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Childhood Exposure to Conjugal Violence: Consequences for Behavioral and Neural Development

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CHILDHOOD EXPOSURE TO CONJUGAL VIOLENCE: CONSEQUENCES FOR BEHAVIORAL AND NEURAL DEVELOPMENT

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INTRODUCTION

The effects of exposure to violence in the home are both dramatic and measurable. Children living in homes where violence is present are not only at risk of personal injury or death, but also a wide range of short-term and long-term psychological and physical symptoms. These children suffer from a host of side effects, including trauma, physical ailments, academic difficulties, relational complications, and a heightened risk of becoming aggressors in future relationships. Even infants, who are seemingly unaware of the violence occurring in their midst, may suffer long-term effects. Research indicates that infants and toddlers up to three years old are at higher risk for permanent damage than older children due to the plasticity of their developing brains.[1] Measurable structural differences exist in the brains of children who have witnessed conjugal violence as infants or toddlers; these changes may be the source of a host of adolescent and adult psychiatric disorders.

This Article examines the physical and psychological effects of exposure to violence on the brain of the developing child. It addresses basic neurodevelopment, the chemical makeup of the brain, the role of the limbic system, and the effects of stress and maternal depression on attachment. Finally, this Article presents research on the short-term and long-term outcomes for children who view domestic violence.

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1. Swati Karandikar et al., *The Neurodevelopmental Outcome in Infants Who Have Sustained a Subdural Haemorrhage from Non-accidental Head Injury*, 13 CHILD ABUSE REV. 178, 185–86 (2004); Martin H. Teicher, *Scars That Won't Heal: The Neurobiology of Child Abuse*, SCI. AM., Mar. 2002, at 68, 68–70.

II. BRAIN STRUCTURE AND DEVELOPMENT

A. *Functionality*

The brain consists of four major areas: the interbrain, the midbrain, the hindbrain, and the cortex.[2] The interbrain (*diencephalon*) includes the thalamus and hypothalamus. The thalamus directs information throughout the brain, while the hypothalamus organizes behavior, aids in controlling the autonomic and endocrine systems, and controls responses such as fight or flight, hunger, and the drive to reproduce. The midbrain (*mesencephalon*) includes part of the brain stem; its primary functions are motor regulation, arousal, appetite, and sleep. The brain stem generally controls autonomic functions such as blood pressure, heart rate, and body temperature, and it directs information from the peripheral nervous system to the appropriate areas of the midbrain and cortex. The hindbrain (*metencephalon*) includes the pons, the cerebellum, and the medulla oblongata (*myelencephalon*). Its primary functions are motor control, balance, and the integration of visual and somatosensory information with muscular movements.

A human can survive with only these three components intact, but it is the cortex that makes one distinctly and uniquely human. For example, although humans and chimpanzees have brains that are in many ways similar, differences in the cortex make it impossible for primates to function at the same cognitive level as humans. The cortex, also called the forebrain (*telencephalon*), is responsible for problem-solving, coping, reasoning, and abstract thinking. It includes the limbic system and the integrated neural networks that allow other parts of the brain to work in harmony.[3] "These various brain areas develop, organize, and become fully functional at different stages during childhood,"[4] a point that will be important later in this discussion.

Each area of the brain is intricately wired to other areas, creating an amazing web of neural networks. These networks allow for a potentially infinite number of connections between neurons, and these permutations allow a number of systems within the brain to develop, such as the limbic system and memory. These systems are not identified by a single area or set of cells, but instead are defined by chemically traced, reused routes through which information routinely passes.

2. NEIL R. CARLSON, PHYSIOLOGY OF BEHAVIOR 96–112 (3d ed. 1986).

3. For example, integrated neural networks allow other parts of the brain, such as vision, auditory function, and interpretation of stimuli to function properly. *Cognitive Reserve*, HARV. HEALTH LETTER (Harvard Med. Sch., Boston, Mass.), Aug. 2006, at 1.

4. Bruce D. Perry, *Incubated in Terror: Neurodevelopmental Factors in the "Cycle of Violence," in* CHILDREN IN A VIOLENT SOCIETY 124, 128 (Joy D. Osofsky ed., 1997) [hereinafter Perry, *Incubated in Terror*].

Understanding the neurobiological effects of viewing violence requires an understanding of how these systems are interrelated and function in conjunction with one another. Neurological functioning is a combination of development, anatomy, chemistry, neural integration, and as this Article will demonstrate, social interaction.

B. Neurodevelopment

The brain is one of the first parts of the body to develop after conception.[5] It adds cells at a fantastic rate from the second week of prenatal development until birth. During some stages of prenatal development, as many as half a million neurons are produced every second.[6] By the second trimester, convolutions of the cortex begin to appear.[7] The convolutions (*sulci*) provide the cortex with more surface area, which in turn allows more neurons to be tightly packed into the confined space of the cranium.[8]

During prenatal development, neurons literally migrate into predetermined positions. By the time babies are born, most of the brain's neurons are already in place.[9] Therefore, babies are born with all the neurons they will ever need—approximately 100 billion of them.[10] Even so, the weight of an infant's brain is only 25% of an adult's brain, whereas the chimpanzee is born with a brain weight that is 45% of its adult counterpart.[11] It is only the human "brain that continues to 'grow at fetal rates after birth, and . . . continues for the first [two] years of life before it begins to show any signs of abating.'"[12] The growth of the brain from approximately "400 gm at birth to 1000 gm at 12 months" of age is accounted for by the development of synapses, glial cells, and myline.[13] During the first year of life, the cortex triples in thickness, and "[a]t its peak, some 15,000 synapses are produced on every cortical neuron, which corresponds to a rate of 1.8 million new synapses per second between two months of gestation and two years

5. Robin Balbernie, *Circuits and Circumstances: The Neurobiological Consequences of Early Relationship Experiences and How They Shape Later Behaviour*, 27 J. CHILD PSYCHOTHERAPY 237 (2001).

6. *Id.* at 240.

7. *Id.*

8. *Id.*

9. Danya Glaser, *Child Abuse and Neglect and the Brain—A Review*, 41 J. CHILD PSYCHOL. & PSYCHIATRY 97, 99 (2000).

10. Eugenia Hepworth Berger, *Supporting Parents with Two Essential Understandings: Attachment and Brain Development*, 26 EARLY CHILDHOOD EDUC. J. 267, 269 (1999).

11. *Id.* at 268.

12. *Id.* (quoting BRADD SHORE, CULTURE IN MIND: COGNITION, CULTURE, AND THE PROBLEM OF MEANING 3 (1996)).

13. Glaser, *supra* note 9, at 99.

after birth."[14] Although this growth spurt slows significantly after the age of two, the cortex continues to grow for the first ten years of life.

The brain of an infant or toddler is not only growing, it is also active. For the first four years of life, the cerebral cortex consumes glucose at more than twice the rate of an adult brain.[15] Even though this process continues for ten years, the first two years of life are especially critical because it is during this time that the "proliferation, and overproduction of axons, dendrites, and synapses," occurs.[16] Many of these synapses will eventually be lost, but overproduction is necessary to ensure enough neurons survive into adulthood to maintain normal functioning.

By age two, a child's brain "has as many synapses as an adult," and by age three, nearly 1000 trillion synapses will have developed.[17] Many of these connections, however, will not survive. Neural connections that are actively used are maintained, but those that are not are pruned and lost;[18] the child either uses these cells or loses them. By age ten, a child's brain will have lost half of the neural connections it had at age three and will maintain only about 500 trillion throughout life.[19]

These changes in the child's early years demonstrate the plasticity of the still developing brain. The brain is prepared for many different outcomes and is capable of learning how to use the body's existing physical structures. In other words, a newborn has the basic brain tissue necessary for developing the things that people would consider important parts of what makes humans unique, but it is not until after birth—through social interaction—that the "unique person" begins to take form based on structural changes in the brain. Therefore, environmental interaction is critical. As will be demonstrated, chronic stress and severe abuse and neglect cause the "atrophy" of these neural connections.[20]

The various regions of the brain mature "in a sequential and hierarchical fashion," and these areas "develop, organize, and become fully

14. Balbernie, *supra* note 5, at 240 (emphasis omitted) (internal quotation marks omitted) (quoting LISE ELIOT, EARLY INTELLIGENCE: HOW THE BRAIN AND MIND DEVELOP IN THE FIRST FIVE YEARS OF LIFE 27 (2001)).

15. Glaser, *supra* note 9, at 99.

16. *Id.* (emphasis omitted).

17. Balbernie, *supra* note 5, at 240.

18. *Id.*

19. *Id.*

20. *Id.*

functional at different times during childhood."[21] Some areas of the brain, especially in the cortex, are structurally present many years before they are fully functional.[22] During these first years of life, the brain is trained how to respond, when to respond, and what to respond to. This process of training the brain alters brain structure, a phenomenon known as neuroplasticity.[23]

As mentioned above, well-used pathways in the brain are strengthened and made permanent.[24] The development of these pathways, which are connections between neurons, is called connectivity, and the infant's interaction with a primary caregiver is critical in this process.[25] Through one-on-one interactions, the child learns by transforming cerebral tissue and chemical traces. By "respond[ing] sensitively to the infant[s]" and "by gauging their emotion accurately," caregivers teach infants to regulate emotions, frustrations, and attention.[26] It is the development and reinforcement of these structures that make up "[t]he prim[ary] task of brain development in the first few years of life."[27]

By late adolescence, the brain is complete in all of its structures and has fully matured. Unused pathways are pruned, while well-used pathways are strengthened and remain indefinitely. At this point, it has become "an amazingly complex organ composed of over 100 billion neurons and ten times as many glial cells, all organized into systems designed to sense, process, store, perceive, and act on information from the external . . . and the internal . . . environment."[28]

Therefore, when babies are born, they have unlimited cerebral potential. The systems that affect the most important parts of what makes us human develop last—and are dramatically affected by environment. For example, the frontal cortex is most seriously at risk when the child is neglected, abused, or exposed to aggressive behavior in the home because it is one of the last areas to mature.[29]

To summarize, "the anatomic brain structures that govern personality traits, learning processes, and coping with stress and emotions are

21. Bruce D. Perry et al., *Childhood Trauma, the Neurobiology of Adaptation, and "Use-Dependent" Development of the Brain: How "States" Become "Traits,"* 16 INFANT MENTAL HEALTH J. 271, 276 (1995) [hereinafter Perry et al., *Childhood Trauma*].

22. *Id.*

23. Balbernie, *supra* note 5, at 239.

24. *See supra* notes 18–19 and accompanying text.

25. Balbernie, *supra* note 5, at 239.

26. Glaser, *supra* note 9, at 101.

27. Balbernie, *supra* note 5, at 239.

28. Perry et al., *Childhood Trauma*, *supra* note 21, at 273 (emphasis omitted).

29. Balbernie, *supra* note 5, at 240 (citing ELIOT, *supra* note 14, at 21); Karandikar et al., *supra* note 1, at 185–86.

established, strengthened, and made permanent" in early childhood.[30] Abuse, neglect, violence, lack of stimulation, and negative environmental conditions within the family threaten neural development.[31] There is little doubt "that emotional and cognitive disruptions in the early lives of children have the potential to impair brain development."[32]

III. THE CHEMICAL BRAIN

It is important to recognize that, even though they are closely related, the structure of the brain is not synonymous with chemical production and transmission within the brain. The chemicals of the brain, referred to as neurotransmitters, allow the structures to communicate and do their respective jobs. Not only are structural changes in the brain likely when the child is exposed to conjugal violence, but research demonstrates how chemical production in the brain changes when children are exposed to stressful events:

> Any perception of danger causes the hypothalamus to trigger the sympathetic nervous system, at the same time catecholamines (neurotransmitters) are released by sympathetic nerves and the adrenal medulla (the interior). The body is being prepared for action. "These amines also activate the amygdala, which is central in orchestrating the behavioral reactions to a stressful event, but their prolonged release in the prefrontal cortex can cause cognitive defect." If stress continues, the hypothalamus secretes corticotrophin-releasing hormone so that adrenocorticotropic hormone enters the bloodstream and, when it reaches the adrenal cortex (the shell of the adrenal gland), stimulates the release of corticosteroids, the major one being cortisol.[33]

Increases in cortisol and other neurotransmitters appear to be an adaption to continued exposure to stressful events (a coping strategy of the mind), yet these same functions produce long-term emotional reactions in children that are undesirable.[34] For example, Melissa Nachmias of the University of Minnesota Institute of Child Development and her colleagues found elevated levels of cortisol in toddlers

30. Comm. on Early Childhood, Adoption & Dependent Care, Am. Acad. of Pediatrics, *Developmental Issues for Young Children in Foster Care*, 106 PEDIATRICS 1145, 1145 (2000) [hereinafter *Developmental Issues for Young Children in Foster Care*].

31. Berger, *supra* note 10, at 268–70; *Developmental Issues for Young Children in Foster Care*, *supra* note 30, at 1145.

32. *Developmental Issues for Young Children in Foster Care*, *supra* note 30, at 1145.

33. Balbernie, *supra* note 5, at 249 (quoting M. DERIC BOWNDS, THE BIOLOGY OF MIND: ORIGINS AND STRUCTURES OF MIND, BRAIN, AND CONSCIOUSNESS 258 (1999)).

34. Megan R. Gunnar, *Reactivity in the Hypothalamic-Pituitary-Adrenocortical System to Stressors in Normal Infants and Children*, 90 PEDIATRICS 491, 496 (1992).

with insecure attachment relationships.[35] Once these circuits are established and strengthened through repeated exposure to the stressful events, they become engrained patterns of processing that are very difficult to reverse.[36] This relationship between cortisol and attachment appears especially critical in infants six to eighteen months old.[37]

According to Dr. Bruce Perry and his colleagues, repeated exposure to stress also results in a hypersensitivity to stimuli: "Everyday stressors that previously may not have elicited any response now elicit an exaggerated reactivity .... [T]his means that the child will very easily be moved from being mildly anxious to feeling threatened to being terrorized."[38] These effects are present even when no threat exists:

> Cortisol can also be produced in response to a danger that has not been consciously registered, galvanizing implicit memory held in the right hemisphere. Once programmed in, the reactions that went with the initial period of abuse or neglect are immediately reactivated whenever a reminder occurs, whether or not the threat is real ....[39]

This can easily lead to threat-response symptoms—like posttraumatic stress disorder (PTSD)—even though the subject may be completely unaware of any threat.

A. Limbic System

The limbic system, including the amygdala and the hippocampus, involves a complex dance between the physical brain (the neurons and neural tissue) and the chemicals that flow between the neural tissue.[40] It directs emotion and behavior, controls the fight or flight response, and controls interpretation of events.[41] The limbic system is also critically involved in memory.[42] The fact that memories are closely tied to emotion has huge ramifications for trauma. An individual's memory of past events is inseparable from the emotion of those same events. Renowned posttraumatic stress researcher Bessel van der Kolk notes that the amygdala and the hippocampus are critical in processing "emotionally charged memories" as well as "the evaluation of the emotional meaning of incoming stimuli," which are then integrated as

35. Melissa Nachmias et al., *Behavioral Inhibition and Stress Reactivity: The Moderating Role of Attachment Security*, 67 CHILD DEV. 508, 519 (1996).

36. Balbernie, *supra* note 5, at 245–46.

37. Nachmias et al., *supra* note 35, at 519.

38. Perry et al., *Childhood Trauma*, *supra* note 21, at 278.

39. Balbernie, *supra* note 5, at 249–50.

40. *Id.* at 243 (citing ELIOT, *supra* note 14, at 293).

41. *Id.* (citing ELIOT, *supra* note 14, at 293).

42. Robert S. Astur et al., *Hippocampus Function Predicts Severity of Post-traumatic Stress Disorder*, 9 CYBERPSYCHOLOGY & BEHAV. 234, 234–35 (2006); Teicher, *supra* note 1, at 68–70.

"internal representations of the external world."[43] In essence, the brain is trained to decide not only what memories mean, but also which affective response is appropriate for those memories. As the limbic system develops, the child learns to recognize emotions and read body language, vocal tone, and eye contact.[44] These skills are critical in determining appropriate behavioral responses to social interactions. A child whose system has learned dysfunctional interpretations and responses will exhibit dysfunctional behaviors.

IV. Environmental Conditioning of Neural Response

In normal development, brain tissue and the systems within it are programmed to respond appropriately to stimuli within a given sociocultural setting. While initial responses to threats and aggression are effective and serve a purpose at the time, the child who is exposed to conjugal violence generalizes these responses, thus programming the brain to respond inappropriately to stimuli outside of the threatening context. These programming errors lead to a host of behavioral and psychological symptoms. The following discussion addresses how the environment affects the development of the brain and, subsequently, the child's behavior.

Animal studies have demonstrated that environmental variables directly affect the mass of animal brains. These studies found that rats raised in an enriched environment had up to 30% more brain mass, as well as more synaptic connections, than those in deprived environments.[45] German researcher Daniel Van den Hove and his colleagues found that prenatal stress also affects brain size.[46] They discovered that maternal prenatal stress in laboratory animals resulted in an approximately 50% decrease in cell proliferation *after delivery*.[47] These changes are likely the result of an increased release of neurohormones—such as cortisol, epinephrine, and norepinephrine—in response to the stress.[48] Not only does environment contribute to slowed cell proliferation in laboratory animals, but deprivation and neglect can also cause cell atrophy. Child psychiatrist Danya Glaser notes that, in laboratory studies with rats, a single day of maternal

43. Bessel van der Kolk, *The Body Keeps Score: Memory and the Evolving Psychobiology of Post Traumatic Stress*, 1 HARV. REV. PSYCHIATRY 253 (1994), *available at* http://www.trauma-pages.com/a/vanderk4.php.

44. Balbernie, *supra* note 5, at 241.

45. Perry, *Incubated in Terror*, *supra* note 4, at 134; *see also* Glaser, *supra* note 9, at 100.

46. D.L.A. Van den Hove et al., *Prenatal Stress and Neonatal Rat Brain Development*, 137 NEUROSCIENCE 145 (2006).

47. *Id.* at 148–49.

48. van der Kolk, *supra* note 43.

deprivation (equivalent to approximately six months in humans) can result in "preprogrammed cell death" in the hippocampus.[49]

While these controlled studies cannot ethically be replicated in humans, the data on human brain development demonstrate that numerous environmental variables affect brain development. Specifically, these studies focus on the effects of stress and maternal depression on attachment and how attachment issues result in psychological and behavioral problems in children, adolescents, and adults.

A. Stress

At the very least, exposure to conjugal violence is stressful both for the victim and the witness. Stress results in elevated catecholamines (i.e., norepinephrine and epinephrine) and low seratonin in animals; these neurotransmitters are directly related to the inability to modulate arousal.[50] This means that a likely outcome of stress is an inability to control arousal—an issue that is symptomatic of attention deficit/hyperactivity disorder.[51] Animal studies have demonstrated that maternal behavior can produce this response in offspring, apparently by wiring the developing brain for the stress response.[52] During the first few years of life, a child learns how to cope with the environment; these skills become fixed response patterns in the brain. A child who continually experiences threatening situations may respond with apathy and withdrawal, while a child experiencing acute stress may resort to tantrums and aggression.[53]

These neurochemical changes in response to stress affect the prefrontal cortext, "making the child less able to govern his behavior."[54] This obviously has marked behavioral, social, and educational ramifications. Professor Michael De Bellis and his colleagues noted the numerous effects of these neurochemical changes, including intrusive thinking, avoidance, hyperarousal, and dissociation.[55] They also noted measurable physical changes in the brain structure of subjects who had experienced PTSD, including "smaller intracranial and cerebral volumes," smaller lateral ventricles, and smaller corpus col-

49. Glaser, *supra* note 9, at 103.

50. van der Kolk, *supra* note 43.

51. *See infra* note 96 and accompanying text.

52. Dong Liu et al., *Maternal Care, Hippocampal Glucocorticoid Receptors, and Hypothalamic-Pituitary-Adrenal Responses to Stress*, 277 SCIENCE 1659 (1997).

53. *Developmental Issues for Young Children in Foster Care*, *supra* note 30, at 1146–47.

54. Amy F.T. Arnsten, *Development of the Cerebral Cortex: XIV. Stress Impairs Prefrontal Cortical Function*, 38 J. AM. ACAD. CHILD & ADOLESCENT PSYCHIATRY 220, 221 (1999).

55. Michael D. De Bellis et al., *Developmental Traumatology Part II: Brain Development*, 15 BIOLOGICAL PSYCHIATRY 1271, 1279 (1999).

losum.[56] They concluded that the overwhelming stress of maltreatment in childhood is associated with adverse brain development.[57] Even though individual differences in threshold, intensity, duration, and recovery of the stress response exist,[58] the preponderance of the research demonstrates that chronic stress has detrimental affects on children.

B. Maternal Depression

Maternal depression is also likely in a home where domestic violence is present, and it is likely to reduce parenting abilities.[59] A depressed mother will have more difficulty meeting her own needs as well as the needs of her child, making child neglect more probable. Several research studies have demonstrated that maternal depression has an effect on the developing brain in the ways described above.[60] Further, children of depressed mothers frequently have various other physical responses, including electroencephalogram asymmetry[61] and atypical frontal brain electrical activity.[62] Professor Richard Davidson suggests that asymmetric activity in the brain may "play an important role in producing enduring behavioral consequences that are supported by specific molding of the underlying neural machinery."[63]

Mothers can also inadvertently "transmit" their depression to their children. For example, in an examination of the literature, child psychotherapist Robin Balbernie found that "having a depressed mother [when one is] between 6 and 18 months of age can lead to emotional and cognitive difficulties that persist through the early school years,

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56. *Id.* at 1278–79.

57. *Id.* at 1281.

58. W. Thomas Boyce et al., *Temperament and the Psychobiology of Childhood Stress*, 90 PEDIATRICS 483, 485 (1992).

59. *See generally* David M. Fergusson et al., *Partner Violence and Mental Health Outcomes in a New Zealand Birth Cohort*, 67 J. MARRIAGE & FAM. 1103 (2005); Kelly L. Jarvis et al., *Psychological Distress of Children and Mothers in Domestic Violence Emergency Shelters*, 20 J. FAM. VIOLENCE 389 (2005); M. Pilar Matud, *The Psychological Impact of Domestic Violence on Spanish Women*, 35 J. APPLIED SOC. PSYCHOL. 2310 (2005); Emiko A. Tajima, *Correlates of the Co-occurrence of Wife Abuse and Child Abuse Among a Representative Sample*, 19 J. FAM. VIOLENCE 399 (2004).

60. Geraldine Dawson et al., *Infants of Depressed Mothers Exhibit Atypical Frontal Electrical Brain Activity During Interactions with Mother and with a Familiar, Nondepressed Adult*, 70 CHILD DEV. 1058, 1058 (1999); Glaser, *supra* note 9, at 98.

61. Nancy Aaron Jones et al., *EEG Stability in Infants/Children of Depressed Mothers*, 28 CHILD PSYCHIATRY & HUM. DEV. 59, 60 (1997).

62. Dawson et al., *supra* note 60, at 1058.

63. Richard J. Davidson, *Asymmetric Brain Function, Affective Style, and Psychopathology: The Role of Early Experience and Plasticity*, 6 DEV. & PSYCHOPATHOLOGY 741, 756 (1994).

whether or not the mother continued to be troubled by depression."[64] In brief, maternal depression brought about by domestic violence exposes children not only to the potential for injury and neglect, but also predisposes them for a variety of difficulties that are directly related to structural changes in the brain.

C. *Attachment*

Caregivers who are victims of violence in the home are likely to experience stress, depression, and PTSD. These effects could reduce a caregiver's ability to perform normal parenting tasks; if severe enough, they could completely incapacitate a caregiver. Domestic violence increases stress in both parent and child. Conjugal violence also increases the likelihood that the mother will experience depression. These dysfunctions lead to neglect and poor parent-child interactions, and they have measurable effects in the child's developing brain. Perhaps the most significant result of stress and maternal depression in infancy is their effect on attachment. Even if the child is unaware of the violence occurring in the home, the resulting marital stress could produce results similar to those found in children who had in fact witnessed the violence. For example, in their study of foster care, Dr. Rebecca Johnson and her colleagues at the University of Birmingham in England claim that "neglect and damage caused by early privation and deprivation is *equivalent to violence*."[65]

Research showing an increased probability of neglect and attachment disorders in children in foster care settings has been documented for decades, and children are most at risk for attachment problems during their earliest years. They are likely to suffer "[d]elays in physical growth, neural atrophy and abnormal brain development," and "[i]nfants who are placed into residential care will suffer harm to their development if [they are] not moved to family-based care by the age of 6 months."[66] Glaser additionally notes that children in foster care are at risk for delays in their cognitive and social functioning.[67] It is generally believed that these risks are due to a lack of personal contact with primary caregivers, which is not uncommon in foster care.[68] Specifically, it is well established that "[i]nterpersonal communication

64. Balbernie, *supra* note 5, at 250.

65. Rebecca Johnson et al., *Young Children in Institutional Care at Risk of Harm*, 7 TRAUMA VIOLENCE & ABUSE 34, 35 (2006).

66. *Id.* at 57.

67. Glaser, *supra* note 9, at 98.

68. Tiffany Field, *Infants' Need for Touch*, 45 HUM. DEV. 100 (2002); Laurel K. Leslie et al., *Developmental Delay in Young Children in Child Welfare by Initial Placement Type*, 23 INFANT MENTAL HEALTH J. 499, 501 (2002).

through eye contact is particularly important" in the first year of life.[69] Children need not only interpersonal eye contact but an emotionally sensitive caregiver if they are to learn to modulate their own emotional states.[70] Child abuse and neglect results in fewer of the "sensitive interactions between the parent(s) and the young child" that are necessary for emotional bonding.[71]

Interaction between parent and child, or the lack thereof, during sensitive developmental periods has a direct effect on the developing brain. Balbernie notes that the orbitofrontal cortex is strongly affected by the quality of the caregiving relationship and governs the individual's social interaction.[72] Balbernie also notes, as has long been believed, that early impoverished environments provide correlational evidence between "early trauma and abuse, and both adult borderline personality disorder and dissociative . . . disorders."[73]

In summary, Professor Eugena Berger argues that "[e]arly experiences of trauma or abuse—whether in utero or after birth—can interfere with development of the subcortical and limbic area of the brain, resulting in extreme anxiety, depression, and/or the inability to form healthy attachments to others."[74] Professor Alison Wismer Fries and her colleagues reached a similar conclusion.[75] They found that the social and emotional difficulties faced by children who have experienced abuse or neglect demonstrate that early experience is critical in the development of the areas of the brain that control social behavior.[76] In other words, attachment is biological and directly related to social interaction.

D. Outcomes

Due to neuroplasticity, the child's brain is pliable and therefore vulnerable to dysfunctional development when regularly exposed to conjugal violence, neglect and abuse, stress, and maternal depression. These issues lead to many possible outcomes, including potentially serious attachment disorders. Perry and his colleagues note that trauma

69. Balbernie, *supra* note 5, at 243.

70. *Id.* at 242.

71. Glaser, *supra* note 9, at 101.

72. Balbernie, *supra* note 5, at 242–43.

73. *Id.* at 242 (citations omitted).

74. Berger, *supra* note 10, at 270 (quoting RIMA SHORE, *RETHINKING THE BRAIN: NEW INSIGHTS INTO EARLY DEVELOPMENT* 40 (1997)).

75. Alison B. Wismer Fries et al., *Early Experience in Humans Is Associated with Changes in Neuropeptides Critical for Regulating Social Behavior*, 102 PROC. NAT'L ACAD. SCI. 17237 (2005).

76. *Id.* at 17239.

leads to psychological disorders.[77] Others have found that early adverse life experiences, such as viewing domestic violence, increase the likelihood of anger, anxiety, and aggression in childhood,[78] as well as the likelihood of depression in adulthood.[79] Ongoing stress has been linked to "developmental, cognitive, and behavioral disorders, and possible onset of psychopathology in later life."[80] Balbernie argues that changes in the brains of children being reared in a hostile environment are "associated with hyperactivity, impulsive behaviour, anxiety and poor emotional control."[81] Children who are maltreated have shown elevated cortisol concentrations,[82] which "cause cell loss in the hippocampus, damaging learning and explicit memory"[83] and increasing the likelihood of emotional and attachment problems. If abuse or neglect persists, "general mental health and cognitive ability" are seriously threatened.[84]

Glaser also notes that general health can be compromised because the regular presence of the stress response suppresses the immune system.[85] Modulating these response mechanisms is a life skill that also has ramifications for one's health. For example, Professor Michael Lewis found that an infant's ability "to suppress responding to acutely painful events (the inoculation) was negatively related to illness, such that the more the infant was unable to suppress his or her response, the more the incidence of illness."[86] Exposure to conjugal violence has other behavioral risks. Perry describes reactions in three-year-olds due to changes in the brain, noting that the unorganized cortex in a frustrated child causes difficulties in "modulating the reactive, brainstem-mediated state of arousal."[87] Therefore, "they will scream, kick, bite, throw, and hit."[88] Changes in the brain structure in children who are exposed to conjugal violence find themselves in "a persisting fight

77. Perry et al., *Childhood Trauma*, *supra* note 21, at 273.

78. Renee M. Johnson et al., *Adverse Behavioral and Emotional Outcomes from Child Abuse and Witnessed Violence*, 7 CHILD MALTREATMENT 179, 179 (2002).

79. Josephine Beatson & Suzanna Taryan, *Predisposition to Depression: The Role of Attachment*, 37 AUSTRALIAN & N.Z. J. PSYCHIATRY 219, 223 (2003).

80. D. Koubovec et al., *Effects of Psychologic Stress on Fetal Development and Pregnancy Outcome*, 7 CURRENT PSYCHIATRY REP. 274, 274 (2005).

81. Balbernie, *supra* note 5, at 246.

82. Jordan Hart et al., *Altered Neuroendocrine Activity in Maltreated Children Related to Symptoms of Depression*, 8 DEV. & PSYCHOPATHOLOGY 201, 210 (1996).

83. Balbernie, *supra* note 5, at 250.

84. *Id.*

85. Glaser, *supra* note 9, at 104.

86. Michael Lewis, *Individual Differences in Response to Stress*, 90 PEDIATRICS 487, 490 (1992).

87. Perry, *Incubated in Terror*, *supra* note 4, at 128.

88. *Id.*

or flight state."[89] By adolescence, the child is unable to escape this state. In essence, what was originally an adaptive mechanism becomes a day-to-day response that results in a neural system that is "overactive and hypersensitive."[90] Balbernie also notes that "[t]he chronic overactivation of neurochemical responses to threat in the central nervous system, particularly in the earliest years of life, can result in lifelong states of either dissociation or hyperarousal."[91]

Among those outcomes listed above, changes in brain structure as well as chemical changes in the brain lead to numerous other negative outcomes: depression;[92] bonding problems and loss of social skills;[93] "motor hyperactivity, anxiety, mood swings, impulsiveness, and sleep problems";[94] increased likelihood of PTSD;[95] an increased likelihood of exhibiting symptoms consistent with attention deficit hyperactivity disorder;[96] lack of empathy and increased probability of sociopathy and borderline personality disorder;[97] more inhibited behaviors and nonempathetic behaviors in response to mock distress of mothers;[98] differences in emotional expression and infant emotional behavior;[99] diminished self-control and language delays;[100] as well as problems with gross motor skills, fine motor skills, cognition, speech and language function, self-help abilities, emotional well-being, coping skills, and relationships.[101]

The evidence for neurological changes due to exposure to conjugal violence may have even further implications. Many of the behavioral effects in older children that have been cited in the literature may have a biological cause. In a prior publication, I noted that numerous studies have demonstrated that children who witness domestic vio-

89. *Id.* at 136 (internal quotation marks omitted).

90. *Id.*

91. Balbernie, *supra* note 5, at 247 (internal quotation marks omitted) (quoting ROBIN KARR-MORSE & MEREDITH S. WILEY, GHOSTS FROM THE NURSERY: TRACING THE ROOTS OF VIOLENCE 168 (1997)).

92. Beatson & Taryan, *supra* note 79, at 221–22.

93. James P. Henry, *Psychological and Physiological Responses to Stress: The Right Hemisphere and the Hypothalamo-Pituitary-Adrenal Axis, an Inquiry into Problems of Human Bonding*, 640 ACTA PHYSIOLOGICA SCANDINAVICA 10, 19 (1993).

94. *Developmental Issues for Young Children in Foster Care*, *supra* note 30, at 1147.

95. K.H. Brisch, *The Importance of Early Traumatic Experiences for the Development of the Infant's Brain*, 147 MMW FORTSCHRITTE DER MEDIZIN 39 (2005).

96. Glaser, *supra* note 9, at 104.

97. Henry, *supra* note 93, at 17–19.

98. Jones et al., *supra* note 61, at 68.

99. Megan R. Gunnar & Charles A. Nelson, *Event-Related Potential in Year-Old Infants: Relations with Emotionality and Cortisol*, 65 CHILD DEV. 80, 92 (1994).

100. Balbernie, *supra* note 5, at 242.

101. *Developmental Issues for Young Children in Foster Care*, *supra* note 30, at 1147.

lence exhibit many problems.[102] These problems are grouped into five categories: externalized reactions, internalized reactions, intellectual and academic reactions, social developmental reactions, and physical reactions.[103] Included within these categories are aggression, phobias, insomnia, conduct problems, depression, anxiety, lower levels of social competence, lower levels of self-esteem, poor academic performance, and symptoms consistent with PTSD.[104] These effects vary depending on the child's age and some of them, such as self-esteem issues, may have their root in neurological changes during critical developmental periods.

These neurological and behavioral problems are likely outcomes when a child is regularly exposed to conjugal violence, maternal depression, and stress. The effects of neglect and trauma, as Balbernie argues, "can be indirect as in witnessing domestic violence," and this exposure "will alter the developing central nervous system, predisposing [a person] to [become] a more impulsive, reactive, and violent individual."[105]

V. CONCLUSION

It is likely that viewing conjugal violence causes trauma and stress in the viewer, and such stress leads to changes in brain structure. Infants are especially at risk due to the neuroplasticity of the brain during the early years of development. Perry notes that brain development involves "critical periods . . . during which specific sensory experience is required for optimal organization and development of any brain area."[106] When these critical periods are missed, a delay in development or even a failure to develop critical skills may become permanent. These critical periods exist in utero,[107] leading to the conclusion that maternal stress could be an issue for the developing child even before birth. Professor Megan Gunnar has addressed the complex interaction of brain activity and emotional outcomes, and stated that the data "point to the need to create safe, secure, supportive environments for infants and young children."[108]

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102. Gregory K. Moffatt, *Viewing Domestic Violence: A Summary of Research and What We Know*, 10 GA. J. PROF. COUNSELING 7 (2002).

103. *Id.* at 11–13.

104. *Id.*

105. Balbernie, *supra* note 5, at 245.

106. Perry, *Incubated in Terror*, *supra* note 4, at 132.

107. Heidelise Als et al., *Early Experience Alters Brain Function and Structure*, 113 PEDIATRICS 846, 846 (2004).

108. Megan R. Gunnar, *Quality of Early Care and Buffering of Neuroendocrine Stress Reactions: Potential Effects on the Developing Human Brain*, 27 PREVENTIVE MED. 208, 210 (1998).

Neurology, environment, and human behavior involve complex interactions that cannot easily be reduced to simple cause-effect dyads, but the evidence is clear that children in homes where conjugal violence exists are at risk for multiple problems that are not simple or short-term. Children learn how to interpret information and respond to their environment at an early age. Once these response patterns are established, they can become permanent response patterns, even when they have outlived their original, adaptive purpose.