The Impact of Neglect, Trauma and Maltreatment on Neurodevelopment: Implications for Juvenile Justice Practice, Programs and Policy

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Summary

Over the last twenty years advances in neuroscience have provided invaluable insights that have implications for understanding human development and behavior. Among these insights is the profound impact that childhood trauma and maltreatment have on the brain; this, in turn, plays a major role in creating complex and multi-dimensional problems that impact every sector of our society including the juvenile justice system.

This chapter will present some key concepts related to brain development, brain functioning and traumatology that provide invaluable perspective when crafting juvenile justice practice, programs and policy. Some of the key implications of this neurodevelopmental perspective are summarized in Table 1.

Table 1. Key Implications of a Neurodevelopmental Perspective for the Juvenile Justice System

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<td>2. Punitive practices do not build new skills or promote healthy development; they do not lead to effective remediation or rehabilitation. Punitive practices often create new problems including aggression and make existing issues worse. Simply stated punitive practices do not result in the intended decrease in recidivism, offending or rehabilitation.</td>
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<td>3. Respectful, relationally enriched, humane and “trauma-informed” interventions will have highest probability of success.</td>
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<td>4. Promoting relational health by increasing the quality, number and density of supportive, nurturing and trauma-informed people is the most effective and enduring form of “intervention.” Connection to family, community and culture facilitate healthy development including healing from traumatic experiences, minimizing substance abuse and developing of new skills.</td>
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<td>5. Total systemic exposure to – and adoption of – neurodevelopmentally aware and trauma-informed practices will be essential for juvenile justice models to optimize outcomes for individuals and for society.</td>
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Introduction and Context

Over the last 40 years advances in neuroscience have provided useful insights for a range of disciplines focused on human development, learning, and behavior. This includes the myriad disciplines involved in family courts, juvenile justice and the adult criminal justice systems. While these advances are exciting and prodigious, the neurosciences are just beginning to unravel the astounding complexity of the human brain (e.g., Johnson, Blum & Giedd, 2009). For a tiny taste of it’s structural complexity, consider that there are approximately 86 billion neurons and up to 400 trillion synapses in the human
brain (Azevedo et al., 2009; Herculano-Houzel, 2009); add to this the dynamic complexity of always active, always changing neural networks; there are roughly 2.5 quadrillion neuronal depolarizations per minute (e.g., Whalley, 2013). In a recent interview regarding progress in neuroscience, Dr. Jeff Lichtman stated, “if understanding everything there is to know about the brain is one mile... we have come about 3 inches.” (National Geographic: A Voyage Into the Brain; Feb 2014).

Despite the ‘infancy’ of our knowledge base about the functioning of the brain, there are multiple useful concepts and principles that can help us better understand the origins of anti-social, impulsive, and illegal behaviors. These same concepts can help us better craft practices, programs, policy and law to 1) minimize the development of maladaptive, anti-social behaviors and 2) remediate, educate and heal those who exhibit these behaviors.

We believe that a neurodevelopmental perspective can add to an understanding of anti-social, criminal and offending behaviors. The purpose of this chapter is to provide an overview of some key principles of neurobiology that can contribute to creating more developmentally aware and ‘trauma’-informed practices within the juvenile justice system.

Key Principles of Neurobiology

1. Brain Development: Timing and Process

The brain develops most rapidly in the first five years after conception but it continues to have important maturational changes through young adult life (primarily increased myelination in pre-existing neural networks: see Geidd et al., 1999). In general, neurodevelopmental organization proceeds from lower, central to higher, outer structures (i.e., brainstem to cortex) and is greatly influenced by experience. A key principle of development and neuroplasticity is “use-dependence” – neural networks change with activation or lack of activation (for more detail discussion see Perry, 2002). While core processes in neurodevelopment are genetically mapped, the final phenotypic expressions of brain-mediated capabilities, therefore, are very experience dependent. When developing neural networks receive patterns of stimulation during sensitive and critical periods in development, they will organize, modify and become optimally functional. The actual neural architecture of the brain – and the resulting functional capabilities – mirrors the nature, timing and pattern of experience. When a child grows up in a family and community enriched in healthy relational interactions that provide, (among basic physical needs), cognitive, motor and social stimulation, he will have a higher probability of expressing his potential to become creative, productive and humane. When a child experiences chaos, neglect, threat, violence and other developmental adversities, his potential is blunted. This disrupted development is often expressed as undeveloped, fragmented or maladaptive functioning in emotional, cognitive and behavioral domains (see below).

The long-term consequences of development maltreatment and adversity are complex and heterogeneous (see Perry, 2002; 2009). In-depth study of the differential effects of the nature, timing, quantity of adversity as well as the impact potential attenuating or resilience-related factors on development has really just begun (see Perry, 2006; 2009). While there is so much more to know, what we do know is that trauma, neglect and maltreatment during childhood has profound effects on physical, social, emotional, behavioral and cognitive development (e.g., Anda et al., 2006). Some of the mechanisms related to these developmental adversities are related to the neural networks involved in mediating the stress responses.
Figure 1. Efferent distribution of key regulatory networks. The brain is organized in a hierarchy that develops in a sequential manner. Four developmentally distinct regions (brainstem, diencephalon, limbic, and cortical) are woven together by multiple neural networks. The monoamine (i.e., NE: norepinephrine and DA: dopamine) and other related (e.g., SER: serotonin, ACH: acetylcholine) systems originate in lower brain areas and have widespread impact on widely distributed “upstream” systems in the brain and the “downstream” systems of the body. These regulatory networks play a role in integrating, processing and acting on incoming patterns of neural activity from the primary sensory networks (such as touch, vision and sound that monitor the external environment), somatic networks (such as motor-vestibular, cardiovascular, respiratory that monitor the internal environment) and cerebral networks (such as cortical modulating networks that monitor the brain's internal environment). This ongoing, dynamic input from the brain, body and world is integrated, processed, and acted on to help regulate the individual.

2. Impact of Trauma and Neglect on the Stress Response Systems

Some of the primary neural systems impacted by developmental trauma are those involved in the stress response (see Perry et al., 1983; Perry and Pollard, 1998). The brain and body have a set of widely distributed systems that mediate the stress response; this involves the neuroendocrine, neuroimmune, central and autonomic nervous systems (see Figure 1). Several important monoamine (adrenergic, noradrenergic and dopaminergic), cholinergic and serotonergic neural networks originate in lower areas of the brain (brainstem and diencephalon) and send projections “upstream” to essentially all...
other regions of the brain, and “downstream” to the neuroendocrine and autonomic nervous systems which communicate with and influence the regulation of the rest of the body (e.g., Huang, Ghosh and van den Pol, 2006; Shiff et al., 2012; Sara and Bouret, 2012; Dautan et al., 2014).

This complex and diverse distribution gives these centrally located networks a unique role in the stress responses; rapid activations and deactivations of various neural and physiological functions can be coordinated and regulated by these networks. Further, all incoming sensory input from the body and from the outside world directly communicates with these neural networks that are key components of the “reticular activation system” (RAS: see Steriade, 1996). The RAS is essential for regulation of multiple arousal related functions including sleep, attention, vigilance, reward anticipation, reward and interpretation of threat (Kinomura et al., 1996). Through these and related mechanisms, the development and regulation of the monoamine, serotonergic and cholinergic networks of the lower brain are essential to hundreds of important brain-mediated functions. When these systems develop normally, there can be smooth integrated regulation of cognition, emotional regulation, social interactions, motor movements and dozens of other functions essential to healthy human development and functioning. When the development or regulation of these systems is altered, a cascade of functional deficits can result (see below).

As mentioned above, neural networks are “plastic” – they are malleable; neural number, physical structure of the neuron including dendritic and synaptic density and structure all change with various patterns of activation. One determinant of “how” the neural networks change is the pattern of activation (see Figure 2); the variable impact of different patterns of activation on the monoamine and serotonergic networks that are crucial to the stress response has been a focus of research in animal models since the 1980s (e.g., Kalivas and Stewart, 1991; Kleven et al, 1990; Farfel et al., 1992) and in humans over the last twenty years (e.g., Perry and Pollard, 1998; Steketee and Kalivas, 2011). One clinically relevant feature of the stress response systems is their malleability; basically how “reactive” and responsive they are to stimulus (stressor) can be modified by activation (see Steketee and Kalivas, 2011). By activating the stress response systems in moderate, controllable and predictable “doses” the sensitivity of these systems decreased; the individual is more capable of “tolerating” a dose of stressor. This capability is related to the ability to demonstrate resilience in the face of significant or extreme stress (Ungar and Perry, 2012). In turn, the activation of these systems in variable, unpredictable or extreme patterns will lead to a host of molecular and physiological changes that make these systems “sensitized”; the baseline level of activity is increased and for any given stimulus (stressor) there will be a more extreme (and disproportional) response. This has profound clinical implications (see Figure 3 and Table 2 below).
Figure 2. Variable effects of stress response activation. Two very different effects on the sensitivity of the stress response systems can be created with different patterns of activation. The tolerance-inducing pattern that leads to resilience involves smaller, predictable doses of challenge or stress and the “sensitizing” pattern associated with vulnerabilities involves unpredictability and more severe or prolonged activation.

The individual's response to any significant stressor will vary depending upon many factors including pre-existing stress response sensitivity, the presence of relational “buffers” and the nature of the stressor (for review see Perry, 2008). Whether the threat is immobilizing, painful, prolonged, avoidable, interpersonal, a natural disaster, unexpected or anticipated are among the many features that will determine the specific “recruitment” of the body’s heterogeneous stress response capabilities. There are two major and interactive adaptive response patterns to significant threat: the arousal response and dissociation. The arousal response activates the individual and prepares them to flee or fight (see Perry et al., 1995; Perry, 2008). Dissociation is less well characterized and is engaged when there is a perception that fighting is futile or fleeing impossible; the dissociative response is more internalizing and is hypothesized to help the individual prepare to survive injury. Peripheral blood flow decreases, heart rate goes down, and the release of endogenous opioids and dissociation at the cognitive and emotional level occurs. In many cases both of these adaptive responses will be activated during the same complex traumatic experience.
Both response patterns can become ‘sensitized’ such that future stressors or challenges will activate the most common adaptive pattern used in a similar situation in the individual’s past and, in combination with ‘state-dependent’ shifts in cognition and behavior can lead to impulsive, aggressive and maladaptive, anti-social behaviors (e.g., an young boy growing up in a domestic violence situation who used a “fight or flight” response during those traumatic experiences may respond to authoritarian males – even when they are not being threatening – with hostility and aggression).

Figure 3. Differential Stress-Reactivity: This figure illustrates three stress-reactivity curves; the middle straight line indicates a neurotypical relationship between the level of external challenge, stress or threat and the appropriate proportional shift in internal state required to adapt, adjust, and cope with the level of stress; with minor stressors, there are minor shifts in the internal state and with major stressors a larger shift in internal state is required. The upper (Sensitized) curve illustrates the distorted, sensitized stress-reactivity curve that results from patterns of extreme, unpredictable or prolonged stress activation such as is seen in many youth and adults in the juvenile and criminal justice systems. In this case, there is a significant over-activity at baseline and an over-reaction even in the face of relatively minor challenges. All learning – social, emotional, behavioral, or cognitive – requires exposure to novelty; in turn, novelty will activate the stress response systems. In an individual with neurotypical reactivity this will create a moderate, but manageable, dose of “stress.” Repetition with novelty (such as in an academic setting – or certain therapeutic situations) will ultimately lead to a tolerance pattern (see Figure 2 and text) and the capacity to demonstrate resilience (lower curve). In contrast, a sensitized individual will find the introduction to simple
challenges such as transitions, new academic concepts, complex or unpredictable social situations overwhelming – even fear-inducing, thereby inhibiting opportunities for normal social, emotional and cognitive development. We hypothesize that this is one of the primary mechanisms underlying many of the emotional, behavioral and developmental problems seen in the juvenile justice population.

3. State-dependent Functioning of Neural Systems

When challenged with a variety of stressors (including perceived threat), the body responds in an adaptive fashion, making changes in the state of arousal (mental state), mode of thinking (cognition), and physiological activation (e.g., increase heart rate, muscle tone, rate of respiration). In response to a challenge, or overt threat, the mental and physical state will move along an arousal continuum—from calm to arousal, then to alarm, fear and terror (see Table 2). As this takes place, different networks in the brain will shut down and others will be recruited (Hermans et al., 2011). While clearly over-simplifying the process, the more threatened the individual feels, the more their functioning shifts from higher, more complex and mature cortical networks to lower and more reactive networks (see Perry et al., 1995; Perry and Pollard, 1998; Hermans et al., 2011). The more threatened, the more ‘primitive’ (or regressed) thinking and behaving becomes. An individual in a state of alarm will be less capable of concentrating, more anxious and more attentive to “non-verbal” cues, such as tone of voice, body posture, and facial expressions. This has important implications for understanding the way the youth in a juvenile justice system will process, learn and react in a given situation. The sensitized youth will be more likely to demonstrate regressed, impulsive and reactive behaviors. If the youth was maltreated in context of his primary caregiving relationships (see below), a neutral or minimally negative relational interaction can be enough to move him along this arousal continuum and result in maladaptive social interactions and very impulsive (often aggressive) responses. A simple re-direction, reminder of rules or expressions of frustration can precipitate a major behavioral outburst. This state-dependent functioning of a ‘sensitized’ stress response that has been “associated” with previous inter-personal harm is one of the main reasons that contingency-based points/level programs not only do not “build” skills they tend to escalate youth and make it more likely that they will behave in regressive and aggressive ways (see below; Mohr et al., 2009).

One key to understanding traumatized youth is to remember that they will often, at baseline, be in a state of low-level fear - responding by using either a hyperarousal or a dissociative adaptation - and that their emotional, behavioral and cognitive functioning will reflect this regressed state.
Table 2. State-dependent Functioning: Different individuals may have different styles of adaptation to threat depending upon a wide range of factors, including age, nature of threat, history of previous exposure to trauma and gender (see Perry et al., 1995; Perry, 2008). Some use a primary hyperarousal response, others a primary dissociative response. Most use some combination of these two adaptive styles in any typical ‘traumatic’ experience. When an individual grows up in an unpredictable, chaotic or threatening environment, his stress response systems become sensitized (see Figure 3). Table adapted, with permission, from: Perry, B.D. (2008) Child maltreatment: the role of abuse and neglect in developmental psychopathology in Textbook of Child and Adolescent Psychopathology in (Theodore P. Beauchaine and Stephen P. Hinshaw, Eds) pp. 93-128 Wiley, New York

4. Neurosociology: Importance of Relational Neurobiology

We are a social species. The glue of a civil society is the capacity to form and maintain healthy relationships with some empathic perspective for others (see Szalavitz and Perry, 2010). Without this fundamental capacity, human interactions are characterized by selfish, manipulative and exploiting behaviors. Others are viewed as less valuable or worthy; the result can be anti-social or even abusive, aggressive behaviors to satisfy self-interests. The creation of a core neurobiological capacity for healthy, empathic relationships requires healthy caregiving and parenting. Furthermore, the development of resilient stress and relational neural networks depends upon attentive, attuned and responsive caregiving. With these early relational experiences an infant can develop the neurobiological capacity to form and maintain healthy relationships, to share, to become empathic, to love and become a productive member of a community (see Szalavitz and Perry, 2010). The patterned, repetitive bonding interactions of the attentive, attuned and responsive caregivers creates an internal catalogue of “associations” with human relational cues (e.g., tone of voice, eye contact, touch) and helps organize key areas of the brain involved in stress reactivity, reward and relational functioning, including the amygdala. (see Szalavitz and Perry, 2010; Tronick and Perry, 2014). The size of the amygdala in adult life, for
example (a brain area very involved in interpreting and acting on threat related cues), correlates positively with the size and complexity of social networks (Bickart, et al, 2011). For individuals with relational histories of inconsistent or abusive care (all too common in youth and adults in the justice system), relational associations will be negative; interacting with others will be likely to be threat-inducing and dysregulating. Intimacy becomes associated with threat and loss, not comfort and safety. This has profound clinical implications; among them is an alteration of the sense of personal space.

Each of us has a sense of physical boundaries; when another person is approximately 3 meters away this is considered a social space; when someone gets within 1.2 meters (approximately) this is our personal space and within 0.5 meter this is intimate space (see Hall, 1966, for more on the study of personal space or proxemics). The closer someone becomes to us, the more vigilant we become, the more the amygdala will activate. We may feel significantly threatened by the proximity if we have not “invited” the person to be so physically close (see Kennedy et al., 2009). An inter-related concept, the Intimacy Barrier, focuses on both personal and emotional space boundaries (see Perry, Hambrick and Perry, 2015). The emotional component of this barrier can include any topics (e.g., sexuality) or personal issues (e.g., your weight, cultural or religious beliefs) that you hold as personal and intimate. When the Intimacy Barrier is crossed without permission (e.g., someone makes a negative comment about race or religion or for a child in the child welfare system someone asks about your family), the individual feels threatened. The stress response systems (including the amygdala; see Kennedy et al., 2009) activate, and the individual will engage in protective behaviors. The nature of these protective behaviors will vary depending upon 1) the sensitivity of the individual’s stress response system (see Figure 3) and 2) the adaptive preferences the individual may have developed based upon earlier developmental trauma (see Table 2; Perry, et al., 1995; Perry and Pollard, 1998). If the individual utilizes a ‘freeze/flight/fight’ response, when someone crosses this barrier, verbalizations (e.g., raised voice, profanity, threats) or behaviors (e.g., pushing, hitting) may be used to attempt to ‘push’ the offending person back across the Intimacy Barrier. If the predominant style of adaptation is dissociation, the person will avoid social interactions. If this is not possible, he may passively disengage. It can be very confusing for peers, carers, and educators when their intended nurturing behaviors and words are met with either overt hostile and aggressive behavior or indifferent and dismissive attitudes.

It is important to note that not all people share the same sensitivity or threshold for what is an Intimacy Barrier “violation.” Consider what happens if an individual has both early attachment problems and a sensitized stress response system – such as many youth in the juvenile justice system (see Levy and Orleans, 2000; Amatya and Barzman, 2012; Kenny et al., 2014; ). In the same way a combat veteran may be emotionally and behaviorally reactive when re-exposed to “cues” or “triggers” associated with combat (e.g., gunfire, the sound and feel of a helicopter), the individual with attachment problems and relationally-mediated abuse will find relational cues (e.g., eye contact, tone of voice, touch and physical proximity) threatening. A person with a high degree of ‘relational’ sensitivity will often misinterpret neutral or positive social interactions from peers as threatening and respond by either avoiding or disengaging (which leads to problems with social learning and peer interactions) or, worse, by using aggressive, hostile or hurtful words or behaviors to push peers, teachers and parents away. In extreme cases, as the child grows up, this relational sensitivity can result in significant anti-social or even assaultive behaviors. It is no surprise, therefore, that individuals in prison (90% of whom have histories of interpersonal trauma in childhood) have a much larger sense of personal space than the average person (Wormith, 1984), and will often respond to personal space violations with aggressive and violent behaviors.
5. Impaired Cortical Development and Executive Functioning

The majority of research in this area suggests that the neuropsychological factors involved in offending behavior include compromised executive functioning (“weaker” cortically-mediated functions) in combination with an increase in impulsivity and other dysregulated diencephalon/brainstem mediated functions (see Perry, 2009; Piquero et al., 2010). These neuropsychological characteristics are all well documented sequelae of childhood trauma and maltreatment and the expected result of impaired cortical development in the face of 1) higher probabilities of chaotic and cognitively “impoverished” environments and 2) impaired cognitive stimulation seen with chronic dysregulation and sensitization of the stress-response systems (see Table 2; Perry et al., 1995; Perry and Pollard, 1998; Perry, 2009; Perry and Dobson, 2013).

Executive functioning is a rough indicator of the “strength” of cognitive regulatory capacity relative to the “dysregulation” (i.e., disorganization, under-development, impairment) of lower networks in the brain; in essence it is an estimate of how hard it is for an individual to use cortical (top-down, flexible, future-oriented, rational) mechanisms to self regulate. This capability is related to “self control” indicators (Moffit et al., 2011; Piquero et al., 2010) known to be predictive of positive outcomes in high-risk children. In order for an individual to function in any cognitive-predominant activity (i.e., following directions, attend in a classroom) he needs the capacity for cortical (“top-down”) regulation. The older a child gets, the more we expect her to be capable of listening, following directions, sitting for sustained periods of time and “learning.” These are all challenging tasks for many severely maltreated children both youth and adults in the justice systems (Hanson and Morton-Bourgon, 2005; McGarvey, 2012). These youth often “think” and “behave” in a much less mature manner than their chronological age – the result can be a toxic negative feedback cycle of adults (teacher, staff member, parole officer, judge) getting frustrated, angry, confused and demoralized while the youth feels stupid, inadequate, misunderstood, rejected and unloved. All of this just creates more threat, loss, rage, and chaos -reinforcing and adding to their history of developmental adversity and distrust of the adults in the “system.”

Optimal self-regulation and executive functioning cannot be reached until well past adolescence. Simply stated, the brain of a youth will be more likely to lead to poor judgment and impulsive, high-risk behaviors – and this is under typical developmental conditions. Maltreatment and trauma will predictably delay or interrupt this process and result in emotional, social, cognitive and behavioral functioning that is well below the chronological age of the youth. The result may be a 15-year-old with the self-control of a two-year old and the reasoning capacity of a six-year old. Unfortunately while most youth in the juvenile justice system have these splinter developmental capacities we create expectations, programs, practice and policy based upon their chronological age; and the outcomes from these efforts predictably fail (see below).

Implications for the Juvenile Justice System

The principles of neurobiology outlined above are neither comprehensive nor fully elaborated, yet they provide important insights for forensic mental health and the juvenile justice system. Some of the primary policy, program and practice implications are outlined below. At the core of these implications is the knowledge that the vast majority of individuals in the juvenile and adult criminal justice system have experience significant developmental adversity, and often, overt trauma as children
Children, youth and adults are at greater risk for health, behavioral, emotional and social problems following adverse childhood experiences (ACEs: see Felliti et al., 1998; Anda et al., 2006). Children, youth and adults in the criminal justice systems are all too often growing up in these fragmented childhoods with very high rates of exposure to violence, sexual and physical victimization and other adversities (Abram et al., 2004; Kerig, 2012a; 2012b). A recent study examined the prevalence of ACEs in juvenile offenders in Florida (Baglivio et al., 2014).

Table 3. Categories of “Adverse Childhood Experience (ACE)”

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<td>1. Emotional Abuse</td>
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<td>2. Physical Abuse</td>
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<td>3. Sexual Abuse</td>
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<td>4. Emotional Neglect</td>
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<td>5. Physical Neglect</td>
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<tr>
<td>6. Family Violence</td>
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<tr>
<td>7. Household Substance Abuse</td>
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<tr>
<td>8. Household Mental Illness</td>
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<td>9. Parental Separation or Divorce</td>
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<td>10. Household Member Incarceration</td>
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Very high rates of adversity were documented, with fewer than 5% of this population reporting no history of an ACE; further they reported: “Of the 13,692 females with one or more ACE indicators, 92% reported at least two ACEs, 80% reported at least three, 63% reported at least four, and 46% reported five or more. Of the 48,844 males who reported at least one ACE indicator, 89% reported two or more, 71% reported three or more, 48% reported four or more, and 28% reported five or more.”

The adversities reported in this population are associated with significant long-term risk for health, mental health, academic, social and anti-social behaviors (see Felliti, et al, 1998; Anda et al., 2006). These adverse life events would result in sensitization of the stress response system and, often, disruptions of neurotypical development of relational neurobiology as discussed above. Taken together, these developmental adversities are likely major factors in the etiology of the dysregulated, impulsive, substance-using and anti-social behaviors increase the probability that these children and youth would be involved in the mental health, healthcare and juvenile justice systems. Earlier in life, the anxiety, depression, hopelessness and disconnection which are manifestation of these trauma-related changes in the brain often can lead to increased risk for school failure, social problems, behavioral and self-medicating use of alcohol and drug. This of course can cascade into the actions that lead to involvement in the juvenile justice system. Early in life these are treated as mental health and educational problems but as children age the very same trauma-related issues enter the arena of truancy,
assault, possession and use of illicit substances, defacing of public property, and so forth.

1. Prevention, Early Identification and Diversion:
   
The primary policy implications of a neurodevelopmental perspectives are to focus on prevention of the predisposing vulnerabilities associated with impulsive, reactive, aggressive and anti-social behaviors. A focus on policy and law related to employment, housing, poverty and a host of contributing factors that make early childhood and young vulnerable families at greater risk seems sensible and just.

   Early childhood provides unique opportunities for prevention and diversion due to the increased malleability of the brain during this time in life. By the time a child is 4 years old more than 80% of the primary neural architecture has been established. The primary implication of this is that experiences of early childhood – good and bad - will have a disproportionate influence on shaping the individual. Early identification of struggling families, home visitation, economic and housing supports, high quality early childhood programs and trauma-informed pre-school programs can all divert young children from trajectories that increase risk for health, academic, emotional, and social problems, including ending up in the juvenile justice system (e.g., Schweinhart and Weikart, 1993; Walker et al., 2011; Campbell et al., 2014).

2. Sentencing and Intervention:
   
   What should a society do with children and youth who commit crimes? In the United States, children and youth have always been viewed as different from adults with regard to judgment, reasoning and culpability under the law (see Steinberg and Scott, 2003; Griffin and Sallen, 2013). And clear cognitive impairment or obvious mental illnesses – both neurobiological conditions – have always been taken into consideration in sentencing. As we learn more about the brain and its development, the Courts in the US have considered this knowledge. In recent landmark cases, including Supreme Court cases, the neurodevelopmental immaturity of the adolescent cortex plays a role judgment and impulsivity has been cited in modifying sentencing guidelines (Graham v Florida, 2011; Miller v Alabama, 2013). There is an increasing awareness by the Judiciary that developmental trauma a crucial factor in considering assessment and treatment of the youth in the juvenile justice systems; it remains to be seen how and if the core learnings from this young area of clinical neuroscience will begin to inform case law and the legislation (Arredondo, 2003; National Child Traumatic Stress Network. 2008).

   Curiously, despite the well-documented under-development of the adolescent cortex and the knowledge that the most common neuropsychological deficits in the juvenile justice population include executive functioning problems, the majority of treatment approaches and programs are based upon “top-down”, cortex-dependent therapies and strategies. These include a cognitive focus on changing distortions in thinking to modifying maladaptive behaviors through role-playing and reinforcement to the use of Multi-systemic Therapy focusing on the offender, their family and larger community. Cognitive Behavioral Therapy (CBT) seems to be the most widely used in treatment of offenders, whether juvenile or adult. This effort to use cognitive methods to change thinking and behavior has been shown to have some modest level of success in lowering recidivism rates – from 1.4% to 8.2% compared to 14% in the larger population of offenders (Hanson & Bourgon, 2005). However, these treatment programs have been applied to offending populations as if they are a homogeneous group. Considering the complexities of development, the variable nature and timing of adversity and attenuating factors, the population in the juvenile justice system is far from heterogeneous.

   Fishbein and Sheppard (2006) examined the role of neuropsychological functioning in inmates’ response to various forms of treatment. They observed that neuropsychological deficits, including
impulsivity, difficulties in social-emotional regulation, and attention play an important role in the behavioral outcomes for the inmates studied. With an understanding that there exist identifiable subgroups within inmate populations, they expose a critical need to better assess youth entering the juvenile justice system; they are clearly not a homogeneous group. “The ability to identify fundamental differences between offenders who respond to standard correctional therapies and those who do not” is of prime importance if more effective treatments are to be designed. Without the ability to understand the underlying strengths and weaknesses of youthful offenders, programs and interventions will continue to be applied in a one-size-fits-all manner and recidivism rates will continue to be high.

In the last decade, trauma-informed programs and practices have been developed and applied in juvenile justice systems (e.g., Ford et al., 2007; Griffin, Germain and Wilkerson, 2012; Ford and Blaustein, 2013; Perry and Dobson, 2013). In all of these approaches there is recognition of the need to assess the trauma history and identify the strengths and vulnerabilities of the youth and target interventions to, initially, address the regulation problems. Further, all of these trauma-informed interventions are moving away from punitive and contingency-based program elements and towards more attachment aware, relational approaches. Considering the neurobiological factors outlined above these are sound strategies.

Many studies have demonstrated that youth in the juvenile justice system have high rates of attachment problem (see previous sections). And the frequency of transgenerational trauma, neglect, substance use and abuse, domestic violence and other factors that disrupt optimal early bonding experiences is very high in the juvenile justice population. This has two primary implications; the first is that the stress-response systems of individuals will be more “sensitized” and overly reactive leading to a host of problems with learning, social development and self-regulation (e.g., more impulsive reactive and less rational behaviors - see above) and that typical relationally-mediated rewards that serve to shape behavior during development will be less effective. Further than just suggesting that respectful, relationally based approaches will be effective, these neurodevelopmental principles predict that typical contingency-based and punitive interventions will be ineffective and even inappropriate with these individuals (Mohr et al., 2009). This is of utmost importance in the area of rehabilitation and remediation. Currently in the US and many other countries “points and level” systems permeate the juvenile justice programs and rely on a set of practices that will predictably escalate and further dysregulate traumatized or maltreated youth.

Common practices such as mandatory shackling in court or solitary confinement are punitive and potentially destructive; they reinforce old maladaptive patterns of coercive and abusive interactions with adults and may create new traumatic experiences further compromising potential for healthy development and functioning. Juvenile justice practice elements that are punitive or operant based: a) have no capacity to generalize any behavior changes outside of the specific context of the program or setting; b) do not create internal motivation that will provide the moral and social values to modify self-absorbed, anti-social or illegal behavior; c) do not teach new skills and d) will predictably escalate and further dysregulate a youth who has trauma-related problems, resulting in higher rates of aggression, impulsivity, non-compliance and learning problem. In other words, practices, policy and law that are not developmentally respectful and trauma-informed, while well-intended, will not help children and youth in the juvenile justice system and will frequently make their complex problems worse.
Summary

Understanding the individual’s path to the present will be the best way to create effective approaches, supports, interventions and resources to help them succeed. This means that a developmentally informed assessment with a focus on trauma and on potential resilience related factors must be part of an effective juvenile justice program. Any “one-size-fits-all” intervention or “punishment” will not be effective. Individualized, humane and developmentally matched interventions will have a higher probability of success (see Table 1). In contrast, developmentally mismatched and non-trauma informed interventions will have minimal probability of success; they may provide temporary containment, isolation, retribution but the can not provide long-term meaningful change that will ultimately enhance or protect the community.
References


Graham V. Florida, 130 Supreme Court. 2011.


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


