Childhood Adversity Impact on Brain Development and Persistence in Adulthood

Threat versus Deprivation and Therapeutic Interventions

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Abstract

Sixty-four percent of adults in the U.S. report having endured at least one adverse experience before the age of eighteen. In this paper, the two major sections are threat versus deprivation and the differences in functional and structural brain neurodevelopment. In the context of this research, this paper discusses the distinct differences between threat and deprivation as adverse experiences, as well as the resulting differences in structural and functional brain neurodevelopment. We also consider how adverse experiences may increase the risk of developing disorders such as post-traumatic stress disorder. The paper concludes with a brief review of potential ways to mitigate adverse outcomes by promoting a functional, healthy lifestyle early in development. Moreover, by examining numerous studies conducted in the United States, each targeting different aspects of child adversity and brain development, my research will encompass recent trends in America while also considering the statistics that often go unreported.

Keywords: *adolescent, child adversity, threat, deprivation, adult progression, PTSD, persistent effects, structural development, functional development*

Introduction

One in seven children experiences child maltreatment each year in the United States (CDC, 2025). The U.S. Federal Child Abuse Prevention and Treatment Act describes maltreatment as the infliction of severe emotional and physical damage, sexual abuse, and/or exploitation (Division (DCD), 13 C.E.) Children who experience childhood maltreatment often exhibit altered developmental trajectories compared to children raised in non-threatening environments. For example, research finds that children who have been maltreated have interruptions to their emotional development, such as regulating emotions, an increase in emotional reactivity, anxiety, and depression (Petersen et al., 2014). Interestingly, certain types of maltreatment may differentially influence outcomes (e.g., higher instances of neglect vs. abuse).

There are two different approaches to characterizing the effects of childhood maltreatment: cumulative and dimensional. The cumulative approach measures the number of experiences, often disregarding the severity of the adversity or the type of maltreatment. The cumulative approach is often used to generate statistics to display the number of at-risk people. The dimensional model (DMAP) parses types of maltreatment to understand how they differentially influence developmental outcomes, most notably, neurodevelopment. The present paper will use a dimensional framework of maltreatment to show how childhood adversity impacts children and adolescents' structural and functional brain development. We conclude the paper by providing practical solutions to minimize the adverse outcomes associated with childhood adversity. This paper will examine the structure and key functions of brain regions, while also revealing the lasting psychological and behavioral consequences of childhood adversity.

Threat

Threat is a physical threat to one's physical health and well-being. There are three primary types of abuse most commonly discussed in the literature: physical, emotional, and sexual abuse. Physical abuse is most typical between the caregiver and child, and may look like causing intentional harm and injuries. Emotional abuse is nonphysical behavior aimed at inflicting fear, isolation, and control. Sexual abuse is unwanted, coerced, or manipulated sexual acts inflicted on individuals. All three experiences serve as exposure to threat, which may result in long-term mental health struggles (Stensvehagen et al., 2022), such as post-traumatic stress disorder (PTSD), anxiety disorders, substance abuse, and depression. One such mechanism linking these outcomes to experiences of threat may be alterations in neural maturation in regions responsible for memory and fear-processing (e.g., hippocampus, amygdala; McLaughlin et al., 2014).

Deprivation

Deprivation occurs when social, cognitive, and emotional inputs are lacking during an individual's development. Deprivation is characterized as neglect, typically in the absence of parents or guardians, or material deprivation. There are two primary types of neglect discussed in the literature: physical and emotional neglect. Physical neglect is the failure to provide adequate basic physical needs such as food, water, and shelter, while emotional neglect is ignoring a child's emotional needs and not displaying support, love, or attention. These two experiences serve as exposure to deprivation, which may result in long-term mental health struggles and differences in cognitive functioning (Orben et al., 2020). One mechanism potentially linking experiences of deprivation to these adverse outcomes is alterations in neural maturation in regions such as the prefrontal cortex, which is primarily responsible for supporting cognitive development (Sheridan & McLaughlin, 2014). Childhood is a very critical time for brain development. Early experiences can shape one's cognitive, emotional, and social abilities for a lifetime. But when a child experiences abuse or neglect, this can result in differences in trajectories of functional and structural brain development that are associated with differences in behavior, such as vulnerability to developing mental health symptoms related to PTSD (Herringa, 2017).

The Consequences of Threat and Deprivation on Structural Brain Development

Structural brain development involves changes in the thickness, volume, and surface area of an individual's brain over time (Machlin et al., 2023a).

Threat. Individuals who experience higher levels of threat tend to exhibit thinner cortices in regions such as the prefrontal cortex (PFC) compared to those with lower levels of threat-related experiences in early childhood during adolescence (Bounoua et al., 2020). Differences in the development of cortical surface area have been seen in the lateral temporal, temporal lobe, and occipital lobe, such that individuals with higher levels of threat-related experiences exhibit less cortical surface area (Hill et al., 2010). Furthermore, there are differences in volumetric growth, with individuals who have more threat-related exposure exhibiting decreased volume in the hippocampus and the prefrontal cortex, but increased volume in the amygdala (Starcevic et al., 2014). Regions affected by threat exposure are functionally implicated in the amygdala, which plays a crucial role in processing emotions, particularly fear and anxiety (Machlin et al., 2023b). The PFC is for regulating these emotions, and the hippocampus is for consolidating memories (O'Donovan et al., 2013). This could explain behaviors observed in individuals with higher threat-related exposure, such as exaggerated fear responses and increased prevalence of psychopathology (McLaughlin & Lambert, 2017a).

Deprivation. Individuals who experience higher levels of deprivation exhibit lower brain volume in areas such as the medial prefrontal cortex, inferior frontal cortex, and inferior temporal cortex

(Mackes et al., 2020). This may be due to the brain's adaptation to its environmental expectations, which in turn leads to a lack of stimulation and brain development pathways. These specific differences in structural neurodevelopment have been linked to learning and memory (Marzola et al., 2023a), as well as to neuroticism and extraversion (Verduyn & Brans, 2012). This may explain the higher prevalence of cognitive difficulties in individuals with higher levels of deprivation (Marzola et al., 2023b). Those who experience deprivation are also more likely to have reduced cortical thickness in the lateral and medial prefrontal cortex (Machlin et al., 2023b). Because this early childhood adversity is unnurturing and disrupts typical neurodevelopment, which is responsible for brain structure, the surface area of the medial orbital frontal cortex is also decreased in individuals with higher levels of these experiences (Sheridan et al., 2022).

The Consequences of Threat and Deprivation on Functional Brain Development.

Functional brain development refers to the changes in the degree of activation of specific regions during behavioral tasks.

Threat. Experiences of threat are associated with differences in amygdala activation when viewing angry faces during adolescence, as measured by magnetic resonance imaging (MRI) (van den Bulk et al., 2014). Some researchers find that individuals with chronic threat exposure, such as family violence, exhibit decreased amygdala habituation while viewing angry faces (McCrory et al., 2011, Bilek et al 2019). Others find that shorter-term exposure to familial violence is associated with increased amygdala reactivity when viewing angry faces (McCrory et al., 2011, Goetschius et al., 2020, Hein 2020). These differences in findings may be due to the varying lengths of exposure to threat-related experiences. Short-term exposure can lead to an increase in reactivity, whereas longer-term exposure results in more blunted responses. These specific differences in the functional neurodevelopment of the amygdala have been linked to altered fear processing (Zimmermann et al., 2023), which may explain the higher prevalence of mood disorders in individuals with higher levels of threat (Zimmermann et al., 2023).

Deprivation. Individuals with increased exposure to deprivation tend to exhibit decreased activity in the ventral striatum while viewing happy faces during adolescence. The ventral striatum is implicated in reward processing (Hanson et al., 2015, Hein et al. 2016). The reduced brain activity in the ventral striatum may explain why people with higher levels of deprivation-related experiences are more likely to develop depression later on (Avinun et al., 2017). These functional differences in the ventral striatum could be due to less positive interactions received during childhood, which may alter reward processing (McLaughlin et al., 2014b).

Discussion

Threat and deprivation are both forms of childhood adversity. Threat is where a child is at risk of being harmed physically, and deprivation is not getting the basic things to be healthy, grow, and develop. They both affect one's brain development in different ways. Threat more so impacts the volume and surface area of certain regions such as the prefrontal cortex, amygdala, and hippocampus. This is because these regions play a role in regulating emotions. Deprivation affects brain regions such as the ventral striatum, prefrontal cortex, and temporal areas, which have significant implications for reward and cognitive processing.

One significant outcome of experiencing early life adversity is post-traumatic stress disorder (McLaughlin et al., 2017). Different factors can contribute to the severity of the symptoms. These factors include: how severe the trauma is, the parents' or guardians' reaction to the trauma, and how close or far the child is from the trauma. The highest rates of PTSD have been seen in children who experienced threat (violent and sexual abuse). Neurobiological research has been done that shows early abuse associated with PTSD symptomatology results in altered neurological and physiological response to stressful situations, which is a response to the effect of the child's subsequent socialization (McLaughlin & Lambert, 2017b). A diagnosis of PTSD often presents with other mood-related symptomatology, which may further contribute to adverse outcomes following threat exposure. Importantly, research has identified potential neural mechanisms to help identify differences in outcomes related to childhood adversity. For example, persisting threat vigilance, impaired threat discrimination, and associative learning (Lambert & McLaughlin, 2019). Research further contributing to the understanding of the mechanisms contributing to a PTSD diagnosis may help identify at-risk youth and inform intervention efforts.

So, what are the further steps and courses of action people can take to lower the rates of adverse childhood outcomes? A large factor driving rates in child maltreatment in the United States is systemic. Some children and families are not able to meet the three pillars of health (discussed later). This could be influenced by poverty and lack of access to necessities, such as healthcare. Although there is no perfect solution, we could build more community programs that provide access to healthcare and grocery stores. Previously mentioned, one major issue is the unreported cases that are not accounted for in child maltreatment statistics. Not only are the statistics incorrect, but people and children are not receiving the help they need to overcome this issue. One way to prevent this is to raise awareness among schools and through various support programs. Everyone needs to recognize the signs of childhood adversity. One of the most critical periods in a person's life is childhood. Positive childhood experiences are extremely important, and obtaining the three fundamental pillars of health — diet, sleep, and exercise — is crucial. Positive socialization enables children to develop essential skills, including communication, self-control, and emotional regulation (Fostering Social Skills - Kids First, n.d.).

Good nutrition can have a profoundly positive impact on brain development and cognitive abilities (Roberts et al., 2022). Sleep quality and duration also have significant impacts on neurocognitive development (Yang et al., 2022). Exercise, especially in children, is important because it allows children to focus and retain information (Bidzan-Bluma, I., & Lipowska, M, 2018). Through exercise, children can learn how to use their energy and handle stress (To Improve Your Kid's Mood, Make Them Move, n.d.). These key elements work together to help children grow, learn, and thrive at each stage of development. Nurturing children extends beyond physical growth to encompass the parental influence of a caring and safe environment.

Conclusion

To conclude, this paper analyzed what child maltreatment does to the brain. Examining the differences between threat and deprivation-like experiences reveals that the impact on development also differs significantly. Beyond the simple definitions of threat and deprivation and their differences, there are also regional volume differences in the brain, as well as differences in activation. This paper goes beyond the statistics of child maltreatment to what we can do to further lower these rates and try to stop it altogether. Child adversity as a topic can sometimes be avoided due to shame or fear; therefore, conversations surrounding childhood adversity should occur in order to understand the long-term effects that lead well into adulthood. Child adversity not only directly impacts a child's behavior and brain, but it can also persist. This is why it is imperative to understand all the different aspects of child maltreatment, the significance of how these early experiences can shape the brain, which stays plastic, so they are able to adapt with more positive experiences later on.

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