**STATE OF MICHIGAN**
**IN THE SUPREME COURT**

People of the State of Michigan,

Plaintiff-Appellee,

-vs-

Kemo Knicombi Parks,

Defendant-Appellant.

Supreme Court No. 162086
Court of Appeals No. 346587
Circuit Court No. 17-040829-FC

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# Brief of *Amici Curiae* Neuroscientists, Psychologists, and Criminal Justice Scholars in Support of Defendant-Appellant Mr. Parks

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## STATEMENT OF QUESTION PRESENTED

Does the Michigan Constitution's prohibition against "cruel or unusual punishment" bar imposing mandatory life imprisonment without the possibility of parole ("LWOP") on individuals in late adolescence?

## INTEREST AND IDENTITY OF *AMICI CURIAE*[1]

*Amici* are experts in the study of adolescent behavior and brain development and criminal justice. This body of scientific literature and data has enabled courts to assess the constitutionality of imposing on adolescents life-determinant sentences such as capital punishment and LWOP.[2]

*Amici* respectfully submit this Brief to address the scientific evidence regarding continued development of brain structure, function, and connectivity through late adolescence—commonly defined as ages 18, 19, and 20—that has profound implications for their decision-making and self-control.[3] Over the past decade the field has enjoyed tremendous, widespread advances, thanks to specific attention paid to late adolescents as a distinct subject of study and improved methods

[1] Counsel for *amici* authored this Brief in full. No person or entity, including counsel or *amici*, made a monetary contribution intended to fund the preparation or submission of the Brief.

[2] Research cited in this Brief includes data from studies conducted using the scientific method, which is subject to critical review by outside experts, including during the peer review process preceding publication in a scholarly journal.

[3] *Amici* share a consensus view that at a minimum the sentences at issue are invalid for individuals up to and including age 20, though scientists have recognized relevant changes that continue through age 25 (commonly referred to as young adulthood), and trauma may also slow brain development. *See infra* Section II.C (discussing the impact of trauma); *see also, e.g.*, National Academy of Science, Engineering, and Medicine, *The Promise of Adolescence: Realizing opportunity for all youth* 22 (Washington, DC: The National Academies Press, 2019) (framing "young adulthood" to include ages 18 to 25); Dosenbach et al., *Prediction of individual brain maturity using fMRI*, 329 Science 1360 (2010) (defining "young adults" as ages 18 to 30); Arain et al., *Maturation of the adolescent brain*, 9 Neuropsychiatric Disease and Treatment 450 (2013) (describing "adolescence" as "ages 10–24 years").

to assess the human brain, such as magnetic resonance imaging ("MRI"). This relatively recent but robust body of psychological and neuroscientific evidence shows that personality, behavior, and the brain itself all continue to change and grow markedly through late adolescence.

As a result, individuals throughout late adolescence remain more likely to engage in irrational, risky, and impulsive behavior by virtue of their immature brains and vulnerability to influences that promote such behavior. The evidence further indicates that most late adolescents will naturally grow out of this phase in ways that fundamentally change their behavior, including through neurological growth that enhances their cognitive capacity for reasoned decision-making under stress and future-looking orientation, and are amenable to evidence-based rehabilitation.

*Amici* have a strong interest in ensuring that States, including Michigan, have access to this powerful scientific evidence in evaluating the constitutionality of imposing on late adolescents life-determinant sentences.

Identities, titles, and affiliations of *amici* are described in the Appendix.

## INTRODUCTION AND SUMMARY OF ARGUMENT

Under well-established law, Michigan courts may not impose life-determinant sentences such as mandatory LWOP on adolescents who committed their offense before their 18th birthday. That prohibition arose in light of scientific findings that led courts to conclude that these adolescents are less culpable and more capable of rehabilitation than adults. Currently, however, Michigan courts *may* impose mandatory LWOP on adolescents who committed the same offense on or after the day they turn 18. This divergent approach is unsound and unconstitutional because

significant recent scientific advances, including brain imaging, have demonstrated that across the relevant metrics, late adolescents are fundamentally similar to those in earlier phases of adolescence. Accordingly, LWOP is no more justified for late adolescents than it is for younger ones.

To date, imposing mandatory LWOP on late adolescents has relied on the misconception that these young people are incorrigible and beyond reform for reentry into society. But abundant, more recent psychological and neuroscientific evidence now establishes that an individual's brain, personality, and behavior evolve throughout the life span—including and especially during late adolescence—in ways that cannot be squared with those suppositions. Thus, drawing the line at 18 for when mandatory LWOP cannot be constitutionally imposed is, from a scientific perspective, both arbitrary and underinclusive.

This Brief addresses the current scientific consensus regarding brain development and behavior which shows meaningful, relevant changes throughout late adolescence. Because brain structure and function, as well as an individual's behavior, personality, and propensity for risk-taking and danger are all profoundly in flux through late adolescence, there is no scientific basis for drawing a line at age 18 for when LWOP sentences may be constitutionally applied. To the contrary, the science supports treating these sentences as unconstitutional for late adolescents.

## ARGUMENT

### I. An Individual's Youth, Immaturity, and Developmental State Inform Whether an LWOP Sentence Violates the Michigan Constitution.

The U.S. Supreme Court has repeatedly recognized that adolescents under 18 are protected by the U.S. Constitution from overly punitive sentencing, including LWOP, because they lack self-control, are particularly susceptible to bad influences, and exhibit evolving, redeemable character. *See, e.g.*, *Roper v Simmons*, 543 US 551 (2005) (capital punishment unconstitutional for offenders under 18); *Graham v Florida*, 560 US 48 (2010) (LWOP unconstitutional for offenders under 18 when they commit non-homicide offense); *Miller v Alabama*, 567 US 460 (2012) (mandatory LWOP unconstitutional for offenders under 18 when they commit any crime); *Montgomery v Louisiana*, 577 US 190 (2016) (*Miller* applies retroactively to juvenile offenders whose convictions and sentences were final when *Miller* was decided). In reaching these holdings, the U.S. Supreme Court relied on, among other things, then-available scientific literature (since supplemented and affirmed) related to adolescent immaturity and continued brain development.[4]

Psychological and brain science now demonstrate that all the characteristics recognized as relevant by the U.S. Supreme Court in striking down overly punitive

[4] *See, e.g.*, Arnett, *Reckless Behavior in Adolescence: A Developmental Perspective*, 12 Dev Rev 339 (1992) (cited in *Roper*); Steinberg & Scott, *Less Guilty by Reason of Adolescence: Developmental Immaturity, Diminished Responsibility, and the Juvenile Death Penalty*, 58 Am Psychol 1014 (2003) (cited in *Roper*); Erikson, *Identity: Youth and Crisis* (1968) (cited in *Roper*); Rosso et al., *Cognitive and Emotional Components of Frontal Lobe Functioning in Childhood and Adolescence*, 1021 Annals NY Acad Sci 360-61 (2004) (submitted in *Graham*); Bunge et al., *Immature Frontal Lobe Contributions to Cognitive Control in Children: Evidence from fMRI*, 33 Neuron 301 (2002) (submitted in *Graham*); Gogtay et al., *Dynamic Mapping of Human Cortical Development During Childhood Through Early Adulthood*, 101 Proc Nat'l Acad Sci 8174 (2004) (submitted in *Graham*).

sentences for individuals under the age of 18 are powerfully exhibited through late adolescence as well. Just as adolescents under 18 may act impulsively and without regard for consequences due to ongoing brain development pivotal to long-term planning, reasoned judgment under stress, and future orientation—so too may late adolescents. From a scientific perspective, a person's 18th birthday is not a rational dividing line for justifying LWOP or similar sentences because the brain continues to develop and change rapidly across all the relevant metrics for several more years.

The U.S. Supreme Court's decisions and reasoning are instructive to the question presented by this case—the validity of Mr. Parks's sentence under the Michigan Constitution. *See People v Bullock*, 440 Mich 15, 27–42 (1992) (analyzing U.S. Supreme Court reasoning in reversing LWOP sentence). Notably, however, the Michigan Constitution's prohibition on "cruel *or* unusual" punishment, Const. 1963, art. 1, § 16 (emphasis added), is "broader than that provided for under the United States Constitution," which more narrowly proscribes punishment that is both "cruel and unusual." *People v Stovall*, 334 Mich App 553, 566–67 (2020) (quoting US Const, Am VIII). Thus, this Court is not limited to the constitutional floor established by the U.S. Supreme Court to date.

Even under the narrower federal standard, however, the rationales for barring overly punitive sentences on adolescents are clear: adolescents' lack of self-control, their vulnerability to peer pressure, and the possibility for their redemption all make life-determinant sentences for adolescents cruel *and* unusual. *See, e.g.*, *Miller v Alabama*, 567 US at 471 (holding mandatory LWOP cruel and unusual because

during adolescence, individuals (1) display "a lack of maturity and an underdeveloped sense of responsibility, leading to recklessness, impulsivity, and heedless risk-taking," (2) "are more vulnerable to negative influences and outside pressures, including from their family and peers," and (3) have "traits [that] are less fixed" so their "actions [are] less likely to be evidence of irretrievable depravity" (quoting *Roper*, 543 US at 569)). As explained in the following Sections, recent advances in science powerfully demonstrate that all these factors equally apply to late adolescents.

## II. Scientific Research Shows Significant Changes in Brain Development, Behavior, and Personality Beyond 17 Years of Age and Throughout Late Adolescence.

With the benefit of significant, relatively recent scientific developments, the contemporary scientific community broadly recognizes late adolescence—*i.e.*, the period of growth widely accepted to capture ages 18, 19, and 20—as a key stage of adolescent development, characterized by significant brain, behavioral, and psychological change.[5] This consensus arises out of a multitude of peer-reviewed studies on adolescent brain and behavioral development in the years following *Roper* (2005), *Miller* (2012), and *Montgomery* (2016). Many of these studies assess brain structure and function in large numbers of individuals of different ages and over multiple time points, enabling researchers to use averages to measure accurately the age at which changes in specific brain structures and functions show a relative leveling off or stability.

[5] *See, e.g.*, Steinberg & Icenogle, *Using Developmental Science to Distinguish Adolescents and Adults Under the Law*, 1 Annu Rev Dev Psychol 21, 34 (2019).

These recent studies have conclusively established late adolescence as its own pivotal developmental stage, one that shares key hallmarks of adolescence. Late adolescence is marked by ongoing brain maturation in areas that govern emotional arousal and self-control regulation. This brain development emerges in tandem with the unique demands that late adolescents face (*e.g.*, physical, sexual, and social changes) as they prepare to transition into adulthood.[6] Late adolescence also often operates as an important sociocultural transition phase, as individuals lose certain family and academic structures and supportive family- and child-centered health and social services.[7]

The scientific evidence regarding neurocognitive maturation *after* a person's teenage years powerfully demonstrates that adolescence undoubtedly extends beyond the age of 18, when Mr. Parks committed his offense. Late adolescent brain development does not merely entail minor changes in brain structure and function, but rather "a series of developmental cascades" of neurological transformations across multiple brain networks that, in turn, enable late adolescents to transition to the more rational control of behavioral impulses observed in adulthood.[8]

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[6] Sawyer et al., *The age of adolescence*, 2 Lancet Child Adolesc Health 223–28 (2018).

[7] *Id.*; *see also* Arnett, *Emerging Adulthood: A Theory of Development From the Late Teens Through the Twenties*, 55 Am Psychologist 469 (2000); Jaworska & MacQueen, *Adolescence as a unique developmental period*, 40 J of Psychiatry & Neuroscience 291 (2015); Teipel, *Developmental Tasks and Attributes of Late Adolescence/Young Adulthood*, State Adolescent Health Resource Center, available at http://www.amchp.org/programsandtopics/AdolescentHealth/projects/Documents/SAHRC%20AYADevelopment%20LateAdolescentYoungAdulthood.pdf (accessed December 20, 2021).

[8] Arnett, s*upra* note 7; Jaworska, *supra* note 7; Teipel, *supra* note 7; Masten & Cicchetti, *Developmental cascades*, 22 Dev Psychopathol 491–95 (2010); Casey et al., *Development of the Emotional Brain*, 693 Neuroscience Letters 29–34 (2019).

### A. *Fundamental Changes in Brain Development Begin Before Birth and Continue Through Late Adolescence.*

#### 1. The brain has exceptional plasticity through late adolescence.

While the human brain has capacity for change (or "plasticity") throughout life, it shows truly remarkable potential for learning and change through late adolescence.[9] Influenced by a person's genetics, cognitive development, and upbringing (including childhood trauma and chronic stress, *see* Section II.C, *infra*), brain plasticity can radically reshape neural pathways.

During adolescence, the brain undergoes substantial synaptic pruning, in which unused excitatory synapses (connections between neurons) are eliminated to increase efficiency in communication among the remaining neuronal connections, which supports learning, cognition, and reasoned decision-making.[10] A "hallmark of the brain transformations of adolescence," synaptic pruning during adolescence—continuing through late adolescence—removes approximately half of the synaptic connections in certain brain regions.[11] This marked reduction in synapses corresponds with "the 'rewiring' of brain connections into adult-typical patterns."[12]

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[9] Bavelier et al., *Removing brakes on adult brain plasticity: from molecular to behavioral interventions*, 30 J Neurosci 14964–71 (2010).

[10] *See* Selemon, *A role for synaptic plasticity in the adolescent development of executive function*, 3 Translational Psychiatry 1 (2013) ("Synaptic pruning of excitatory contacts is the signature morphologic event of late brain maturation during adolescence"); Casey et al., *Structural and Functional Brain Development and its Relation to Cognitive Development*, 54 Biological Psychol 245–46 (2000) (reviewing studies examining prefrontal cortical activity in adolescents and concluding that increased cognitive capacity coincides with a loss of some synapses and strengthening of remaining synapses).

[11] Spear, *Adolescent Neurodevelopment*, 52 J Adolescent Health 7–13 (2013).

[12] *Id.*

Adolescent brains simultaneously undergo gradual myelination, in which axons (the parts of nerve cells along which nerve impulses are conducted to other cells) become insulated with fatty, insulative tissue known as myelin. Myelination increases the transmission speed of electrical signals. Myelination thus enables the remaining connected neurons to communicate with greater speed and efficiency, even between distant regions of the brain.[13] Through at least late adolescence, these developing pathways facilitate greater dialogue among different brain systems that process cognitive, emotional, and social information important for self-control. As shown in Figure 1, these processes together prime the brain for learning and change during late adolescence, especially in pathways involving the prefrontal cortex that supports decision-making and self-control.

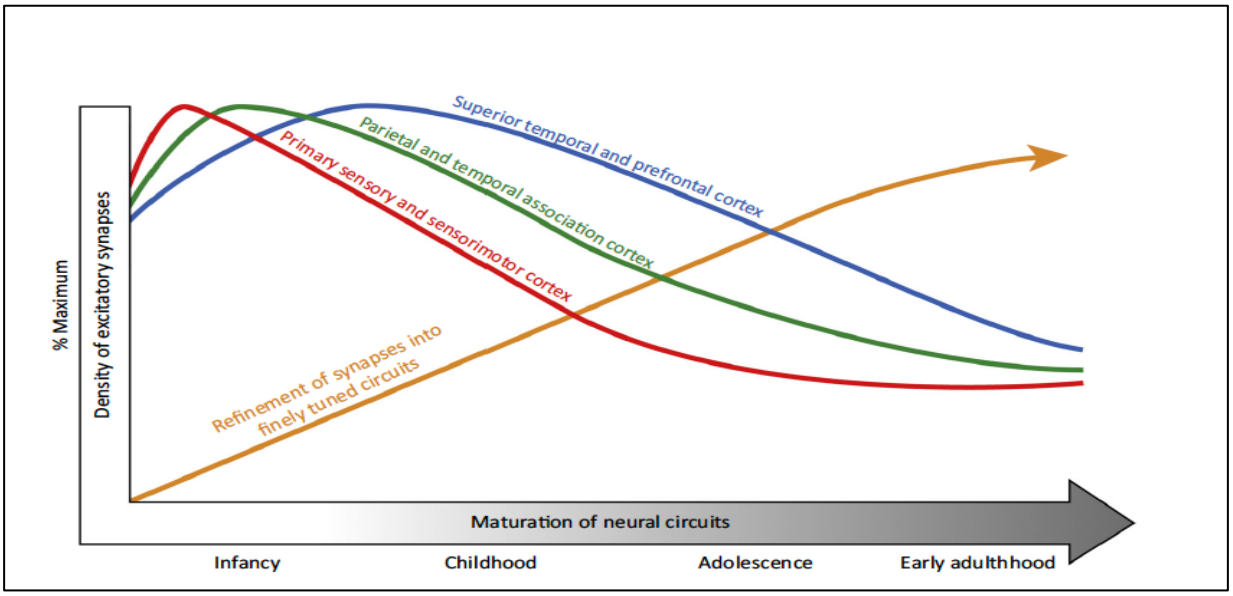


Figure 1 — The density and maturation of various neutral circuitry through early adulthood. Forsyth & Lewis, *Mapping the Consequences of Impaired Synaptic Plasticity in Schizophrenia through Development: An Integrative Model for Diverse Clinical Features*, 21 Trends in Cogn Sci 765 (2017).

[13] *Id.*

**2. Brain imaging provides robust evidence of crucial neurological development beyond age 17.**

The brain shows dynamic changes in structure and function throughout late adolescence. Imaging tools like MRI provide researchers with the ability to see structural changes in tissue (gray and white matter) related to processes at the level of the synapse and myelin sheath and functional changes related to neuronal activity.

This increased visibility into brain development shows significant changes in gray and white matter that extend through and even beyond late adolescence. Figure 2 below demonstrates findings across key brain metrics related to changes in cognitive abilities (including decision-making, self-control, and social and emotional behavior):

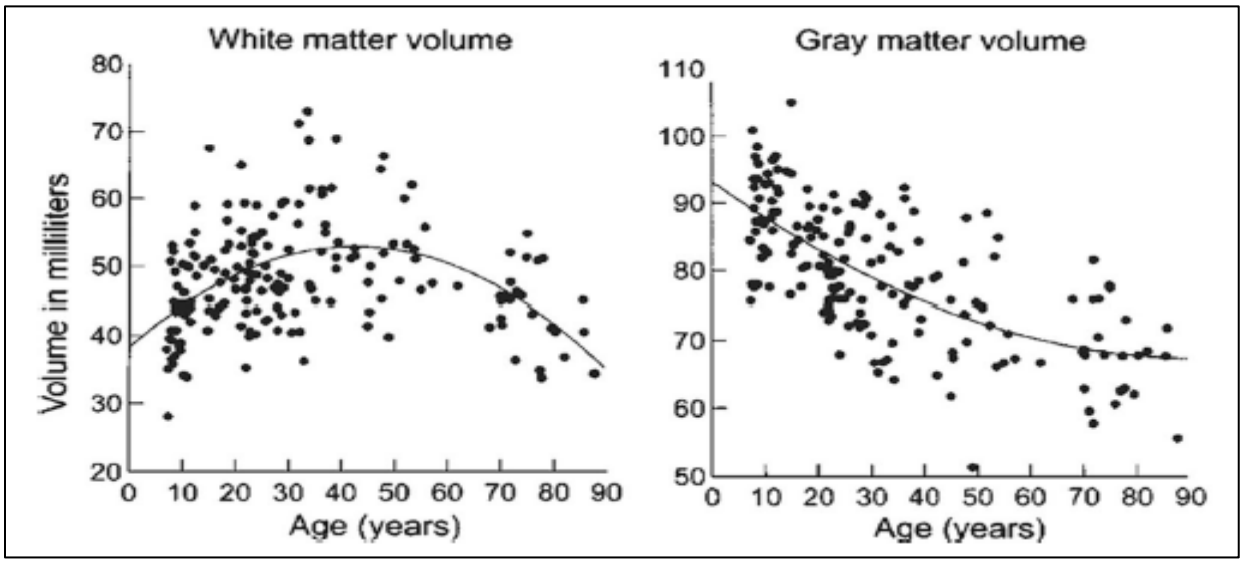


Figure 2 — Changes in white and gray matter volume throughout life. Sowell et al., *Mapping cortical change across the human life span*, 6 *Nature Neuroscience* 314 (2003).

- **Gray matter development**: Thinning of cortical gray matter (the regions containing most of the brain's neuronal cells, and correlated with improved decision-making, self-control, and other key milestones) continues through an

individual's late twenties and beyond—and is associated with continued synaptic pruning during late adolescence.[14] Gray matter changes also demonstrate disparate regional development as shown in Figure 3 below. The prefrontal cortex that modulates cognitive control shows a dramatic 17% reduction in gray matter volume between ages 6 to 26. By comparison, over the same period, the subcortical regions implicated in emotional and motivation processing, the amygdala and ventral striatum, exhibit a 7% reduction.[15] These results track a developmental mismatch during late adolescence between (i) the less developed regions controlling foresight, planning, self-control, and risk-aversion, and (ii) the more developed and dominant regions implicated in states of emotional arousal.

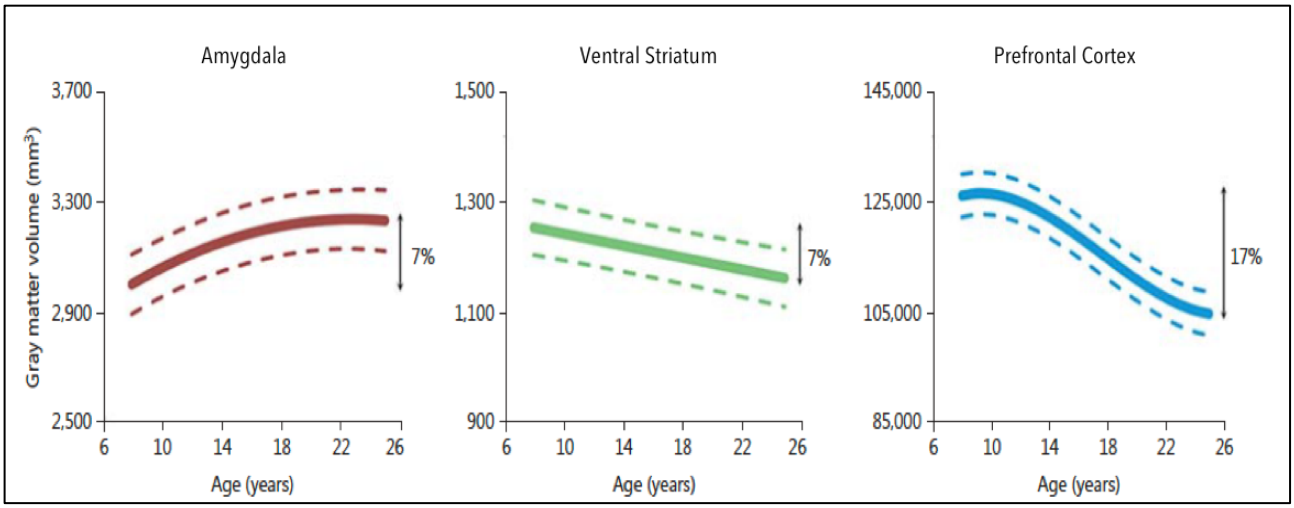


Figure 3 — Gray matter volume in the amygdala, ventral striatum, and prefrontal cortex from childhood to early adulthood. Mills et al., *The Developmental Mismatch in Structural Brain Maturation during Adolescence*, 6 Dev Neuroscience 153 (2014).

[14] Schnack et al., *Changes in Thickness and Surface Area of The Human Cortex and Their Relationship with Intelligence*, 25 Cerebral Cortex 1608 (2015); Fjell et al., *Development and Aging of Cortical Thickness Correspond to Genetic Organization Patterns*, 112 Proc Nat'l Acad. Sci 15462 (2015).

[15] Mills et al., *The Developmental Mismatch in Structural Brain Maturation During Adolescence*, 36 Dev Neuroscience 147–60 (2014).

- **White matter development**: White matter increases throughout late adolescence, well beyond age 18, and is thought to reflect heightened brain processing, impulse control, and reasoned decision-making.[16] Associated with gradual myelination and the brain's stimuli processing speed, the incomplete development of these connections throughout childhood and late adolescence has been implicated in diminished self-control and increased impulsive and risky behavior.[17] During late adolescence, white matter connections between the prefrontal cortex and subcortical regions multiply and mature, contributing to improved self-control needed for neurocognitive adulthood.[18]
- **Functional brain development**: Functional brain development is assessed during rest or during a task. Resting-state functional MRI ("fMRI") measures correlations in spontaneous activity between brain regions over time when resting and is referred to as functional connectivity. Task-based fMRI looks at regional changes in brain activity in response to stimuli or performance of a

[16] Lebel et al., *A Review of Diffusion MRI of Typical White Matter Development from Early Childhood to Young Adulthood*, 32 NMR Biomedicine E3778 (2019).

[17] Casey, *Beyond simple models of self-control to circuit-based accounts of adolescent behavior*, 66 Annu Rev of Psychol 1 (2015).

[18] Simmonds et al., *Developmental stages and sex differences of white matter and behavioral development through adolescence: a longitudinal diffusion tensor imaging (DTI) study*, 92 Neuroimage 356 (2014).

task. Changes in functional connectivity during rest show continued significant changes well beyond 18 years as demonstrated in Figure 4.[19]

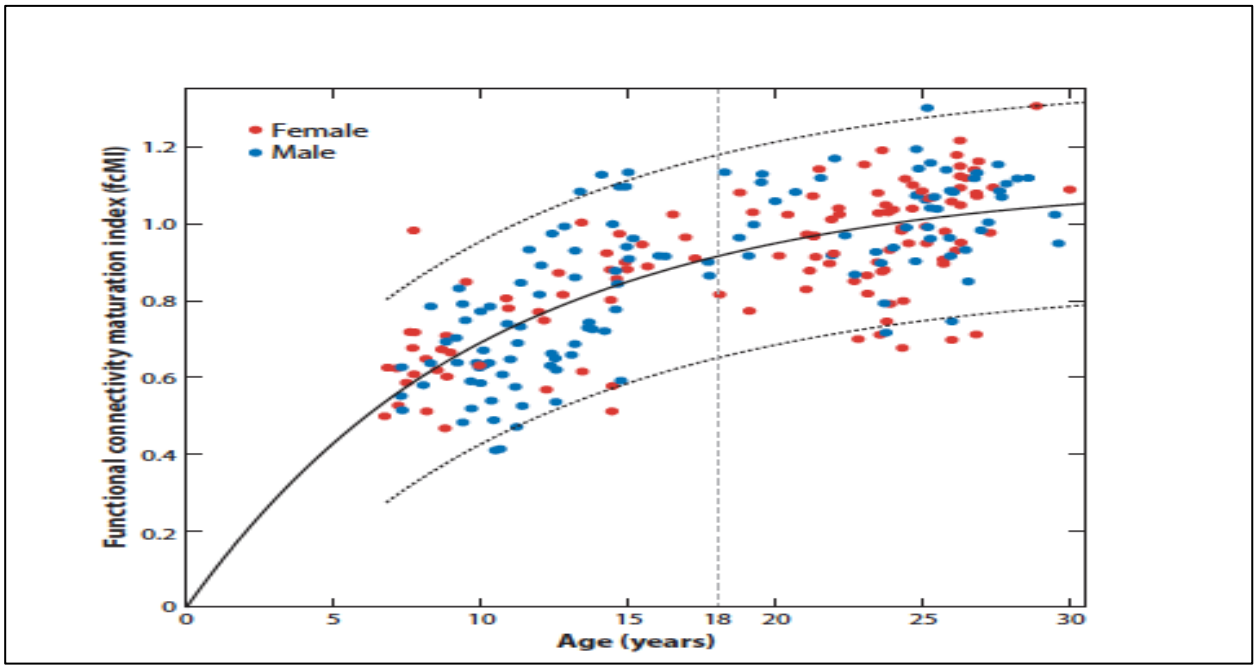


Figure 4 — Functional connectivity maturation in the brain from birth through 30 years of age. Dosenbach et al., *Prediction of individual brain maturity using fMRI*, 329 Science 1359 (2010).

During adolescence, including late adolescence, a transition occurs from a state that features more local connections to one that exhibits strengthened distal connections. *Id.* Both functional connectivity and task-based prefrontal activity appears less mature under conditions of emotional arousal (*e.g.*, anticipation of a threat) relative to non-arousing ones. In these conditions, earlier-teens and late adolescents show similar increases in impulsivity and risk preferences unlike

[19] Dosenbach et al., *Prediction of individual brain maturity using fMRI*, 329 Science 1358–61 (2010).

adults, suggesting susceptibility to situational diminished capacity during late adolescence.[20]

* * *

Both individually and collectively, recent studies have shown that late adolescence is a time of substantial ongoing maturation and development in the regions and circuits of the brain that process information associated with rewards and emotional reactivity, especially in those regions such as the prefrontal cortex important for decision-making and impulse control.[21] As the brain matures, particularly from late adolescence into early adulthood, changes in subcortical and cortical pathways are associated with improved cognitive capacity in social and emotional situations and a substantial reduction in a late adolescent's propensity to engage in reckless behaviors.[22] So while the transformations leave late adolescents particularly vulnerable to certain forms of transient mistakes and misconduct, those processes do not freeze them in a state of late adolescence. To the contrary, their

[20] Rudolph et al., *At risk of being risky: the relationship between "brain age" under emotional states and risk preference*, 24 Dev Cogn Neurosci 93–106 (2017); Cohen et al., *When is an adolescent an adult? Assessing cognitive control in emotional and nonemotional contexts*, 27 Psychol Sci 549–62 (2016).

[21] *See* Somerville, *Searching for Signatures of Brain Maturity: What Are We Searching For?*, 92 Neuron 1166–67 (2016) (signs of brain maturity, including structural development and connectivity patterns, continue to change dramatically through late adolescence, such that the "age of 18 as a cut-point for comparison between 'adolescents' and 'adults' . . . could obscure or even mask continued developmental change"); *see also* Cohen, *supra* note 20; Braams et al., *Longitudinal Changes in Adolescent Risk-Taking: A Comprehensive Study of Neural Responses to Rewards, Pubertal Development, and Risk-Taking Behavior*, 35 J Neuroscience 7226 (2015); Insel et al., *Development of corticostriatal connectivity constrains goal-directed behavior during adolescence*, 8 Nat Commun 1605 (2017).

[22] Cohen, *supra* note 20; Rudolph, *supra* note 20.

brains continue to develop into adulthood, at which point they are more mature, more in control, and substantially less likely to engage in criminal behavior.[23]

### 3. The brain undergoes dynamic and hierarchical development rendering it uniquely vulnerable to maladaptive behavior during late adolescence.

Brain development is a dynamic and hierarchical process that occurs throughout life, and especially during the extended period of adolescence. Recent scientific findings indicate that, due to the timing of certain brain development processes, late adolescents are particularly susceptible to engaging in maladaptive behavior, and that their proclivity for such behavior recedes upon reaching adulthood.

Brain systems and the connections between them undergo refinement with age and experience. The timing of these changes, however, varies for different brain regions and networks. Subcortical regions including the ventral striatum and amygdala, which are important in reward and emotional learning and processing, show earlier structural and functional development than cortical regions.[24] By contrast, the prefrontal cortex, which guides self-control and complex decision-making, continues to mature throughout late adolescence into early adulthood. This extended window of prefrontal maturation parallels the prolonged social, emotional, and cognitive development that marks late adolescence.[25] Because the prefrontal cortex is more developed during late adolescence than earlier stages of adolescence,

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[23] *See* Hawes et al., *The developmental course of psychopathic features: Investigating stability, change, and long-term outcomes*, 77 J Research in Personality 83–89 (2018).

[24] Mills, *supra* note 15; Braams, *supra* note 21.

[25] Steinberg & Icenogle, *supra* note 5, at 21.

late adolescents have somewhat better cognitive control and decision-making skills than they did when they were younger. However, because the brain's motivational and emotional systems are hyper-responsive through late adolescence, late adolescents tend to be more vulnerable than young adults to lapses in self-control or impulsive decision-making—especially when in emotionally heated situations,[26] even if they show mature cognitive appraisal of emotional information.[27]

At the tail-end of late adolescence, the brain's development exhibits a crucial shift. Where the younger brain predominantly relies on emotional, or limbic circuitry, this period facilitiates the transition to a neurocognitively adult brain that relies more on the cognitive control, or prefrontal circuitry.[28] While both brain systems play important roles in decision-making, limbic circuitry dominant in adolescence governs short-term reward/pleasure (through the ventral striatum and orbitofrontal cortex)[29] and emotional arousal (through the amygdala, hippocampus, and ventromedial prefrontal cortex).[30] By contrast, the prefrontal circuitry (lateral prefrontal cortex and posterior parietal cortex) dominant in adulthood regulates cognitive control responses such as reasoning, attention, planning, and memory retrieval. When fully developed, this brain system facilitates a person's ability to efficiently engage in

[26] Cohen, *supra* note 20.

[27] Silvers et al., *VlPFC-vmPFC-amygdala interactions underlie age related differences in cognitive regulation of emotion*, 27 Cerebral Cortex 3502–14 (2017).

[28] Casey, *supra* note 17, at 295-319; *see also* Cohen, *supra* note 20; Casey, *supra* note 8.

[29] Galván et al., *Earlier development of the accumbens relative to orbitofrontal cortex might underlie risk-taking behavior in adolescents*, 26 J Neurosci 6885–92 (2006).

[30] Casey et al., *Healthy development as a human right: insights from developmental neuroscience for youth justice*, 16 Annu Rev Law Soc Sci 203–22 (2020); Somerville, *supra* note 21, at 1164–67.

complex decision-making by weighing alternative choices and actions based on future objectives and consequences.

Prior to this transition, adolescents (including late adolescents) are uniquely vulnerable to impulsive and risky behavior because their more developed emotional circuitry causes outsized receptiveness to short-term rewards and adverse overreaction to threats. For persons in adolescence and late adolescence, dramatic changes are believed to occur in the prevalence and distribution of dopamine receptors across the brain.[31] These changes favor fleeting rewards and pleasure and correlate with a spike in risk-taking and peer-influenced behaviors.

When faced with acute stress or emotional arousal, late adolescents' supercharged threat and stress response and eagerness for short-term rewards are more likely to culminate in poor decision-making, weak impulse control, and limited regard for future consequences. Thus, for adolescents and late adolescents alike, the conflicting interactions within and between the more developed limbic system and the less developed prefrontal systems generate a heightened propensity to engage in maladaptive activities including irresponsible or criminal conduct.[32] The cognitive control system begins to develop in infancy and continues through at least late

[31] Braams, *supra* note 21 (measuring changes to dopamine receptors in animals).

[32] *See* Dreyfuss et al., *Teens Impulsively React rather than Retreat from Threat*, 36 Dev Neurosci 225-26 (2014); Arain, *supra* note 3, at 453–55; Tyler, *Understanding the Adolescent Brain and Legal Culpability*, American Bar Association (Aug. 1, 2015), available at https://www.americanbar.org/groups/public_interest/child_law/resources/child_law_practiceonline/child_law_practice/vol-34/august-2015/understanding-the-adolescent-brain-and-legal-culpability/ (accessed January 17, 2022).

adolescence through a slow process that requires multiple systemic changes, and by adulthood better moderates such impulses.[33]

As brain imaging suggests, individuals' ability to engage in mature decision-making through effective impulse control, risk avoidance, and coordination of emotion and cognition is not fully developed until after late adolescence is complete.[34] After that point, the brain systems are more evenly developed, such that the systems and the neural pathways linking them can interact to enable suitable regulation of perceived incentives, threats, and consequences. This understanding from contemporary neuroscience offers a powerful explanation not only as to why late adolescents are uniquely vulnerable to engaging in risky, irresponsible, and illicit behaviors, but also as to why their proclivity for such behaviors recedes upon reaching neurocognitive adulthood.[35]

**4. Brain imaging shows that late adolescent brains, especially under emotional arousal, resemble brains earlier in adolescence.**

Neuroscientists have discerned age brackets for which brain imaging data indicates greater neurological similarities than differences, notwithstanding marginal differences in physical or neurocognitive ages. For example, although it is easy to distinguish between brain images of young adolescents compared to young

[33] Arain, *supra* note 3, at 451.

[34] Icenogle et al., *Adolescents' cognitive capacity reaches adult levels prior to their psychosocial maturity: evidence for a "maturity gap" in a multinational, crosssectional sample*, 43 Law Hum Behav 69–85 (2019).

[35] Casey et al., *Making the Sentencing Case: Psychological and Neuroscientific Evidence for Expanding the Age of Youthful Offenders*, 5 Annu Rev of Criminology 7.1 (forthcoming 2022).

adults, it is exceedingly difficult to differentiate the brain images of adolescents and late adolescents.[36] This is due to strong similarities in brain immaturity as well as changes in functional connectivity between brain systems that prevail throughout this developmental period.[37] Other studies demonstrate that late adolescents not only exhibit the highest risk preferences among all age groups, but their brain images also reveal indistinguishable levels of underdeveloped functional connections, especially under emotional arousal (including stressful states in which serious crimes such as homicide may be committed).[38]

These findings suggest that in emotionally-charged situations the late-adolescent brain manifests as less mature than in calm, controlled environments, and that this immaturity is linked to risky behaviors.[39] Together, the neuroscientific evidence demonstrates that brain function and cognitive capacity vary as a function of emotional and social contexts and that full adult capacity in these contexts is not generally observed until after late adolescence—even though late adolescents may appear, from external appearances, to be fully mature.

### B. *Psychological Capacity Matures with Continued Brain Development Through Late Adolescence.*

The brain's continued development through late adolescence is intertwined with changes in psychological and cognitive abilities, as well as social and emotional

[36] Cohen, *supra* note 20.

[37] Cohen, *supra* note 20; Dosenbach, *supra* note 19.

[38] Rudolph, *supra* note 20; Cohen, *supra* note 20.

[39] Rudolph, *supra* note 20.

responses, which, in turn, impact sentencing considerations such as culpability and capacity for change. *See Graham*, 560 US at 68 (citations omitted).

Specifically, the scientific literature makes clear that different psychological abilities develop at different times, in keeping with gradual biological changes in the brain. Strategic behaviors involving planning and decision-making under demanding and emotionally arousing conditions show steady improvements beyond 18 years.[40] Individuals in adolescence and late adolescence still show diminished capacity in such scenarios, exhibiting heightened sensitivity to rewards, threats,[41] social cues,[42] and peer influences[43]—combined with an underappreciation of risks, consequences, and self-regulation.[44] Figure 5 below provides a visual representation of these changes in

[40] Steinberg et al., *Age differences in future orientation and delay discounting*, 80 Child Dev 28-44 (2009) (concluding that brain "remodeling" affecting planning ahead, temporal orientation, anticipation of future consequences, and delay discounting continues to occur throughout early and late adolescence); Steinberg et al., *Are adolescents less mature than adults?: minors' access to abortion, the juvenile death penalty, and the alleged APA "flip-flop,"* 64 Am Psychol 592 (2009) (finding that "in situations that elicit impulsivity" and are "characterized by high levels of emotional arousal," adolescent decision-making is likely "less mature than adults'"); Gardner & Steinberg, *Peer influence on risk taking, risk preference, and risky decision making in adolescence and adulthood: an experimental study*, 41 Dev Psychol 625–35 (2005) (concluding that adolescents are "more inclined toward risky behavior" in the face of peer influence).

[41] Cohen, *supra* note 20.

[42] *See, e.g.*, Hare et al., *Biological substrates of emotional reactivity and regulation in adolescence during an emotional go-nogo task*, 63 Biological Psychiatry 927–34 (2008) (finding that adolescent brains' weaker top-down regulation of emotional centers, such as the amygdala, affects ability to control behavior in highly emotional contexts); Somerville et al., *Frontostriatal maturation predicts cognitive control failure to appetitive cues in adolescents*, 23 J Cogn Neurosci 2129 (2011) (concluding that adolescents are "biased to engage in risky behavior at the service of approaching potential rewards").

[43] *See, e.g.*, Gardner & Steinberg, *supra* note 40, at 625-35.

[44] Beardslee et al., *An examination of parental and peer influence on substance use and criminal offending during the transition from adolescence to adulthood*, 45 Crim Justice Behav 783–98 (2018); Smith et al., *Peers increase adolescent risk taking even when the probabilities of negative outcomes are known*, 50 Dev Psychol 1564–68 (2014).

sensation-seeking and self-regulation.[45] This heightened sensitivity can distract individuals and bias decisions in suboptimal ways for late adolescents, such as placing them at a greater risk for criminal activity.[46] Under situations of threat, their cognitive capacity is diminished and does not reach mature levels until at least age 22.[47] Indeed, distinguishing the capacity of a 17-year-old from a late adolescent in these situations would be functionally impossible.

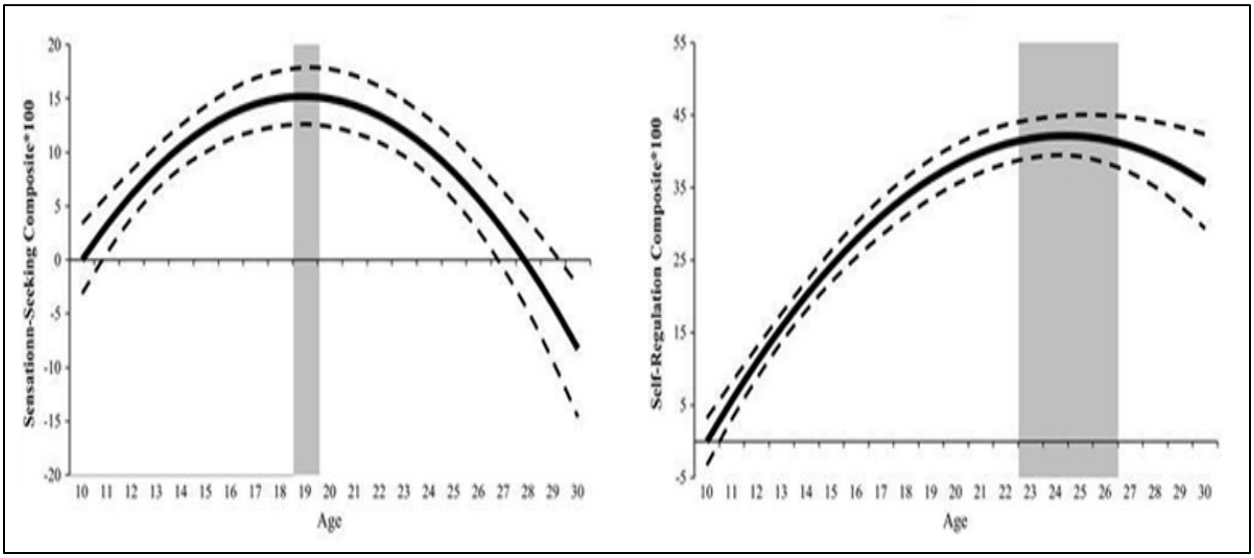


Figure 5 — Sensation-seeking peaks in late adolescence (left). Self-regulation stabilizes in young adulthood (right). Steinberg et al., *supra* note 45.

The U.S. Supreme Court has recognized that adolescents "are more vulnerable or susceptible to negative influences and outside pressures, including peer pressure." *See Graham*, 560 US at 68 (reasoning that this susceptibility, as well as other considerations, make adolescents less culpable and less deserving of the most severe

[45] Steinberg et al., *Around The World, Adolescence Is a Time of Heightened Sensation Seeking and Immature Self-Regulation* 21 Dev Sci 1111 (2018).

[46] Beardslee, *supra* note 44; Smith; *supra* note 44; McCord et al., *Co-offending and patterns of juvenile crime: Research in brief*, National Institute of Justice, Washington, DC (2005).

[47] Cohen, *supra* note 20.

punishments). Several studies have likewise found heightened risk-taking among late adolescents in the presence of peers compared to being alone or in the presence of an adult, whereas peer pressure has little impact on risk-taking among adults.[48] "A necessary condition for an adolescent to stay law-abiding is the ability to deflect or resist peer-pressure," a cognitive process that develops—and remains a work-in-progress—throughout late adolescence.[49]

This wealth of literature addressing the development of psychological abilities confirms there is little difference between adolescents age 17 and younger and late adolescents regarding cognitive capacity in demanding and emotionally charged situations. Three key findings emerge. First, as a group, adolescents and late adolescents show immature psychological abilities relative to adults, which justifies their special treatment and protection. Second, cognitive, emotional, and social abilities do not develop on the same timeline. Third, these abilities fully coalesce only after late adolescence during adulthood.[50]

As such, a late adolescent may make rational decisions in some contexts, such as choosing to attend college or voting, but still lack the ability to engage in mature decision-making in highly charged scenarios—especially where peer influences, threats, or short-term incentives are acutely felt.

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[48] Gardner & Steinberg, *supra* note 40, at 625; Silva et al., *Adolescents in Peer Groups Make More Prudent Decisions When a Slightly Older Adult Is Present*, 27 Ass'n Psychological Sci 327–29 (2015).

[49] Zimring, *Penal Proportionality for the Young Offender: Notes on Immaturity, Capacity and Diminished Responsibility*, Youth on Trial 280–81 (2000).

[50] Casey, *supra* note 30.

### C. *Trauma and Chronic Stress Impact Brain and Behavioral Development Through Late Adolescence.*

Adverse childhood experiences ("ACEs") and other childhood traumas can alter standard brain development and cognitive and perceptual processes. Such events increase the risk of neurocognitive immaturity during late adolescence,[51] stunted emotional development, and limited self-control and other regulatory processes—all of which exacerbate poor decision-making and maladaptive behaviors (including criminal conduct).[52] Given this, a late adolescent chronologically aged in their twenties who has been exposed to significant ACEs/trauma may nonetheless have a much lower neurocognitive age (even under 18) given the resounding impacts of prior trauma on their neurological development.[53] This scientific insight highlights the

[51] *See* Schilling et al., *Adverse childhood experiences and mental health in young adults: a longitudinal survey*, 7 BMC Public Health 2 (2007) (finding increased frequency of ACEs was "significantly" associated with increased prevalence of depressive symptoms, drug use, and antisocial behavior); Dunn et al., *Developmental timing of child maltreatment and symptoms of depression and suicidal ideation in young adulthood: Results from the National Longitudinal Study on Adolescent Health*, 30 Depress Anxiety 955, 961 (2014) (finding "high levels of depression" and increased suicidal ideation in young adults who experienced physical or sexual abuse during childhood); McLaughlin, *The long shadow of adverse childhood experiences*, American Psychological Association (Apr. 2017), available at https://www.apa.org/science/about/psa/2017/04/adverse-childhood (accessed December 28, 2021), (summarizing studies showing ACEs including physical or sexual abuse, domestic violence, exposure to violence in the community, experiences that involve deprivation such as neglect, the absence of a caregiver, poverty, and food insecurity contribute to anxiety, depression, aggressive behaviors, post-traumatic stress disorder, and substance abuse issues); Rollins & Crandall, *Self-Regulation and Shame as Mediators Between Childhood Experiences and Young Adult Health*, 12 Frontiers in Psychiatry 1 (2021) (summarizing a growing number of studies indicating that ACEs lead to increased mental health problems throughout young adulthood).

[52] Bick & Nelson, *Early Adverse Experiences and the Developing Brain*, 41 Neuropsychopharmacology Reviews 179–80 (2016).

[53] *See* The Neurocognitive and Psychosocial Impacts of Violence and Trauma: Proceedings of a Workshop—in Brief, National Academies of Sciences, at 2 (Apr. 2018) ("[T]hreats, abuse, and violence lead to an excessive activation of fear circuitry and stress response systems, which will then compromise normal brain development.").

lack of a scientific basis for imposing LWOP sentences on late adolescents, especially those who have experienced ACEs and other trauma.

Thankfully, the brain shows remarkable plasticity in its potential to adapt to changing environments, even extreme ones (including chronic stress, neglect, and abuse)[54] throughout the life span.[55] Consequently, even with significant prior trauma, studies have shown that sufficient time in less impoverished environments and exposure to effective rehabilitative interventions can mitigate the effects of adverse social environments[56] and curb antisocial behaviors in late adolescence and beyond.[57] The brain's long-term capacity to remedy the effects of past adversity when met with the appropriate rehabilitative frameworks is remarkable and demonstrates the significant potential for redemption.

### D. *Personality Matures with Continued Brain Development Through Late Adolescence.*

Unduly punitive sentencing has been found under the Michigan Constitution to be disproportionate and excessive, and thus unconstitutional, because it is imposed without consideration for the person's "individual personality and history." *People v Lorentzen*, 387 Mich 167, 181 (1972). Numerous studies cast doubt on the once-fashionable idea that personality emerges early and remains stable during late

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[54] Liston et al., *Psychosocial stress reversibly disrupts prefrontal processing and attentional control*, 106 Proc Natl Acad Sci USA 912–17 (2009).

[55] Galván, *Adolescent Brain Development and Contextual Influences: A Decade in Review*, 31 J Research on Adolescence 843–69 (2021).

[56] Chetty et al., *The effects of exposure to better neighborhoods on children: New evidence from the Moving to Opportunity experiment*, 106 American Economic Rev 855–902 (2016).

[57] Baskin-Sommers et al., *Towards targeted interventions: Examining the science behind interventions for youth who offend*, 5 Annu Rev of Criminology 345–69 (2022).

adolescence. Research now demonstrates that people generally show increased self-control and emotional stability as they age, with dramatic increases through late adolescence.[58] *See* Sections II.A & II.B, *supra*.

The classic "age-crime" curve illustrated in Figure 6 reflects, among other things, individuals' growing self-control and emotional stability over time. Statistics consistently show that criminal conduct—especially the incidence of violent offenses—peaks in late adolescence and then drops significantly after the age of 21.[59]

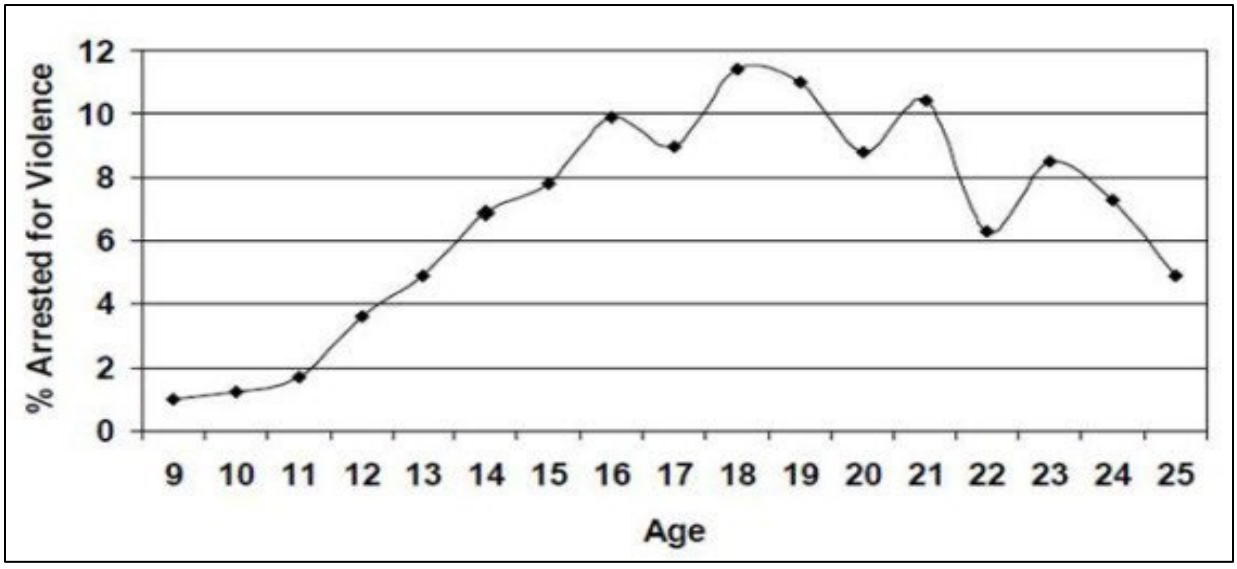


Figure 6 — Percentage of persons arrested for violence by age. National Institute of Justice, *From Youth Justice Involvement to Young Adult Offending* (2014).

Psychological studies track a similar pattern, showing that extreme forms of antisocial behavior and pathological personality traits naturally diminish after late adolescence.[60] Following late adolescence, antisocial behavior and callous-

[58] Roberts & Mroczek, *Personality trait change in adulthood*, 17 Curr Dir Psychol Sci 31–35 (2008).

[59] Most young adolescents show a reduction in problematic traits often related to criminal behavior even without intervention. *See* Hawes, *supra* note 23; Baskin-Sommers et al., *Callous-unemotional traits trajectories interact with earlier conduct problems and executive control to predict violence and substance use among high risk male adolescents*, 43 J Abnormal Child Psychology 1529–41 (2015).

[60] Baskin-Sommers, *supra* note 59.

unemotional/psychopathic traits decrease for the majority of young adults.[61] When individuals age out of late adolescence, for many, their psychological and brain development will largely of its own accord reduce the factors that previously contributed to committing criminal acts. As a result, LWOP sentences for late adolescents are not justified based on the flawed premise of a "pathological" personality or purported need to deter future crimes or protect members of the public.

## III. Traditional Penological Justifications Are Particularly Weak for Sentencing Late Adolescents to LWOP.

Life imprisonment without the possibility of parole is "an especially harsh punishment" for offenders in their adolescence. *Graham*, 560 US at 70. An adolescent sentenced to LWOP will "on average serve more years and a greater percentage of his life in prison than an adult offender." *Id.*

To assess the proportionality of a severe sentence, Michigan courts recognize four penological justifications: "(a) the reformation of the offender; (b) protection of society; (c) the disciplining of the wrongdoer; and (d) the deterrence of others from committing like offenses." *People v Snow*, 386 Mich 586, 592 (1972); *see also Graham*, 560 US at 71–75. None of these factors supports LWOP for offenders through late adolescence.

### A. *Late Adolescence Presents a Unique Opportunity for Reformation or Rehabilitation.*

Michigan's criminal sentencing scheme embodies an "important belief that only the rarest individual is wholly bereft of the capacity for redemption." *Bullock*,

[61] Baskin-Sommers, *supra* note 59.

440 Mich at 39 n 23 (internal quotations omitted). But LWOP "does not serve the penological goal of rehabilitation" because it eliminates hope for the offender to live freely, which would incentivize reform. *People v Carp*, 496 Mich 440, 520–21 (2014), *judgment vacated on other grounds by Carp v Michigan*, 577 US 1186 (2016). Indeed, such a sentence "means denial of hope." *Graham*, 560 US at 70. If the goal of imprisonment is, in part, rehabilitation, the sound approach would be to allow such individuals a measure of hope that one day they can contribute fully to society and to implement practices that produce rehabilitation rather than employ punishments that unequivocally have been shown to do harm.[62]

### B. *Protecting Society Through Incapacitation Does Not Justify Imposing LWOP on Late Adolescents Who Will Mature Out of Criminal Behavior.*

LWOP is premised on the theory that an offender is "incorrigible" and "forever will be a danger to society." *Graham*, 560 US at 72–73. But as demonstrated, brain and psychological development throughout late adolescence plays a pivotal role in minimizing susceptibility to future criminal conduct, *see* Sections II.A & II.B, *supra*, and the vast majority of adolescents who engage in antisocial or violent conduct cease to do so as they mature,[63] *see* Section II.D, *supra*. There is no reasoned basis for imposing LWOP on late adolescents for purposes of incapacitation, given that they

[62] *See generally* Baskin-Sommers, *supra* note 57 (analyzing intervention practices).

[63] *See* Steinberg et al., *Psychosocial Maturity and Desistance from Crime in a Sample of Serious Juvenile Offenders*, DOJ, Juvenile Justice Bulletin (Mar. 2015); *see also* Laub & Sampson, *Understanding Desistance from Crime*, 28 Crime & Justice 5 (2001) ("It is well known that crime declines with age in the aggregate population.").

are still in a state of neurological transition to maturity and cannot reasonably be considered lifelong dangers to society.

As the U.S. Supreme Court has stated, a conclusion of "incorrigibility is inconsistent with youth." *Graham*, 560 U.S. at 73. A sentence of LWOP, based on a flawed emphasis on incapacitation, deprives a late adolescent offender of the "chance to demonstrate growth and maturity." *Id.* Treating late adolescents as incorrigible—when the research shows they are in fact maturing as their brains develop—provides no sound basis for imposing LWOP.

### C. *A Desire for Retribution Cannot Justify Imposing LWOP on Late Adolescents, Whose Youth Mitigates Their Guilt.*

Retribution reflects society's power to punish criminal offenders "to express its condemnation of the crime and to seek restoration of the moral imbalance caused by the offense." *Graham*, 560 US at 71. But retribution may not be proportional when the penalty is unduly "imposed on one whose culpability . . . is diminished, to a substantial degree, by reason of youth and immaturity." *Roper*, 543 US at 571. Neuroscience demonstrates that in terms of brain development in the realms of risk-taking and self-control, this "youth and immaturity" that substantially diminishes culpability persists through late adolescence.

From the perspective of brain imaging, the "immaturity" of a late adolescent's brain renders their brain development and pathways relatively indistinguishable from other adolescents. *See* Section II.A.4, *supra*. Recognizing reduced culpability for such individuals is critical to assessing whether a sentence is "constitutionally proportionate" because "punishment must be tailored to a defendant's personal

responsibility and moral guilt." *Bullock*, 440 Mich at 39 (internal quotations omitted). For persons still in late adolescence, the "personal responsibility and moral guilt" must be considered in the context of ongoing, imbalanced development in their limbic and prefrontal brain circuitry that dramatically heightens their propensity to engage in problematic conduct. *See* Section II.A, *supra*. Under such circumstances, retribution should be well calibrated, and a life-determinant sentence is excessive. Far from being tailored, the punishment of LWOP is an ill fit.

### D. *Purported Deterrence Cannot Justify Imposing LWOP on Late Adolescents, Who Have a Diminished Ability to Gauge Long-Term Consequences in Stressful Scenarios.*

Punishment is meant to discourage individuals from committing crimes, but the deterrence rationale applies with less force to late adolescents because of their neurological proclivity to make impulsive decisions without anticipating long-term consequences. *See* Section II.A, *supra*. Their ability to self-regulate improves with maturity, *see id.*, undermining the need to deter this behavior through overly punitive sentencing.

With late adolescents, the desired general deterrence may simply not be achieved. Laws mandating that adolescent offenders be transferred to the adult criminal justice system for certain crimes, with adult criminal sanctions looming, have been shown to have no measurable deterrent effect on adolescent crime.[64] This

[64] *See, e.g.*, Singer & McDowall, *Criminalizing Delinquency: The Deterrent Effects of the New York Juvenile Offender Law*, 22 Law & Soc'y Rev 526–32 (1988) (comparing juvenile arrest statistics before and after enactment of New York's transfer legislation and finding little measurable impact on serious juvenile crime); Jensen & Metsger, *A Test of the Deterrent Effect of Legislative Waiver on Violent Juvenile Crime*, 40 Crime & Delinq 100–02 (1994) (same for Idaho).

is consistent with the neuroscience literature, *see* Section II.A, *supra*, because the relative immaturity of the prefrontal circuitry for late adolescents drastically limits their capacity to weigh the downstream legal consequences of criminal conduct.

Accordingly, LWOP has not been found to have a meaningful impact on crime rates for this youthful population. To the contrary, research shows longer periods of incarceration in correctional institutions do *not* reduce recidivism in adolescent offenders.[65] Likewise, data show that the rate of imposing LWOP on adolescents in different states during the late 1980s and early 1990s bore no correlation to the rise and fall in adolescent homicide rates. States with large numbers of adolescents incarcerated for LWOP did not see their homicide offense rates decline faster, or to lower levels than states without significant numbers of adolescents sentenced to mandatory LWOP.[66] In short, given that late adolescent brains are still developing and are indistinguishable from adolescent brains, especially under emotional arousal or stress, *see* Section II.A, *supra*, their ability even to consider long-term consequences—much less to let such distant prospects govern behavior in high-stress, high-arousal scenarios—is not developed and thus deterrence is an unfounded justification for mandatory LWOP.

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[65] The Pathways to Desistance study followed 1,354 serious adolescent offenders ages 14 to 18 for seven years, making it the largest study of recidivism in adolescent offenders to date. The study found that only approximately 10% of serious offenders continued to report high levels of antisocial acts. *See* Monahan et al., *Trajectories of antisocial behavior and psychosocial maturity from adolescence to young adulthood*, 45 Dev Psychol 1654–68 (2009); *see also* Mulvey, *Highlights from Pathways to Desistance: A Longitudinal Study of Serious Adolescent Offenders*, Office of Juvenile Justice and Delinquency Prevention (2011) ("The most important conclusion of the study is that even adolescents who have committed serious offenses are not necessarily on track for adult criminal careers.").

[66] *See* Jensen & Metsger, *supra* note 64, at 96.

## IV. The Same Considerations Barring LWOP for Juveniles Apply Powerfully to Late Adolescents.

Scientific research over the past several decades demonstrates unequivocally that significant changes in brain development and behavior continue throughout late adolescence. *See* Section II, *supra*. Those changes merit legal protections to avoid the imposition of unduly punitive, life-determinant sentences on individuals through late adolescence.

Age-related protections from LWOP, such as those recognized in *Roper* and *Miller*, rely largely on behavioral evidence of differences between adolescents and adults. Specifically, adolescents:

(1) lack maturity and have an underdeveloped sense of responsibility, leading to impulsivity and heedless risk-taking;

(2) are more vulnerable to negative influences and peer pressure; and

(3) have character and traits that are not well formed or fixed, making their "actions less likely to be evidence of irretrievable depravity."

*Miller*, 567 US at 471 (quoting *Roper*, 543 US at 569).

These differences persist through late adolescence as the brain continues to undergo significant change. *See* Section II.A, *supra*. Particularly, the "character" of such offenders and their "traits are less fixed" and their "actions [are] less likely to be evidence of irretrievable depravity," *Miller*, 567 US at 471, as evidenced by a significant decrease in criminal activity after this period, *see* Section II.D, *supra*.

That decrease tracks tangible changes in brain development that occur throughout late adolescence, as shown through brain imaging.[67]

Given these ongoing developments, LWOP sentences based on behavior at a single developmental time point in late adolescence—when the brain is still immature and developing—are unjustified. Developmental science played a decisive role in prior decisions holding that adolescents should be treated differently from adults in the criminal justice system. Now the science unambiguously shows that late adolescents are akin to 17-year-olds in relevant aspects of brain development and immaturity, and should be afforded the same protections.

## CONCLUSION

For the reasons stated above, *amici* respectfully submit that the Court hold that imposing mandatory LWOP sentences on persons like Mr. Parks who committed their offenses during late adolescence, is cruel or unusual, and therefore prohibited by the Michigan Constitution.

Respectfully submitted,

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[67] Dosenbach, *supra* note 19; Satterthwaite et al., *Functional maturation of the executive system during adolescence*, 33 J Neurosci 16249–61 (2013).

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Dated: February 9, 2022

## APPENDIX — LIST OF *AMICI CURIAE*[68]

**Dr. Jeffrey Aaron** is a clinical and forensic psychologist who practices independently and teaches in the University of Virginia Medical School. Much of his work focuses on forensic evaluation of adolescents and the influence of adolescents' developmental status on their behavior, capacities, risk, and intervention needs.

**Dr. Apryl Alexander** is an Associate Professor in forensic psychology in the Graduate School of Professional Psychology at the University of Denver. She is the Director of the Denver Forensic Institute for Research, Service, and Training (Denver FIRST)'s Juvenile Justice Project. She also serves as a Board Member for the Colorado Juvenile Defender Center.

**Dr. Jeffrey Arnett** has been researching and conceptualizing the age period from 18 to 25, that he termed emerging adulthood, for the past 30 years. He is the originator of the theory of emerging adulthood (human development from age 18-29) and has written many articles and books on this topic. In addition to emerging adulthood, his other scholarly interests include media uses in adolescence, the psychology of globalization, and responses to cigarette advertising.

**Dr. Arielle Baskin-Sommers** is an Associate Professor of Psychology and Psychiatry at Yale University. Her work focuses on identifying and specifying the cognitive, emotional, and environmental mechanisms that contribute to antisocial behavior (*e.g.*, substance use, criminal activity, aggression). She uses findings from her research to develop novel experimental tasks, assessments, and intervention strategies aimed at developing more humane (and scientific) approaches for addressing mental health and crime.

**Dr. Sara Boyd**, Ph.D., ABPP, is a licensed clinical psychologist, board-certified forensic psychologist, and associate faculty at the Forensic Clinic of the Institute of Law, Psychiatry, & Public Policy (ILPPP) at the University of Virginia. Her primary specialties include Intellectual and Developmental Disabilities and psychological trauma (particularly interpersonal violence) in children and adults. She also develops and conducts trainings for forensic evaluators, mental health care providers and legal professionals, provided under the auspices of ILPPP.

**Dr. B.J. Casey** is an expert in adolescent brain development and behavior. She has published over 220 articles in this area in top tier journals

[68] Unless otherwise indicated, *amici* are signing this brief on their own individual behalf and not on behalf of their affiliated organizations.

(*Nature Medicine*, *Nature Neuroscience*, *Neuron*, *PNAS*, and *Science*) cited over 65,000 times, and her work has also been cited in amicus briefs presented to the U.S. Supreme Court on the sentencing of young people. She has served on several scientific advisory boards and panels including the National Institutes of Mental Health Board of Scientific Counselors and Advisory Council, and the National Research Council of the National Academy of Sciences committees on Assessing Juvenile Justice Reform and The Science of Adolescent Risk Taking and has presented to congressional staff on Capitol Hill, state supreme courts, and federal judges on the adolescent brain.

**Dr. Hayley Cleary**, MPP, Ph.D., is an Associate Professor of Criminal Justice and Public Policy at Virginia Commonwealth University in Richmond, Virginia. She holds undergraduate degrees from the University of Virginia and a Master of Public Policy and Ph.D. in Developmental Psychology from Georgetown University. Her research interests lie at the intersection of social science, law, and policy. Her work examines adolescent behavior and decision-making in justice system contexts, including youths' contact with law enforcement, courts, and corrections.

**Dr. Alexandra Cohen** is a postdoctoral fellow at New York University. She received a B.S. in Neuroscience from Duke University and a Ph.D. in Neuroscience from Weill Cornell Graduate School of Medical Sciences. Her research focuses on understanding the neural and cognitive mechanisms underlying how emotion and motivation influence learning, memory, and the underlying neural circuitry from childhood to adulthood.

**Dr. Adriana Galván** is a Professor of Psychology and the Dean of Undergraduate Education at the University of California, Los Angeles. Her scholarly work focuses on understanding the adolescent brain and behavior, with a focus on motivation, learning, and risk-taking and with an eye towards informing youth-relevant policy. She has received multiple awards for her work, including from the National Academy of Sciences, a Fulbright Award, and the Presidential Early Career Award for Scientists and Engineers.

**Dr. Catherine Hartley** is an Associate Professor of Psychology and Neural Science and is Co-Director of the Institute for the Study of Decision Making at New York University. Her scholarly work focuses on understanding developmental changes in learning and decision-making from childhood to adulthood at both the cognitive and neural levels, with a focus on understanding mechanisms of vulnerability or resilience to psychopathology. She has received multiple awards for her work, including a National Science Foundation CAREER Award, the National Institute of Mental Health Biobehavioral Research Award for Innovative New Scientists, the Association for Psychological Science Janet Taylor Spence Award for Transformative Early

Career Contributions, and the Cognitive Neuroscience Society Young Investigator Award.

**Dr. Luke Hyde** is an Associate Professor of Psychology with appointments at the Institute for Social Research and the Poverty Solutions Center at the University of Michigan and a licensed clinical psychologist in the State of Michigan. He is an expert in neuroscience and the development of aggression, violence, and criminal behavior. His research focuses on the development of high-risk behavior, the interplay of nature and nurture, and factors that promote resilience and desistance from delinquent behavior.

**Dr. Catherine Insel** is a postdoctoral research fellow at the Zuckerman Mind Brain and Behavior Institute at Columbia University. Her research is focused on how adolescent brain development shapes motivation, learning, self-control, and decision-making. Dr. Insel has over a decade of experience conducting brain imaging studies in youth.

**Dr. Daniel Keating** is a Professor of Psychology, Psychiatry, and Pediatrics at the University of Michigan. His research and publications (over 200) have focused heavily on adolescent development and neurodevelopment, with a recent specific focus on the role of brain development on risk behavior, funded by the National Institutes of Health. His recent book on the impact of early life adversity on later development (*Born Anxious* in 2017) received the annual award in developmental psychology from the American Psychological Association.

**Dr. Sharon Kelley** focuses her clinical and research interests on forensic evaluation and legal competencies. She has published and presented on a range of topics in these areas, including juveniles' and adults' *Miranda* comprehension, false confessions, adjudicative competence, evolving Eighth Amendment jurisprudence with respect to juveniles, and the role of the university-based forensic clinic in meeting the growing assessment and treatment needs of forensic populations.

**Dr. Robert Kinscherff** is a clinical/forensic psychologist and attorney serving as Executive Director of the Center for Law, Brain & Behavior at Massachusetts General Hospital. Over a career of more than three decades, he has filled key forensic positions for the Massachusetts Trial Court, Massachusetts Department of Mental Health, Massachusetts Parole Board, and clinical and forensic mental health systems. He teaches and consults nationally and internationally in practice areas including juvenile and criminal justice, violent and sexual offenders, and professional practice and public policy at the intersections of neuroscience, developmental psychology, adversity and trauma, and addictions.

**Tracey Meares** is the Walton Hale Hamilton Professor and a Founding Director of the Justice Collaboratory at Yale Law School that brings together an interdisciplinary group of scholars and researchers at Yale and beyond to cooperatively work toward a theory-driven, evidence-informed justice system. She has worked extensively with the federal government by serving on the National Academy of Sciences Committee on Law and Justice, a National Research Council standing committee, and the U.S. Department of Justice's Office of Justice Programs Science Advisory Board.

**Dr. Joseph Ryan** is Professor and Associate Dean in the School of Social Work at the University of Michigan. He is also the Director of the Child and Adolescent Data Lab, an applied research center focused on using data to drive policy and practice decisions in the field. His research and teaching build upon his direct practice experiences with child welfare and juvenile justice populations.

**Dr. Elizabeth Shulman** is a developmental psychologist with expertise in adolescent psychosocial development. She earned her Ph.D. at the University of California, Irvine. Her research focuses on developmental factors that affect risky decision making in adolescence and early adulthood.

**Dr. Jennifer Silvers** is the Bernice Wenzel and Wendell Jeffrey Term Chair in Developmental Neuroscience at the University of California, Los Angeles. She has published over 40 articles on the brain and behavioral bases of emotion, decision-making, and adolescent development. Dr. Silvers has received funding from the National Science Foundation and National Institutes of Health, as well as awards from the American Psychological Association, Association for Psychological Science, and the International Society for Developmental Psychobiology.

**Dr. Leah Somerville** is a Professor of Psychology at Harvard University, a Harvard College Professor (Endowed 2021-2026), and faculty in the Center for Brain Science. Her research focuses on characterizing adolescent brain development, and the consequences of brain development on psychological functioning and well-being.

**Dr. Elizabeth Sowell** has been a leader in the field of developmental cognitive neuroimaging for over 20 years and has published over 150 peer review manuscripts in leading journals, including *Nature Neuroscience*, *Nature Medicine*, and the *Lancet*, among others. Her research focuses on adolescent brain and cognitive development as well as the impact of pre- and post-natal exposures to drugs of abuse, environmental toxins (*i.e.*, lead exposure), and neighborhood and family level socioeconomic adversity. Dr. Sowell has been continuously funded by the National Institutes of Health for over 20 years, and

she is currently a principal investigator in the Adolescent Brain Cognitive Development study at Children's Hospital Los Angeles.

**Dr. Laurence Steinberg** is the Distinguished University Professor of Psychology at Temple University. He has written extensively about the implications of the science of adolescent development for legal and social policies affecting young people. He directed the MacArthur Foundation Research Network on Adolescent Development and Juvenile Justice.

**Dr. Tom Tyler** is the Macklin Fleming Professor of Law and Professor of Psychology at Yale Law School, as well as a Founding Director of The Justice Collaboratory. He is also a professor (by courtesy) at the Yale School of Management. His books include *Why People Obey the Law*, *Cooperation in Groups*, *Why People Cooperate*, *Trust in the Law*, *The Social Psychology of Procedural Justice*, *Social Justice in a Diverse Society*, and *Why Children Follow Rules*.