the circumstances of the homicide offense, including *the extent of his participation in the conduct* and *the way the familial and peer pressures may have affected him* . . . And finally, this mandatory punishment disregards the possibility of rehabilitation even when the circumstances most suggest it.[145]

---

[142] *Miller v. Alabama*, 567 U.S. 460, 470, 132 S. Ct. 2455, 2463 (2012).

[143] Maroney, "Adolescent Brain Science after Graham v. Florida." One author was convinced that *Graham* represented the extent to which the Court considered brain science of adolescents in expanding constitutional protections. In the *Notre Dame Law Review* article, Adolescent Brain Science after Graham, the author makes this observation of the Court's treatment of science in the juvenile justice context: Assessment of blameworthiness hinges partially on the degree to which the defendant's behavior was subject to deliberate control. Similarly, assessment of dangerousness hinges partially on the degree to which capacity for such control is likely to increase and be exercised. The former assessment informs moral judgment as to intent and character, while the latter informs utilitarian determination of the most effective response. More, that juveniles tend for this reason to be both less blameworthy and (eventually) less dangerous affects the likelihood that the same will be true of any given juvenile.

[144] *Miller*, 476, 2467.

[145] *Miller* at 478, 2468 (emphasis added).

The reference to familiar and peer pressures was no doubt informed by the studies of adolescent brain science cited in the amicus briefs. These studies show that youth understand and appreciate risks and consequences, but set aside those considerations when, in a particular situation, there is emotionally charged situation, peer pressure or fear of rejection. And while there may be environmental factors that contribute to a youth making or resisting these choices, natural adolescent brain development, not the youth, also explain the choices to some degree because the frontal lobe has not caught up with the limbic system.

Miller discusses these four factors about adolescents (#3 is the only one not mentioned in *Roper* but appears in *Graham*):

1. Immaturity, impetuosity, and risk-taking;
2. Peer involvement/influence;
3. Understanding legal proceedings, including the inability to deal with police officers or prosecutors and incapacity to assist one's own attorney; and
4. Greater potential for rehabilitation, recognized by the *Roper* Court.

The *Miller* Court clearly accepted this brain science as reliable, undeniable and applicable.

The Court was also convinced that juveniles are more prone than adults to *falsely confess to crimes*, a fact attributed to immaturity of judgment that affects youths' participation in the early stage of the criminal process. Additional cases have gone further to discuss how youth's immaturity impacts their *interactions with law enforcement*, their understanding or *consideration of Miranda* particularly when presented with an alternative that appears to be a reward, and *their ability to assist in their own defense*. The referenced studies also called into question the effect of harsher criminal sanctions on juvenile recidivism, for instance. This was referenced by the Court and treated like persuasive research.[146]

The U.S. Supreme Court made *Miller* retroactive in cases on collateral review by concluding that the *Miller* holding was a new *substantive* constitutional rule in its decision in *Montgomery v. Louisiana*, 577 U.S. 190 (2016), which involved an inmate, incarcerated for life without parole for crimes committed before he was 18 years old. Once the U.S. Supreme Court made *Miller* retroactive, Montgomery and inmates serving similar sentences were able to go back before the sentencer for application of *Miller*.

Jones v. Mississippi

This discussion would be incomplete without consideration of *Jones v. Mississippi*, 141 S. Ct. 1307 (2021), in which the U.S. Supreme Court affirmed the life without parole sentence of a juvenile convicted of a homicide offense. Jones, who was 15 years old at the time, stabbed his grandfather to death after an argument over Jones' girlfriend sleeping over in Jones' room. Jones did not call 911 after stabbing his grandfather; instead, he tried to destroy and cover up evidence, and he and his girlfriend gave the police fake names when stopped later that day at a gas station. A jury found him guilty of murder, not the lesser included offense of manslaughter.

[146] The APA and the Missouri Psychological Association filed an amicus brief in the Roper case, pointing to significant research findings from the previous three years about the correlation between adolescence and risk-taking. These briefs cited research much of which is mentioned throughout this article because it was also relied upon in *Graham*.

At the time the crime of murder carried a mandatory life sentence without parole under Mississippi law, so Jones was sentenced accordingly but appealed under *Miller*. The State Supreme Court ordered a new sentencing where the judge could consider Jones' youth and exercise discretion in selecting an appropriate sentence. The Judge, with that discretion, re-sentenced Jones to life without parole and did not make any findings regarding "transient immaturity" of the youth or "permanent incorrigibility." The appeal of the re-sentencing centered around the lack of *Miller*-type findings by the re-sentencer and the U.S. Supreme Court, in a majority opinion written by Justice Cavenaugh, affirmed, with Justice Thomas concurring, and three other justices dissenting.

In light of the U.S. Supreme Court's previous rulings the effect of which was to allow the sentencing court to make certain considerations that may mitigate a youth's sentence but eliminating the mandatory life sentence and only impose a life sentence on a child in the rarest of circumstances, the Court's decision was a departure and a much narrower reading of *Miller* than what the dissenters propose.

Much debate continues as to whether *Jones* represents the end to expansion of Eighth amendment protections for juveniles or whether the tides could change again with the appointment of a different justice to the Supreme Court.[147]

A finding of permanent incorrigibility is an unlikely finding for even the most criminal youth, such that if the Court required such a finding in *Miller*, the Court would have prohibited all life without parole sentences for crimes committed by those under 18, not just those imposed under the mandatory laws. The reason it would be an unlikely finding is that, generally speaking, adolescents' brains are still developing. Assigning a label or a diagnosis to an adolescent will be temporary; they need to be re-reviewed/re-assessed, and professionals don't rely on them in perpetuity. Studies showed that assessments of severe antisocial behaviors in adolescents did not remain stable as those individuals grow into adulthood. Henceforth, incorrigibility, like psychopathy, also known as sociopathy, among adolescents, is an inherently problematic diagnosis in an adolescent, prone to error, and creates a risk of cruel and unusual punishment.

At the state court level, however, legislatures, sentencing procedures, and individual case decisions continue to be informed by brain science. The authors of the White Paper (2022) recommend the following criteria be considered with respect to the four *Miller* factors:

1. Immaturity, impetuosity and irresponsibility.[148, 149]

2. Family and home, peer influence, including exposure to threats and exposure to deprivation.

3. Peer involvement

4. Understanding legal proceedings

5. Greater potential for rehabilitation

---

[147] Center for Law, Brain & Behavior at Massachusetts General Hospital, *White Paper on the Science of Late Adolescence.*

[148] White Paper, citing Laurence Steinberg et al., "Around the world, adolescence is a time of heightened sensation seeking and immature self-regulation," *Developmental Science* 21, no. 2 (March 2018): e12532, doi.org/10.1111/desc.12532.

[149] Michelle Achterberg et al., "Frontostriatal White Matter Integrity Predicts Development of Delay of Gratification: A Longitudinal Study," *The Journal of Neuroscience* 36, no. 6 (February 10, 2016): 1954–1961, doi.org/10.1523/JNEUROSCI.3459-15.2016. With regard to delaying gratification, the White Paper considered how longitudinal research testing of individuals ages 8–26 demonstrates that the strengthening of white matter connections between the prefrontal cortex and striatum may also account for why individuals are better able to delay gratification as they age.

On this point, the White Paper is clear: it is currently not possible to reliably predict an individual adolescent's future developmental trajectory based upon current presentation and past history. This is partly because of the high rates of desistance from antisocial conduct as youth mature into young adulthood and partly because behavioral, emotional, and attitudinal changes are expected components of adolescent development. It is also currently scientifically impossible to reliably predict how much or how quickly an individual will change with age based on their presumed brain development, history, or current behavioral profiles.

In U.S. Supreme Court cases, as well as some state supreme court cases, the progression of development of different parts of the brain has become a common concept relied upon for legal arguments at all levels of prosecution of older juveniles and young adults. It will be important for prosecutors to not just understand adolescent brain development and its impact on adolescent behavior in general but how it may apply to the facts of the case, particularly if peers are involved, and to retain the necessary experts if needed to articulate why this scientific theory does or does not apply to a particular set of facts.

In addition, other juvenile justice stakeholders will be discussing brain development during key decision points, and prosecutors must understand what is being discussed, the application of the theory and the limits of the theory, to make cogent arguments and rebuttals to legal positions and policy arguments. Knowledge in this area is also key to understanding expert testimony and deciding whether to present expert witness testimony.

Conclusion

You understand the adolescent brain, stress, and adverse child experiences. How and when do you use that information as a juvenile court prosecutor? The goal is to be familiar with the concepts, acknowledge the existence of the science and research (though always be prepared to question the specific study or generalization raised by defense counsel in court), evaluate each youth individually, assess the needs of the youth and their families and take this opportunity to have an impact on their future and the future of your community. Rehabilitation of youth is prevention of crime in the community.

How will adolescent brain science manifest itself in your daily work? It may be argued to you by juvenile justice partners when you are making decisions on diversion, detention, dispositions, community program evaluation, competency, and transfer. It can be offered in the courtroom through expert witnesses or indirectly through oral advocacy or submission of research.

When evaluating brain development studies and/or theories, a prosecutor should keep in mind legal theories and requirements for their specific case. Legal requirements may differ from brain science theories, but those theories may still be useful when looking at the overall plan for an adolescent involved in the juvenile justice system or what should be present in probation or community programs. Developmental neuroscience supports generalizations about youth as a class but is not a substitute for looking at facts and circumstances of your particular juvenile justice situation. This is referred to in the research world as the "Group to Individual" conundrum.[150] Taking both legal and scientific information into account will lead to a full evaluation of your juvenile justice incident.[151]

[150] Center for Law, Brain & Behavior at Massachusetts General Hospital, *White Paper on the Science of Late Adolescence,* 3.

[151] Terry A. Maroney, "The False Promise of Adolescent Brain Science in Juvenile Justice," *Notre Dame Law Review* 85, no. 1 (2013): 89, scholarship.law.nd.edu/ndlr/vol85/iss1/3/.

Adolescent brain science tells us generally what is happening to youths' brains during adolescence. You should use it to give you a deeper understanding of the impact/social environments we create for youth. Put this information to use to create better programs and evaluate existing programs to see if they are addressing resilience and fostering executive functioning. It should not be used as a rigid framework determining what should happen to youth. It should be used to satisfy our goal of assisting those involved in the system become productive members of society through Juvenile Justice programing and legal proceedings.

How to Prepare for Arguments or Expert Testimony about Brain Science

Anytime scientific research comes up in a case, a diligent prosecutor will need to conduct a credibility check on the study. Ask yourself: is it credible and reliable? Then conduct this 4-stage analysis.[152]

1. Start by evaluating the publication.

- What's the title of the publication?
- Is the article published in PubMed, the National Institute of Health's online catalog of biomedical literature (https://pubmed.ncbi.nlm.nih.gov/)?
- Is the journal/article peer reviewed?

2. Next, consider the author's qualifications and area of expertise.

- Is the author affiliated with a credible institution?
- Is the article's topic within the author's field or area of study?
- Is there obvious confirmation bias?

3. Then, consider the bibliography.

- Are these sources referenced from credible sources?
- Conduct a literature review.
- Do you recognize referenced works?

4. Finally, look at the funding source of the research:

- Is the funding source an indicator of bias?
- Did industry pay for the project? If so, how much control did they retain over the project?
- Does the funding present a conflict of interest with researchers?

Some of the online research journals will provide the option to "check for updates," similar to Shepardizing legal cases. Take advantage of this resource if available to save time and learn of more recent research building off of others'.

[152] Florida International University Global Forensic and Justice Center, *The FIU Research Forensic Library Card Catalog: Is This Research Credible?*, video, 2:27, www.youtube.com/watch?v=_KUFpyRF9nU. Partly funded by a grant from the National Institute of Justice.

When it comes to preparing for an expert witness to testify about brain science, use all the same tools you would use above for considering the expert's qualifications and area of expertise in addition to the following:

- Research expert's qualifications (NDAA can assist), credentials, institutions affiliated with expert, read articles s/he authored.
- Was the research, articles, well received? Peer reviewed? Cited elsewhere? Contradicted later? Does it cite credible sources?
- Review prior testimony including what field s/he was previously qualified as expert in, what states has s/he testified in, what opinions have been given, etc.
- Does the proposed testimony meet Daubert/Frye standard? Is this a novel discovery or opinion? Is it in the expert's area of expertise?
- Conduct legal research into whether courts in your jurisdiction have made findings or adopted the scientific explanation or opinion similar to the expert's.
- Consider whether you want to hire your own expert, either to consult with (e.g., be present in the court room when the expert is testifying or to help you prepare for cross-examination) or to call as your witness, etc.
- Evaluate whether you can utilize the expert to make points that assist your case.
- Review any reciprocal discovery such as reports prepared by the expert, etc.
- Understand limits on what brain science can/cannot tell us.

That last point will be the hardest to determine as someone not in the brain science research field because it is constantly changing. One study alone does not tell the whole story but often raises a myriad of questions that researchers then want to do more research to answer. The most challenging part will be not getting lost in the overwhelming amount of brain science research and articles out there. This article has attempted to distill and navigate that research to provide an overview in the concepts and to broaden the vocabulary of the prosecutors having to make or refute arguments about brain science in court.