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Does Seclusion Alter Amygdala Activity and Amygdala-Medial Prefrontal Cortex Connectivity Leading to Emotional Dysregulation in Children? A Case for Ending Seclusion and Restraint In Public Schools

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Does Seclusion Alter Amygdala Activity and Amygdala-Medial Prefrontal Cortex Connectivity Leading to Emotional Dysregulation in Children? A Case for Ending Seclusion and Restraint In Public Schools

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by

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ABSTRACT

The use of seclusion as a disciplinary practice in schools has been cited as an effective way to mitigate a child's behavior if they pose a threat of imminent danger to others or themselves and an effective means of helping a child regulate their emotions. However, research has shown that this practice has resulted in psychological harm (e.g. traumatic stress responses), physical injuries, and death to both staff applying these techniques and the children experiencing them. The effects of seclusion on the neurodevelopment of children remain widely unknown. Traumatic stress has been shown to increase the volume of the amygdala and decrease the volume of the prefrontal cortex which may prohibit proper connectivity and could have long-term consequences for emotional regulation. The proposed experiment aims to investigate the influence seclusion has on neural responses to distressing images and what effect seclusion has on a child's ability to emotionally regulate distressing images using cognitive reappraisal. To do so, we will recruit participants 10-11 years of age from high-diversity high-poverty school districts. Based on responses to a Seclusion Questionnaire participants will be divided into a seclusion and non-seclusion groups. Participants will complete the Child Revised Impact of Events Scale (CRIES-8), and the Pediatric Traumatic Stress Scale (PTSS) which will be used for statistical analysis. The experiment will use a 2 second instructional cue word (LOOK or LESS) followed by a neutral or fear-evoking image for 7.5 seconds which will be followed by a rating scale appearing for 2 seconds. During LOOK cues participants will be asked to notice their feelings and during LESS cues participants will be asked to reappraise the fear-evoking image by telling themselves a story that makes

the image seem more positive. Functional MRI will be collected [25 axial slices (4mm thick, 1 mm skip), 3T (GE Signa LX Horizon Echospeed), T2* sensitive gradient TR= 2.00, TE= 30 ms, 60° flip angle, 24-cm field view, 64x64 data acquisition matrix] and preprocessed using standard SPM12 pipeline. Data analysis will compare group responses in the emotion and reappraisal conditions. It is expected that, compared to the non-seclusion group, children in the seclusion group will show activity in the amygdala during the fear condition and that the medial prefrontal cortex will be less able to down-regulate the amygdala during reappraisal. One important implication of this proposed study is that determining these neural consequences can push policy makers to develop non-punitive trauma-informed approaches that regulate children's behavior.

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CHAPTER 1: INTRODUCTION - SECLUSION AS A DISCIPLINARY POLICY IN SCHOOLS

DEFINING SECLUSION AND RESTRAINT

Public schools in the United States utilize a variety of disciplinary practices to address behavioral issues in the classroom including seclusion and restraint. Seclusion and restraint are used to address disruptive behaviors such as: whistling, slouching or hand waving, refusing to do classwork, for swearing, for spilling milk, for throwing legos (Cohen et al., 2019; West, 2021). The use of these practices is justified by the belief that these are protective measures for both students and school personnel (Pudelski, 2012). However, the effectiveness of these practices has been called into question. Some have claimed that these practices can be viewed as state-sanctioned legal violence because they can lead to death and injury (Craig & Sanders, 2018; Harkin, 2014; Kutz, 2009; LeBel et al., 2012). Some research has suggested that these practices affect not just psychological and social development but also neural development (Decker, 2009; McCrory et al., 2010). Given that children's brains are still developing, the potential psychological trauma associated with seclusion can have significant neurodevelopmental and long-term consequences for the developing child's brain. This analysis addresses the potential neurodevelopmental consequences of seclusion and proposes an experiment to investigate potential neural effects on emotional regulation from seclusion practices.

In order to understand this complex issue, one must have the appropriate framework for understanding what seclusion and restraint are. Therefore, strict legal definitions will be put forth for adequate understanding of this analysis. Broadly, seclusion has been defined as procedures that involuntarily isolate students from others, while restraint refers to both physically holding and mechanically restraining a student's movement (U.S Department of Education, 2012). More specifically, the U.S. Department of Education defines seclusion as:

> "the involuntary confinement of a student alone in a room or area from which the student is physically prevented from leaving. It does not include a timeout, which is a behavior management technique that is part of an approved program, involves the monitored separation of the student in a non-locked setting, and is implemented for the purpose of calming" (2012, p. 10).

They have also defined restraint, denoting a stark contrast between physical restraint and mechanical restrain:

> " physical restraint is a personal restriction that immobilizes or reduces the ability of a student to move his or her torso, arms, legs, or head freely. The term physical restraint does not include a physical escort…. [on the other hand] mechanical restraint refers to the use of any device or equipment to restrict a student's freedom of movement" (2012, p. 10).

Surprisingly, there are no federal regulations protecting students because federal law does not contain general provisions prohibiting the use of seclusion in public schools (Jones & Feder, 2010). The U.S. Department of Education states that:

> "any use of restraint or seclusion in schools does not occur, except when there is a threat of imminent danger of serious physical harm to the student or others, and occurs in a manner that protects the safety of all children and adults at school" (2012, p.3)

If things such as spilling milk qualify as a "threat of imminent danger" this points to the lack of regulation of seclusion and restraint policies in schools. Although seclusion and restraint are often discussed in tandem, this analysis will focus on the use of seclusion in public schools.

THE LARGE DEBATE: ARE SECLUSION AND RESTRAINT HARM REDUCTION OR HARM ITSELF?

Those who argue for the use of seclusion and restraint are doing so because they believe that this protects the child, their classmates, and school personnel from physical harm; thus, one could argue that these disciplinary policies are employed as harm reduction or safety measures within classrooms and schools. The counter argument is that these practices do not actually reduce harm, rather they may actually inflict harm, particularly to the children who are being secluded.

According to Colaizzi (2005) the use of restraint and seclusion in public schools draws on a strong history of systemic violence against marginalized populations. Colaizzi posits that historically, seclusion and restraint practices came to fruition as people's conceptions of mental illness began to shift and reflect ideas that those with mental illness were dangerous social nuisances. In the nineteenth century there was a rise in rhetoric that cited that it was humane to confine those suffering with mental illness to psychiatric asylums; moreover, enlightenment psychiatrists believed that mental illness coincided with a loss of reason, and advocated that restraints could help patients regain their reasoning skills (Colaizzi, 2005). During this time children with disabilities were treated as adults and were admitted to insane asylums; thus, they suffered from these harsh treatment (Gingell, 2001). Simultaneously, there was a rise of the modern day penitentry which used solitary confinement. Smith (2006) defines solitary confinement as an imprisonment form in which incarcerated folks are involuntarily secluded from other inmates and require additional security measures and equipment. People believed that solitary confinement was a means of maintaining prison order when used as punishment or was an effective measure to separate inmates who were considered an escape risk or threat to themselves or to prisons in general (Smith, 2006).

The Individuals with Disabilities Education Act mandated that children with disabilities are to be provided free and public education that is tailored to their needs (U.S. Department of Education, 1975). Historically, seclusion and restraint were used on children with disabilities in public institutions, so when children with disabilities entered schools these measures trickled in with them. Proponents of seclusion use in schools include: The School Superintendent Association (AASA), Council of Administrators of Special Education (CASE), and the Council for Exceptional Children (CEC), many teachers' unions, and most state agencies who all wield immense power (Tolley, 2021). These beliefs are predicated on idea that these policies create a safer and more secure environment for people, they can be therapeutic, and they are only used when absolutely necessary; however, research has negated these claims and given rise to a counter movement against the use of seclusion and restraint in schools (Substance Abuse and Mental Health Services Administration [SAMHSA], 2010; Pollastri, 2013; Greene & Haynes, 2021).

Individuals opposed to the use of these disciplinary practices have shed light on research and literature that cites the harm that an individual may experience if subjected to these disciplinary practices in schools. Research has shown that psychological harm, physical injury, and death are ramifications for school personnel applying these techniques and the students subjected to them (Kutz, 2009). Moreover, the American Civil Liberties Union has stated that the harmful use of seclusion and restraint, denies students the rights to equal educational opportunity and violates their civil rights (Newman et al., 2019).

In a longitudinal study, Craig and Sanders (2018) implemented a trauma-informed "comfort versus care" approach outlined by the Grafton Integrated Health Network to minimize seclusion and restraint at a behavioral healthcare facility for children and adults with disabilities. This approach creates a caregiving environment that is sensitive to children's past experiences of violence. In this approach staff are actively present during a behavioral crisis and help an individual regulate their emotions, afterwards, both parties engage in conflict resolution. They found that when they implemented this approach, employee injuries dropped to 0, there was a decreased cost to their organization, a 133% increase in the outcomes of individuals, reduced staff turnover, and increased staff satisfaction (Craig & Sanders 2018). It would seem then that positive behavioral interventions may be more adept at helping children regulate their emotions. Moreover, other studies indicate that seclusion and restraint use actually lead to an increase in the behavior that staff are trying to discourage and control (Jones, 2002).

Opponents of the use of seclusion and restraint practices in schools also cite that the use of these harsh punishments are counterproductive because they lead to long-term behavioral and mental health impacts, especially for marginalized children who are disproportionately affected by these practices (Jones, 2002; The Leadership Conference Education Fund, 2019).

Although seclusion and restraint are often discussed in tandem, this analysis will focus on the use of seclusion in public schools; thus, from this point forward this analysis will solely focus on seclusion policies. Despite the immense amount of research and evidence of the harmful effects of these disciplinary practices, they continue to be used in schools. Therefore, one must wonder why seclusion continues to be used in discipline?

WHY PUBLIC SCHOOLS STILL USE SECLUSION TO DISCIPLINE

The U.S. The Department of Education backs claims that seclusion is an effective way to mitigate behavior that pose a threat of imminent danger or physical harm; thereby, ensuring the safety of all children and adults within a school (US Department of Education, 2012). If a student's behavior poses a great risk to themselves or others then de-escalating the situation using seclusion and restraint is a viable and swift option that forces a child to regulate their emotions. In the United States, public schools are federally funded institutions that provide free education to children ages 5-18. Beyond academics, the interactions children have in their schools foster a sense of identity, community, bonds, and relationships, help children master emotional skills, and more. In school, a teacher and school administrators ' jobs should be to recognize a child's potential and encourage them to grow through education. Furthermore, they are primarily responsible for the safety and well-being of all children entrusted to their care during a school day. Many of them do an outstanding job in what is considered a challenging environment especially when students display challenging and defiant behaviors in the classroom. In these instances, if they believe that there is a threat to themselves, the child, or other children's wellbeing, they are trained to fulfill their duty as an educator by taking the measures necessary to ensure safety. This is the key to understanding one of the primary reasons why these two disciplinary practices continue to be employed by educators. Although researchers have been pushing against these practices, citing that they disproportionately target students of color and students with disabilities, they continue to be used in our schools today (Harkin, 2014).

WHAT IS A SECLUSION ROOM?

As stated previously, seclusion occurs when a student is isolated in an environment and physically prevented from leaving this environment until they calm down. This regulation specifically cites that punitive measures like classroom timeouts, supervised in-school detention, or out-of-school detentions do not count as seclusion; however, in some instances, they may be recognized as seclusion responses if a student is denied the freewill of leaving a space (United States Department of Education, 2012). Involuntary confinement of a student into seclusion rooms most directly underscores seclusion policy.

Seclusion rooms come on a spectrum, and this lack of uniformity across school districts is due to loose federal laws surrounding the use of seclusion in public schools. Seclusion rooms are spaces that function to physically separate and isolate a student from others. Oftentimes, these rooms have deceptive names, like calm-down rooms, restorative rooms, or quiet rooms (Cleaver, 2020). Some seclusion rooms, such as rooms in Fairfax County school district of Virginia (one of the largest public school districts in the US), "are built like Russian nesting dolls — rooms within rooms. The innermost room is reserved for students with more egregious behavior issues. That room is concrete and about the size of a closet. Inside, there are no chairs to sit on and no windows on the walls. The doors have small windows and large magnetic locks" (Abamu, 2019). These seclusion rooms create prison-like-environments for children in schools.

DATA DOES NOT PAINT THE FULL PICTURE

What qualifies as instances of "imminent danger" remain undefined on the federal level leaving the door open for varying interpretations of these provisions and a lack of uniform regulation of seclusion in public schools. This is exemplified by the widely divergent laws and practices at the state-level. For example, nineteen states have no laws or regulations related to the use of seclusion in public schools, thirteen states require schools to obtain consent for foreseeable incidents in which a child would be placed in seclusion, and seven states place restrictions on the use of restraint but not seclusion (Kutz, 2009). Even more horrifying, is data that points to the disproportionate use of seclusion on disabled, Black, and Brown children in public schools. Data has shown that students with disabilities make up 58% of those placed in seclusion or involuntary confinement despite only making up 12% of the student population and a majority of these disabled students were Black and Brown children (U.S. Department of Education Office of Civil Rights, 2014). Black students made up 22.4% of students who were involuntarily secluded in public schools, despite only making up 15% of those enrolled in public schools (Civil Rights Data Collection, 2015).

The U.S. Government Accountability Office (GAO) posits that these statistics are not reflective of the true depth of the issue as incidents when seclusion and restraint are employed often go unreported by public school officials when communicating to the United States government (Blunt et al., 2019). Although it is mandatory that schools report restraint and seclusion in Education's Civil Rights Data Collection, this data shows that 70% of public school districts reported zero incidents and some do not even collect the data contrary to this requirement (Kutz, 2009). There is a lack of adequate systems for schools to report, a lack of updated data, and mismanagement which hinders the ability of lawmakers to enforce civil rights in this realm. Without these systems in place, seclusion practices can be employed in schools with no ramifications for the schools themselves.

PURPOSE OF STUDY

This thesis aims to investigate the effect of seclusion on the brain development of children. First, I will posit that seclusion may induce a toxic stress response in children which will foreground the claims made in the literature review. After, a review of normal childhood brain development will be provided. Next, I will discuss the neurodevelopment of emotional processing and the possible implications seclusion can have on this process. Considering all this literature, I will discuss the potential neurodevelopmental consequences of seclusion. This background supports my general hypothesis that seclusion induces a traumatic stress response which has adverse neurodevelopmental consequences for emotional processing. I propose an experiment to investigate the effects of past experiences with seclusion on the processing of aversive stimuli and emotional regulation. After discussing possible results and implications for this study, I will conclude with a consideration of public policy issues that could be informed by this study and what is best for children.

CHAPTER 2: POTENTIAL NEURODEVELOPMENTAL CONSEQUENCES OF SECLUSION

SECLUSION MAY INDUCE A TOXIC STRESS RESPONSE WITH SIGNIFICANT IMPLICATIONS FOR NEURAL FUNCTION

Seclusion causes psychological and emotional damage which leads to poor mental health outcomes and the development of psychological disorders. Literature on the effects of involuntary isolation on adults may point to the possible mental health implications for seclusion use on children (Durante, 2022; Billingsley et al., 2013). Specifically, understanding how solitary confinement affects the brain is imperative to understanding the effects of seclusion (Marx & Baker, 2017). Seclusion is founded on the same inherent principals as solitary confinement which is why a lot of literature proclaims that this practice is solitary confinement for children (Durante, 2022; Billingsley et al., 2013). Although seclusion and solitary confinement are different in terms of the length of time they are administered, such that solitary confinement typically takes place for a longer amount of time, solitary confinement can still be used as a model for study due to the fact that a child's brain is more sensitive than an adult to the environment that they are in (Lenroot, 2008; Luby et al, 2012; Tost et al., 2015). Although it may take an adult significantly more time to develop poor mental health outcomes a child may develop the same issues in response to a short seclusion experience.

A meta-analysis showed that compared to the general population, incarcerated adults who were in solitary confinement had higher scores on scales that measured anxiety and depression (Luigi et al., 2020). Additionally, solitary confinement has been linked with irritability, panic attacks, hypersensitivity to the environment, paranoia, and social withdrawal (Metzner & Fellner, 2010; Shalev, 2008). Solitary confinement leads to poor mental health consequences because the body seemingly perceives social and sensory deprivation as a threat, which activates the stress response of the autonomic nervous system. This causes an elevated state of arousal, or hypervigilance, during seclusion that may continue afterwards leading to the anxiety related mental health outcomes noted by these researchers. These outcomes resemble the symptomatology associated with post-traumatic stress disorder indicating that involuntary seclusion induces trauma that leads to traumatic stress. Consequently, the heightened stress response in adults may be mirrored in children who experience seclusion in schools which may result in toxic stress. Toxic stress in children is marked by prolonged activation of stress response systems in the absence of a protective relationship (Bucci et al., 2016; Franke,2014)

In a school setting staff and teachers are meant to nurture a child and provide a supportive environment, however; when school personnel use seclusion in response to disruptive behavior children may begin associating school caregivers with negative emotions. Classrooms and school may induce anxiety and fear because of the trauma associated with a seclusion incident(s). High levels of anxiety and fear may induce chronic stress in a child which has significant consequences for neural function. This heightened stress response is known as toxic stress.

In a school, if educational staff are perceived as threats then this breaks the protective relationship between a child and their school caregivers which may make them unable to cope and understand their feelings after a seclusion experience; thus, this may give rise to the toxic stress response. Toxic stress leaves the body in an active state of stress over an extended period of time, even when the stressor is removed from an environment (Franke, 2014; Johnson et al., 2013;). Research has revealed that toxic stress disrupts neuron-to-neuron communication in areas responsible for higher cognitive function (Figure 1).

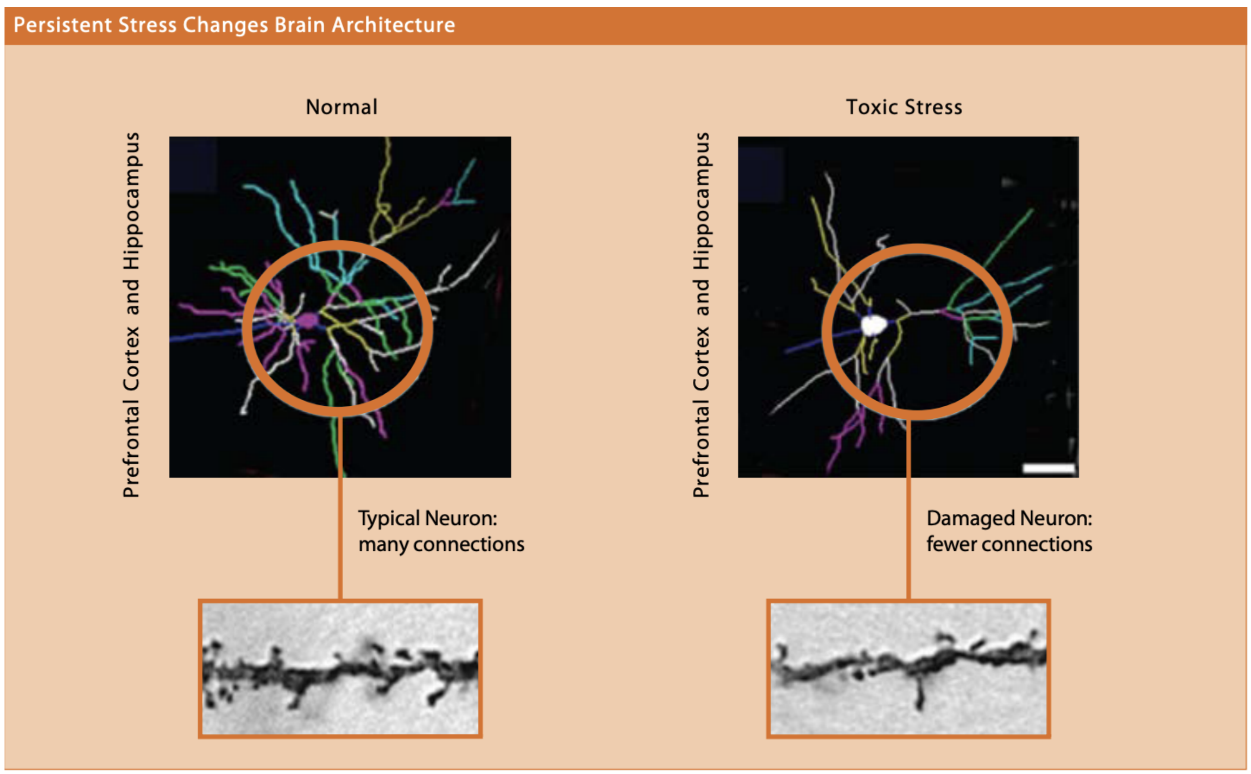


Figure 1. A brain under toxic stress has damaged neurons in areas of the brain most important for successful learning, behavior, and higher cognitive function cousin these areas to form fewer connections. Toxic stress response leads to damaged neurons that are unable to make as many connections with other brain areas (Radley et al, 2004; Bock et al., 2005). Credit: Center on the Developing Child.

Toxic stress damages neurons in the brain leading to fewer connections from cortical to subcortical areas (Wang et al., 2014; Woo et al. 2021). When toxic stress occurs in childhood, there could be significant implications for higher level processing in the brain (National Scientific Council on the Developing Child, 2005/2014). Brain development, like other developmental processes commences with the development of lower level areas first and then to higher levels (Muftuler et al., 2011). If toxic stress leads to neural damage, then there will be communication disruptions between these areas that affect higher level processing. Although the neurodevelopmental consequences of seclusion are not widely known, understanding how stress impacts neurodevelopment aids in the understanding of implications of seclusion on both subcortical and cortical processing.

NORMAL NEURODEVELOPMENT OF A CHILD'S BRAIN

Seclusion has been linked to psychological trauma in children who experience it, but the effects on the neurodevelopment of brain areas involved in emotional regulation are not well understood (Wilson et al., 2011). However, what is known is that stress leads to damage in areas involved in higher level processing, one such higher level process is emotional regulation. Emotional regulation is the ability to exert control over one's emotional state which can include techniques such as reappraisal, suppressing one's emotions, and many more. The primary brain areas involved in emotional regulation are the amygdala (the emotional processing center of the brain) and the prefrontal cortex (an area involved in executive function) (Raschle et al., 2016). It is imperative to understand and review the processes that underlie normal childhood brain development in order to understand the potential implications seclusion has on the neurodevelopment of these areas.

In utero, basic structures of the nervous system come to fruition. In the first trimester, a neural tube is formed which slowly becomes the brain and spinal cord (Brennan, 2021). Brennen (2021) also asserts that the second trimester is marked by the formation of gyri and sulci. Gyri are ridges and bumps that make up the topmost layer of the brain and sulci are grooves on the surface of the brain which help divide the brain into different sections like lobes and hemispheres (Guy-Evans, 2021). Both gyri and sulci serve crucial functions as they increase the surface area of the brain allowing more information to be processed in a very compact space. Lastly, in the third trimester, the brain develops mechanisms for responding to external stimuli through somatosensorial, olfaction, gustation, auditory, and visual processing (Brennan, 2021). Most importantly, all the neurons one will ever need for their entire life are formed; however, the synapses are not.

Early childhood and adolescence are defined as critical and sensitive periods because synaptic connections are strengthened through sensory and motor experiences (Meredith, 2015). The maturation of the brain, or neuroplasticity, is strongly influenced by one's experience and environmental factors (Meredith, 2015). At these critical points during neurodevelopment, the brain is responsive to stimuli that are necessary for the development of a skill or pattern (Rice & Barone, 2000). If an appropriate stimulus is not received then certain skills may become difficult or impossible for someone to acquire later in their life (Simpkins & Simpkins 2012).

During early childhood to preschool the connections between neurons, or the number of synapses, increases at a rapid rate. The synapses that the brain uses frequently are strengthened to support strong connection in certain brain areas. There is an expansion of brain volume due to the development of gray and white matter (Bremner, 2006).

School-aged children experience significant growth and strengthening of neural networks in parts of the frontal, parietal, and temporal lobes which are associated with senses, memory, emotion and language and cognition (Northeastern University, 2010). During adolescence, neural connections in the frontal lobes grow and strengthen as well as brain areas implicated in reward, motivation, and emotion (Northeastern University, 2010). The corpus callosum, prefrontal cortex, hippocampus, and amygdala increase in size during early childhood and adolescence.

These brain areas are also a part of the emotional processing network; the amygdala and prefrontal cortex are particularly important parts of the emotional processing network because in the adult brain the prefrontal cortex exerts control over the amygdala which regulates emotional responses (Phan et al., 2002, Kelley et al., 2019, Motzkin 2015).

THE BRAIN'S EMOTIONAL DEVELOPMENT: CRITICAL PERIODS

Critical periods are a time when the development of brain circuit-based phenotypes like synaptic plasticity are sensitive to environmental pressures (Fox, 2002; Hensch, 2004). the human brain is more sensitive to the environment. For the human brain, there are significant critical periods during childhood as the human brain learns from interactions it has with its environment (Hensch, 2004; Tierney et al., 2009). Therefore, understanding the critical periods for areas involved in emotional regulation may help us understand the neurodevelopmental implications seclusion has for emotional regulation processes.

The amygdala is commonly thought of as the core area for emotional processing; however, this is only part of the larger picture (AbuHasan et al., 2021). The amygdala is important for emotional processing, perception, and expression, especially in the perception and processing of fear (AbuHasan et al, 2021; Arruda-Carvalho & Clem, 2015). The networks the amygdala forms with different brain areas and cortices during neurodevelopment impact how one processes emotions, not only in childhood, but for the rest of their existence (Tottenham, 2017). During development the amygdala is very sensitive to environmental exposure which impacts its dendritic growth, volume, and neuronal connections (Barch, 2016; Hedge, 2017).

Environmental exposure sensitivity is particularly high during early childhood when the amygdala volume is increasing at a rapid rate and during preadolescence when growth reaches a peak volume and synaptic pruning, or the elimination of synapses that the brain does not need, occurs (Pechtel et al., 2014). Researcher has posited that the amygdala exhibits robust responses to emotional stimuli during early childhood which parallels the emotions and fears that accompany childhood; such fears, such as separation anxiety, are mediated by the high amygdala activity that is observed during childhood (Gee et al., 2013). This high sensitivity during these points of childhood, indicates that there may be critical periods for amygdala growth that significantly impact emotional processes for one's lifetime.

Previous studies may provide insight on the different critical periods for structural changes in the right and left amygdala (Dannlowski, 2013; Gee et al., 2013; Hodel et al., 2016; Lyons et al. 2016; Pechtel et al., 2014). The right amygdala is strongly associated with negative emotions, whereas the left amygdala is associated with both positive and negative emotional responses (Glascher & Adolphs 2003; Wright et al. 2001). It

The left amygdala develops rapidly during the early years of childhood, suggesting that it plays a more prominent role during early childhood emotional processing. A study showed that early life stress in humans caused by disorganized attachment with a caregiver in the first eighteen months of life, led to a significant increase in left amygdala volume (Gee et al., 2013; Lyons et al. 2016). This suggests that the first two years of one's life may be a critical period for left-lateralized amygdala development.

Whereas, the right amygdala appears to develop during later years of childhood and adolescence. A longitudinal study performed by Perchel et al. (2014), assessing the effects of adversity on the brain, determined that enlarged amygdala volume was associated with the early life stress that accompanies childhood trauma. The researchers identified strong evidence of a developmental critical period between the ages of ten and eleven, as correlation between types of maltreatment and volume of the right amygdala to was respectively 5.7-fold and 3.5-fold greater than overall exposure during the first eighteen years of life (Pechtel et al., 2014). A cross-sectional study showed that adolescents who had been institutionalized had greater amygdala volumes in the right, but not the left (Hodel et al, 2016). Similarly, hyperactivity in the right amygdala in response to negative stimuli was found in adults with a history of childhood maltreatment. Interestingly, researchers found that right amygdala responsiveness was positively associated with negative facial expressions but not positive expressions in adults with a history of childhood maltreatment (Dannlowski, 2013).

These findings suggest that the critical period for structural changes in areas of the amygdala that process negative emotions, like fear and threat, occurs during late childhood and early adolescence. Over-exposure to things that evoke threat or fear can lead to an increase in the volume of both parts of the amygdala as they both play a role in the processing of negative emotions (Glascher & Adolphs 2003; Wright et al. 2001). Being secluded in school can evoke these emotions in a child; therefore, these patterns may potentially be observed in a child who has experienced this form of discipline. The potential effects of seclusion on the morphology of the prefrontal cortex is vital for this discussion.

The prefrontal cortex is one of the last brain areas to develop. It undergoes significant maturation during childhood which includes: a reduction of neuronal and synaptic density, the growth of dendrites, and an increase in white matter volume which allows it to form neural networks needed for complex cognitive processes like emotional regulation (Tsujimoto, 2008). This slow development may be beneficial to humans because it extends the period of brain development that allows neural networks in the brain to change and subsequently learn from the environment that they interact with. However, this is a double-edged sword. The prefrontal cortex develops connections that regulate the amygdala later than the connections that amygdala makes with it; therefore, the environment has immeasurable influence (Bouwmeester et al., 2001; Pattwell et al., 2016). The type and quality of environmental inputs during this time especially those from relationships (caregiver, teacher, friends, etc.) determines one's ability to regulate their emotions in adulthood (Werker & Hensch, 2015). If these environmental inputs do not positively nurture a child, then the prefrontal cortex may undergo morphological changes.

Several studies have demonstrated that there are child-specific and adult-specific patterns of communication between the prefrontal cortex and the amygdala (Tottenham & Gabard-Durnam, 2017). In one such study on the adult brain, Delgado et al. (2008) explored two mechanisms for diminishing fear: extinction of conditioned fear and emotional regulation, in order to determine the similarities and differences between the neural mechanisms that underlie these two distinct processes. Through analysis of BOLD responses differences in each condition, they found that both mechanisms of emotional regulation relied on the prefrontal cortex exerting control on the amygdala through inhibition through similar connections (Delgado et al. 2008). This suggests that the prefrontal cortex in the adult brain can down-regulate the amygdala reactivity to different stimuli. In another study researchers used rest-state fMRI to compare healthy adults with adults with ventral-medial prefrontal cortex damage, the results showed that damage to the ventral-medial prefrontal cortex disrupted the modulation of the extended amygdala, or the bed nucleus of the stria terminalis (BNST) (Motzkin et al., 2014). These research findings show that the prefrontal cortex sends signals to inhibit the amygdala and reduce its reactivity in adults. Unlike adults, research suggests that the regulatory influence of the prefrontal cortex is not mature in children.

Studies of the human brain indicate that the prefrontal cortex-amygdala circuitry may use subcortical-cortical processing in children, which informs the way that children regulate their emotion. A study aimed at examining the relationship between age and structural connectivity of the major white matter tract that links areas of the human brain that help with emotion processing and regulation (uncinate fasciculus) used diffusion tensor imaging (DTI) and functional magnetic resonance imaging (fMRI) to examine structural connectivity differences of 9-year old children and 19-year old adolescents during an emotional recognition task (Swartz et al., 2014).The results of the study showed that the adolescent participants had greater uncinate fasciculus connectivity which led to reduced amygdala activation during the emotional recognition task, while the opposite was true for children (Swartz et al., 2014). Another similar study showed that the connectivity of the amygdala and areas of executive function increased when a task required emotional regulation; more importantly, the strength of this connectivity was directly correlated with age (Perlman & Pelphrey 2011).

These findings suggest that adults exhibit an anti-correlated amygdala and prefrontal cortex communication in which an increase in the activity in the prefrontal cortex is followed by a down-regulation in the amygdala's activity indicating that there is cortical-subcortical information flow from the prefrontal cortex to the amygdala in the adult brain that helps adults process emotions more effectively and efficiently than children (Tottenham, 2017). These distinct mechanisms of emotional regulation point to a critical period during which the prefrontal cortex undergoes significant functional changes.

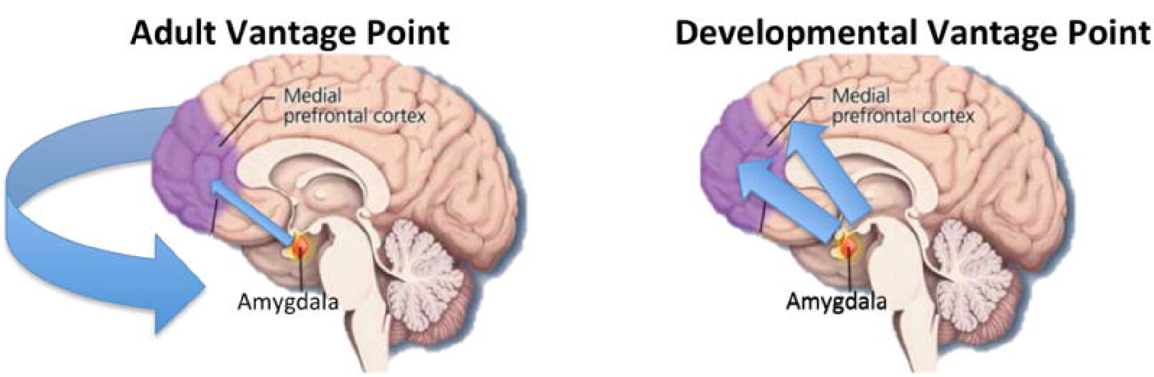


Figure 2. The relationship between the amygdala and prefrontal cortex at different developmental vantage points. During development, the amygdala is in control and is less likely to be regulated by the medial prefrontal cortex, instead it is regulated by social and environmental factors such as social interactions with teachers, peers, and caregivers. As the brain develops the prefrontal cortex begins to exert control over the amygdala during emotional processing (Tottenham & Gabard-Durnam, 2017).

This shift in the prefrontal cortex's role in emotional processing aligns with the decrease in hypersensitivity of the amygdala during childhood (Gabard-Durnam et al., 2014; Gee et al., 2013, Qin et al., 2014, Wu et al., 2016). When the amygdala is more sensitive to environmental stimuli from infancy to around ten years of age, the connectivity between the prefrontal cortex and the amygdala is largely controlled by the amygdala's reactivity to emotional stimuli (Pechtel, 2014). Research has shown that during late childhood to adolescence there is a switch and it appears that the prefrontal-cortex is able to help cognitively process and react to emotional stimuli which points to the normative decline in anxiety as well as why adults are better at regulating their emotions as compared to children (Gee et al., 2013).

A longitudinal study of mothers who experienced high levels of stress during their pregnancy showed that prenatal stress was associated with decreased functional connectivity while the structural connectivity between the amygdala and prefrontal cortex increased (Humphreys et al., 2020). These results indicate that prenatal maternal stress, and other life stressors, have significant consequences for early development of the prefrontal cortex-amygdala circutry. The neurodevelopmental outcomes on the prefrontal cortex and the amygdala must be understood in terms of toxic stress as a means of drawing conclusions about the neurodevelopmental implications of seclusion.

POTENTIAL NEURODEVELOPMENTAL OUTCOMES OF SECLUSION INFORM BEHAVIOR

Combining the literature on neurodevelopmental critical periods and toxic stress allows us to understand the implications that seclusion has for neurodevelopment of children.

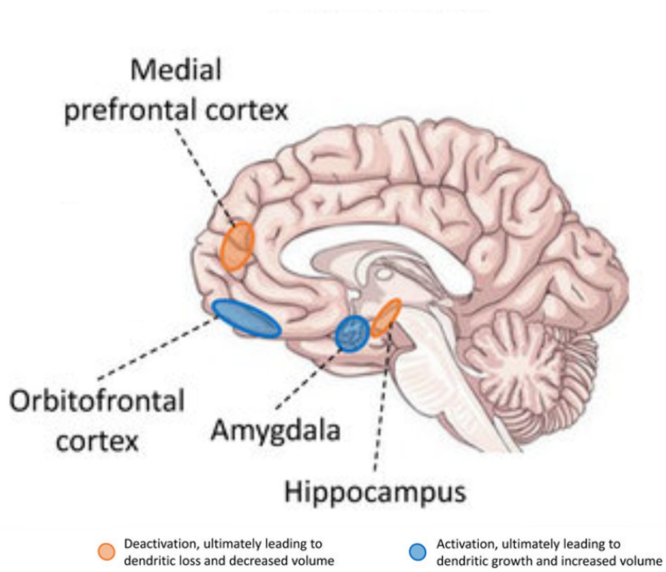


Figure 3. The Effects of Chronic Stress on Dendritic Growth and Volume of Brain Areas. Areas in blue are activated by toxic stress and experience growth. Areas in orange

are deactivated by toxic stress and experience reduction. Indicates that toxic stress may lead to an increase in the size of the amygdala and decrease in the medial prefrontal cortex. Adapted from (Heide et al., 2020)

After an experience with seclusion the toxic stress response may be triggered leading to hyperactive response of the amygdala to its environment (Zhang, 2018). When there is constant stress, fear, or threat the amygdala will constantly release stress hormones which propel the body into constant fight-or-flight mode. Hodel et al. (2016), Dannlowski (2013), and Pechtel et al. (2014) show that constant reactivity of the amygdala to its environment strengthens its neurons leading to the dendritic growth and increased volume. The amygdala also strengthens synaptic connection with the prefrontal cortex. During synaptic pruning the brain eliminates extra synapses to remove connections that are no longer needed by the brain (Chechik et al., 1998). When the brain is under toxic stress then it may fail to eliminate connections, which would have been eliminated in a healthy brain because the brain is tricked into believing that it needs them. Therefore, hyperactivity in the amygdala during neurodevelopment strengthens the synaptic connections from the amygdala to the prefrontal cortex, changing the normal circuitry that exists between them (Bremner, 2006; Gee et al., 2013; McLaughlin et al., 2019). This is in line with literature which shows that early exposure to stress reduces medial prefrontal cortex volumes in children and accelerates the development of amygdala-medial prefrontal cortex circuits (McLaughlin et al., 2019). These premature connections from the amygdala to the prefrontal cortex can have significant impacts on the prefrontal cortex's ability to regulate the amygdala. In this case, the amygdala would serve as the regulator of emotional processing instead of the prefrontal cortex.

Trauma induced toxic stress during a critical period may lead to an increase in the volume of fear centers (amygdala) and a decrease in areas involved in executive function (prefrontal cortex) which may prohibit proper prefrontal cortex-amygdala connectivity and have long-term consequences for emotional regulation. The proposed experiment aims to investigate the effects of seclusion on the ability for a child to perform emotional regulation tasks in order to better understand the neurodevelopmental implications of seclusion use in schools.

CHAPTER 3: PROPOSED EXPERIMENT

BACKGROUND AND MOTIVATION

During a behavioral disruption, teachers or authority figures may place a child in a seclusion room until the child calms down (Glod et al., 1994). Therefore, seclusion rooms are used to force students to tranquilize themselves, or intentionally regulate their emotions, before they leave the room. The goal of this study is to address two questions. First, how does seclusion influence neural responses to distressing images? Second, does seclusion affect children’s ability to regulate their responses to distressing stimuli?

The framework of reappraisal is ideal to address the questions of this study because reappraisal requires people to deliberately regulate their emotions.

Cognitive reappraisal is used to intentionally change the way one thinks about the meaning of an emotional stimulus (Ochsner et al., 2012). During reappraisal one is actively attempting to regulate their emotions by controlling the way they think about an emotion evoking situation or stimulus; however, in other implicit-autonomic forms of emotional regulation such as extinction and reinforcer reevaluation there isn't a conscious effort to engage in emotional regulation (Gyurak et al., 2011; Ochsner et al., 2012). Instead these forms of emotional regulation rely on learned experiences with a stimulus that changes the emotional value of the stimulus once it has been removed (extinction) or altered (reinforcer devaluation) (Braunstein et al., 2017). Therefore, reappraisal is the best mechanism for the proposed study because one must deliberately attempt to regulate their emotional response.

The objective of this study is to determine how past experiences of seclusion in schools may have an impact on children's processing of fear-evoking stimuli and their ability to use reappraisal to downregulate their emotional response. Additionally, this study aims to determine if this has an effect on selective brain area activity. The potential results of this study may contribute to public policy discourse about the effectiveness of seclusion in school settings.

The proposed study uses an fMRI paradigm modeled after Warren et al. (2020). This model was selected because Warren et al. demonstrated that 10-11-year-old children could perform the emotional reappraisal paradigm. In addition, the study results showed differences in cortical activity for reappraisal based on anxiety and stress levels. The aim of these researchers was to investigate how anxiety and stress alter the neurocircuit between the amygdala and dorsolateral prefrontal cortex responsible for emotional regulation. Warren et al. used clinical measures of anxiety and stress, behavioral responses, and fMRI analysis to understand how anxiety and stress affect the connectivity of the amygdala and dorsolateral prefrontal cortex. Using a drift diffusion model, the researchers determined that anxiety and stress altered the ability of individuals to engage in effective emotional regulation because it increased dynamic causal influences from the amygdala to the dorsolateral prefrontal cortex but not in the other direction (Warren et al., 2020). This finding provided insight into how anxiety and stress impact signaling between the two areas during emotional regulation. As this study similarly aims to understand how toxic stress affects connectivity between the amygdala and prefrontal cortex in children, a modified paradigm will be used.

First, there will be two different groups: a non-seclusion group and a seclusion group. Additionally, this study will use two alternative clinical measures to do statistical analyses: Pediatric Traumatic Stress Scale will measure traumatic stress and the Childhood Revised Impact of Events Scale will measure traumatic stress caused by an event (seclusion). This analysis will focus on different neural areas, including the medial prefrontal cortex and amygdala, instead of the dorsolateral prefrontal cortex and the amygdala. This is because this experiment will specifically be using fear stimuli and research has shown that fear-related behaviors are controlled by the neurocircuit between the amygdala and the medial prefrontal cortex (Davis et al., 2003; Phelps & LeDoux, 2005; Shin & Liberzon, 2011).

One branch of literature argues that using seclusion as a behavioral intervention is an effective way to reduce a child's agitation (Fogt, 2008; Ferleger, 2008; Mohr et al., 2010). In other words, these scholars believe that seclusion can be used to help a child regulate their emotions when they are being disruptive in schools. If this is true, then the proposed study will show that children who have experienced seclusion in school would be better able to reappraise their reactions to aversive stimuli. This could imply that seclusion experience actually aids in the development of emotional processing networks from the medial prefrontal cortex to the amygdala, allowing the medial prefrontal cortex to downregulate the amygdala during reappraisal.

On the other hand, an abundant field of new research contradicts these findings. Studies on children with oppositional-defiant disorder, a disorder characterized by consistent disobedient and defiant behavior towards authority figures, examined the effectiveness of collaborative problem solving (Greene, 2004). This approach differs from conventional forms of discipline because it focuses on facilitating adult-child problem solving rather than forcing and teaching children to comply with adult commands through punishment and reward (Greene, 2021). In this model, adults and children are equipped with the tools to collaboratively resolve a child's emotional behaviors or outbursts. If this is true, then the proposed study will result in children who have experienced seclusion in school being less able to down-regulate their emotions to aversive stimuli. Moreover, this study may also reveal that uncontrolled processing of an aversive stimuli shows hyperactivity in the amygdala. Thus, this would show that seclusion is an ineffective measure for regulating children's emotions and propel educators and the government to think about cultivating alternatives to discipline at their institution.

The distinction between a child who has experienced seclusion and a child who has not is that past experience with seclusion can trigger a toxic stress response even in the absence of a stressor, while a child who has not experienced seclusion would have a positive stress response only when a stressor is present (Bucci et al., 2016; Minor et al., 1984; Amat et al, 2006). If this distinction holds true, then in situations where an emotional stimulus evokes fear, children who have experienced seclusion are expected to have higher stress responses than children who have not. Therefore, the hypotheses for this study are:

1. If children have experienced seclusion then there will be hypoactivity in the medial prefrontal cortex and hyperactivity in the amygdala compared to children who have not when processing fear-evoking stimuli because of the activation of the trauma-induced toxic stress response.
2. If children have experienced seclusion then they will be less able to reappraise fear-evoking stimuli compared to children who have not because their brains will display abnormal subcortical processing leading to emotional dysregulation.

Specifically, the hypotheses for the fMRI experiment are:

To test to see if fear leads to hyperactivity in the amygdala of children who have experienced seclusion in the past, fMRI activation in the amygdala for the control and experimental groups during the aversive condition will be evaluated. If there is a substantial difference observed when evaluating the activity levels, then this indicates that when children are frightened and have a past history with seclusion, their amygdala is hyperreactive to the environment.

Because the literature has shown that the toxic stress response may be activated in children who have had a past experience with seclusion, it is expected that the amygdala will exhibit a higher level of reactivity in response to stress or threat (Bucci et al., 2016; Johnson et al., 2013). This is because in these individuals, the flight-or-fight response is activated even when there is no presence of stress/threat in an environment (Franke, 2014). So, when a threat is present in the environment these children are expected to be hypervigilant.

The prefrontal cortex's job is to modulate negative responses by exerting control over the amygdala (Arnsten, 2009). During reappraisal, it is expected that the medial prefrontal cortex down-regulates the amygdala's response to aversive stimuli thereby leading to lower levels of activity in the amygdala and higher levels of activity in the medial prefrontal cortex (Davis et al., 2003; Phelps & LeDoux, 2005; Shin & Liberzon, 2011).

When children are 10-11 years old their brains experience a switch in emotional processing. When a child is young the subcortical areas, specifically the amygdala in this case, aid in the processing of stimuli but as a child goes through development then areas involved in executive function, like the medial prefrontal cortex, begin to play a role in higher level processing. Essentially, the medial prefrontal cortex and the amygdala have some sort of anti-correlated relationship with one another. Therefore, it is expected that during the reappraisal condition if the amygdala is characterized by hyperactivity, this will lead to hypoactivity in the medial prefrontal cortex, prohibiting emotional regulation.

Next, to test the amygdala-medial prefrontal cortex connectivity, a conjugation analysis test will be used to identify regions of the amygdala commonly activated by both groups of children during reappraisal. Then, the difference in the first two BOLD fMRI signals in overlapping voxels will be compared for the seclusion and the non-seclusion group to see if there is a difference in amygdala reactivity at the start of measurements. If there is a difference, further investigation would need to be done to see how/if this amygdala activity affects medial prefrontal cortex activity. In that case, unpleasantness ratings will be correlated with brain activity in the amygdala and medial prefrontal cortex to understand how all three of these measures are correlated.

METHODS

PARTICIPANTS

Children 10-11 years of age (50% female; n=400) will be recruited from high-poverty high-diversity public school districts across the United States.

This 10-11-year-old age group of students was chosen because they would be verbal and able to effectively communicate with researchers. This narrow age group was chosen to ensure that age-related variability in brain regions involved in emotional regulation did not affect the results (Mills 2014). Research pointed out that this age is a critical stage for the development of cortical-subcortical connections between these brain areas, as a switch allows the prefrontal cortex to help process and react to stimuli (Gee et al., 2013).

This type of public school district was chosen because a goal of this study is to examine the health and wellness of low-income minority children who face high-adversity in their schools and in society. Although data has shown that low-poverty and low-diversity school districts report 6.9 restraints per 100 students compared to only 2.7 in high-poverty high-diversity school districts, these metrics were extrapolated from published U.S. government data that does not fully encompass the issue due to a lack of reporting from many school districts (Gagnon et al., 2013). Additionally, high-diversity, high-poverty school districts are more likely to have more low-income minority students who are targeted by the school to prison-pipeline, in which case, these disciplinary practices would be more common even if they go unreported.

MATERIALS

CLINICAL MEASURES

These Pediatric Traumatic Stress Scale (PTSS) and Child Revised Impact of Events Scale (CRIES-8) will be used to perform statistical analyses. The PTSS is used to determine if a child is experiencing traumatic stress, whereas the CRIES-8 scale is used to assess if children are at risk for PTSD due to a specific life event. The statistical analyses used aim to ensure that the independent variable is what is leading to the results in the dependent variable. If seclusion is linked to traumatic stress and trauma, then it is important to ensure that seclusion itself is leading to these results and not the other confounding variables (Pechtel et al., 2014; Bouwmeester et al., 2001; Pattwell et al., 2016). They will be included in the statistical analysis instead of the methodological approach because this increases the generalizable validity of the study, prioritizing external validity and forgoing internal validity.

The PTSS will be used to evaluate if a child is experiencing traumatic stress (Intermountain Health, 2020). This scale was developed in collaboration between the Department of Pediatrics at the University Utah and the Center for Safe and Healthy Families at Intermountain Healthcare's Primary Children's Hospital. This clinical measure asks children to indicate if a traumatic event has happened to them recently and if something like that had happened in the past and how often in the past month: they have had bad dreams pertaining to the incident or generally; they have had trouble going to sleep, waking up often, or getting back to sleep; and they have had trouble paying attention to name a few (Intermountain Health, 2020). The Intermountain Health (2020) measure does not require that children think of a seclusion in school; instead, it is more generalized and determines if a child has trauma from any kind of adverse life event.

For this specific study, all children will use the form meant for children who are 11, as 1) this form allows children to self-report which may provide more truthful answers and 2) using the same scale for everyone eliminates error (Index B).

The CRIES-8 Scale will be used to determine if indirect or direct experiences with seclusion had an effect on a child. This is a child-friendly measure (ages 8 to 18) used to screen children for PTSD in response to a specific traumatic event; thus, it can signify if seclusion has caused trauma for a child (Horowitz et al., 1979; Perrin et al., 2005). When the questionnaire is presented to children, they will be asked to think about their experiences with seclusion before rating how frequently certain statements were true for them within the past seven days (Index C). The types of questions asked on the scale include: Do you think about [the incident] even when you don't mean to? Do you try to remove it from your memory? Do you have waves of strong feelings about it? (Perrin et al., 2005) In the past, children diagnosed with PTSD showed significantly higher scores on the CRIES-8 compared to children without PTSD, signifying that it is an effective measure for assessing traumatic stress in response to a specific life event (Stallard et al., 1999).

It would be expected that children who have experienced seclusion would have trauma from the event, which could trigger a toxic stress response; thus, they would be expected to score higher on the CRIES-8 scale compared to children who have not experienced seclusion.

On the other hand, on the PTSS all children would be expected to score within the same range. All students are recruited from high-poverty high-diversity school districts. Outside these public school districts, children live in the same high-adversity environment riddled with poverty, community violence, racism, gender-based violence, etc. (Centers for Disease Control [CDC], 2021). Therefore, it is expected that all children recruited for this study experience similar levels of traumatic stress because of their similar environmental conditions.

Therefore, PTSS and CRIES-8 scores may be a confounding variable in the study that may lead to the conclusions that are made based on the data found in the study. In this study, these variables will be controlled for using statistical analyses to determine if they have any effect on the data observed.

PROCEDURE

The paradigm for this experiment will be modeled after the one used by Warren et al. (2020). Children will be told that they will see an instructional cue word 'LOOK' or 'LESS' followed by a picture. During 'LOOK' cues, children will be presented with a fear-evoking or neutral picture and will be asked to notice their feelings toward the picture; during 'LESS' cues, children will be asked to reappraise the fear-evoking picture by making it seem more positive or less frightening by telling themselves some sort of story (Warren et al., 2020). After exposure to these images, children will be asked to rate their feelings toward the picture. Participants will also be coached on different reappraisal strategies and practice reappraising images prior to starting the experiment, until researchers feel that they have understood how to emotionally regulate via the reappraisal mechanism (Warren et al., 2020).

The images used in the study will be from the International Affective Picture System (IAPS; Lang et al., 2008). which will be pretested to ensure they are appropriate for children. Neutral and fear-evoking pictures are intended to elicit a strong negative emotional response. Fear-evoking images were selected for this study because fear triggers the amygdala to go into the flight-or-fight response; however, during reappraisal the medial prefrontal cortex is expected to regulate amygdala activity and if it cannot do so, this indicates emotional dysregulation. The fear-evoking images were high-arousal and the neutral one was low-arousal, based on emotional valence and arousal dimensions determined by the IAPS (Lang et al., 2008).

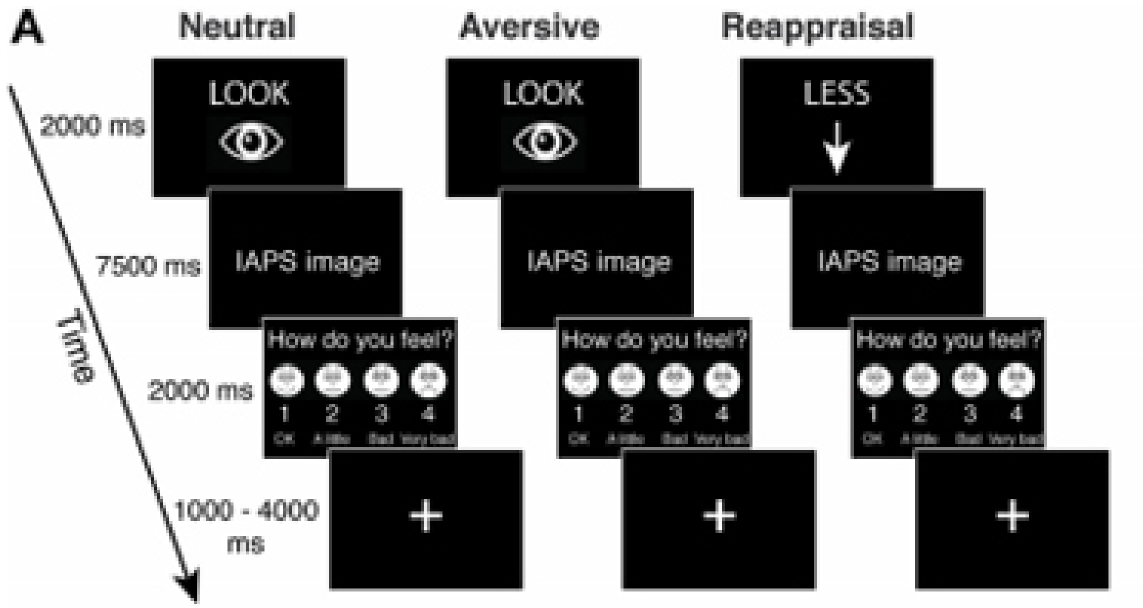


Figure 4. Emotional Regulation Task. (Warren et al, 2020)

Each trial will begin with a 2-second instructional cue word (LOOK or LESS), which will be followed by a fear-evoking or neutral image appearing for 7.5 seconds, followed by a rating scale that will appear for 2 seconds (Warren et al., 2020). Participants will rate how they felt during each of these conditions.

The rating scale will be number 1-4, with 1 indicating that there was an okay response to the picture and 4 indicating that the picture was very scary. The unpleasantness ratings of the reappraisal condition for each individual child will be correlated with amygdala and medial prefrontal cortex activity to determine the interaction between reappraisal ability and activity in these brain areas. Significant differences in the mean unpleasantness rating during the aversive and reappraisal conditions will serve as a metric of reappraisal success.

Prior to this experiment, parents of children 10-11 years old will fill out a seclusion questionnaire which will divide them into seclusion and non-seclusion groups based on the answers.

- Seclusion/Experimental group:
  - To qualify for the experimental group a child's parent must indicate in the seclusion questionnaire that: their child has been placed in a seclusion room because of his or her behavior, their child has been placed in a seclusion room because of his or her behavior in the last year, in the past year their child has been secluded five or more times, and that each time it lasted more than forty-five minutes. To ensure that the experiences referenced can be classified as seclusion the parent must answer yes to all sub questions for question four of the survey (Index A).
- Non-Seclusion/Control Group
  - To qualify for the control group a child's parent must indicate that they have not experienced a seclusion incident in school, on the seclusion questionnaire (Index A).

Children will be eliminated from the study if they do not meet the parameters for each group, they demonstrate excessive motion during functional magnetic resonance imaging, and if they fail to engage in the behavioral task yielding a new study sample of (n=100; seclusion=50 non-seclusion=50) (Warren et al., 2020).

In this study, the independent variable will be the groups children are assigned, and the dependent variable will be the BOLD signal responses and behavioral data taken for each child. After parents and children provide informed consent, children and their parents will fill out questionnaires. Next, they will go through fMRI safety training and will be familiarized with the fMRI environment and the tasks. Then the kids will go into the scanner and perform an emotional reappraisal task while BOLD responses are collected.

FMRI DATA PROCESSING

fMRI data will be pre-processed and analyzed using a standard SPM12 pipeline (need ref for SPM (Ashburner, 2021). The pre-processing pipeline parameters are modeled after McRae et al. (2012) who conducted an fMRI experiment which also dealt with emotional regulation. For the proposed study, 25 axial slices (4mm thick, 1 mm skip) will be collected using a 3T scanner with a T2* sensitive gradient echo-spiral-in-out-pulse sequence (TR=2.00, TE=30ms, 60° flip angle, 24-cm field view, 64x64 data acquisition matrix) (2012). Two scanning runs will be conducted with 30 experimental trials each. There will be 20 trials in each of the three task conditions (Warren et al., 2020).

RESULTS

STATISTICAL ANALYSIS

I will conduct a group (seclusion, non-seclusion) x condition (emotion, reappraisal) ANCOVA on BOLD responses in the amygdala and medial prefrontal cortex using the clinical measures as covariates to control for clinical disorder severity to determine if the group difference is about seclusion practices rather than psychiatric issues or trauma experience. The PTSS and CRIES-8 measures will be used as separate covariates for the ANCOVA statistical analysis.

A two-way ANCOVA can be used in this study to determine whether there is an interaction effect between the independent variable: the treatment group (“non-seclusion/control” and “seclusion/experimental) in terms of a continuous dependent variable (mean BOLD signal response), after adjusting for each of the covariates (Pediatric Traumatic Stress Scale Scores, and Childhood Revised Impact of Events Scale Scores) during each emotional regulation task (“aversive condition” and “reappraisal condition”).

I will conduct four separate two-way ANCOVAs:

- assessing mean BOLD signal response in the amygdala after adjusting for a child’s PTSS score
- assessing mean BOLD signal response in the medial-prefrontal cortex after adjusting for a child’s PTSS score
- assessing mean BOLD signal response in the amygdala adjusting for CRIES-8 score
- assessing mean BOLD signal response in the medial-prefrontal cortex adjusting for CRIES-8 score.

In this ANCOVA there are two main effects, an interaction plus any interactions with the covariate. In the effect condition we would expect to observe a difference between the aversive and reappraisal conditions because this is evidence that emotional regulation is occurring. Interaction of group with condition suggests that past experience with seclusion leads to differences in the ability to emotionally regulate. If psych disorder and trauma experience do not significantly interact with any of these then clinical disorders are not influencing the results.

i. assessing mean BOLD signal response in the amygdala after adjusting for a child's PTSS score

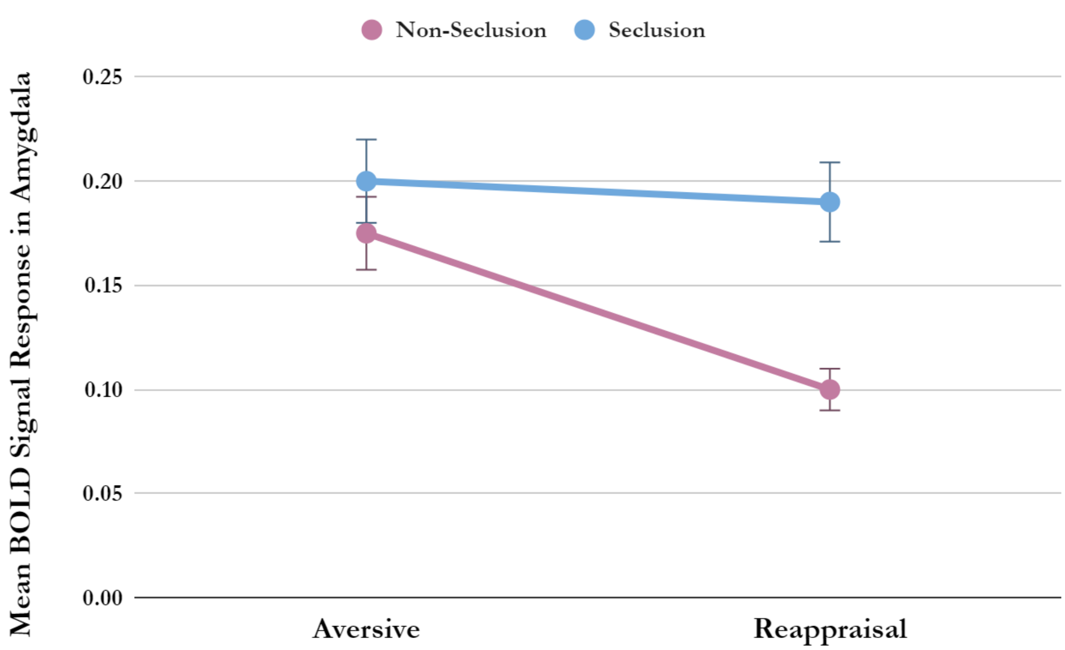


Figure 5. BOLD fMRI signals during the aversive and reappraisal conditions in the amygdala holding PTSS scores constant. All groups are n=50

This figure shows that there is decreased amygdala activity during reappraisal for the non-seclusion group but not for the seclusion group. This data shows that when the psych disorder is held constant then the expected results are observed. This indicates that when the PTSS score is held constant as a covariate, there is no significant effect on the expected results of the study indicating that the results of this study are because of seclusion and not due to the presence of psychiatric disorders in the seclusion group interfering with the reappraisal ability.

ii. assessing mean BOLD signal response in the medial-prefrontal cortex after adjusting for a child's PTSS score

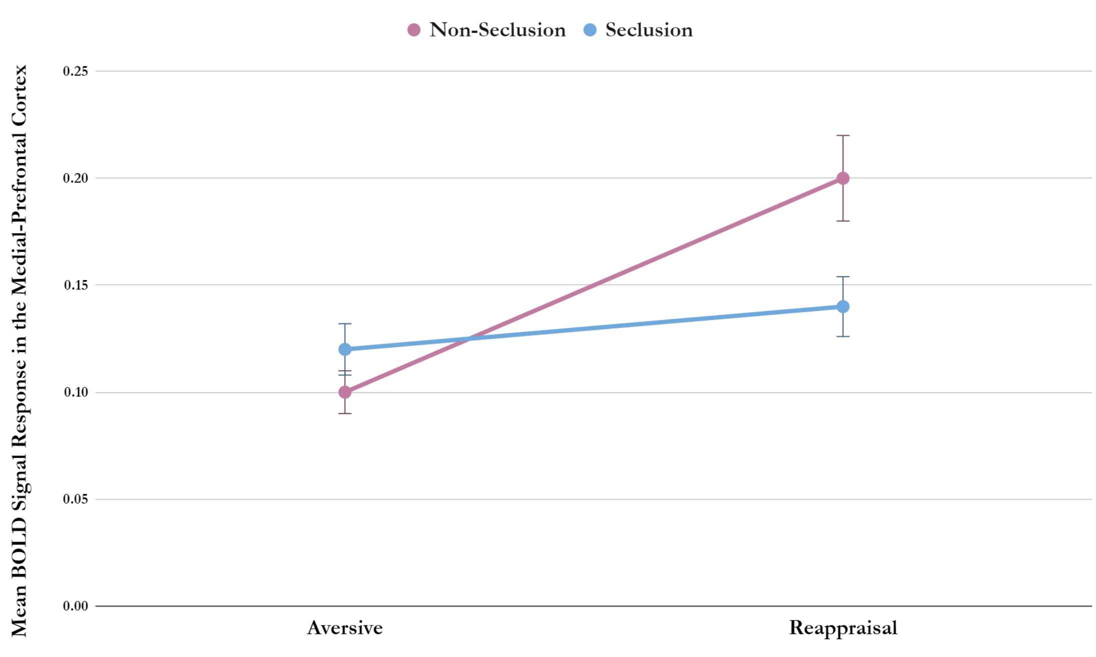


Figure 6. BOLD fMRI signals during the aversive and reappraisal conditions in the medial prefrontal cortex holding PTSS scores constant. All groups are n=50

This figure shows that there is increased medial prefrontal cortex activity during reappraisal for the non-seclusion group but not for the seclusion group. This data shows that when the psych disorder is held constant then the expected results are observed. This indicates that when the PTSS score is held constant as a covariate, there is no significant effect on the expected results of the study indicating that the results of this study are because of seclusion and not due to the presence of psychiatric disorders in the seclusion group interfering with the reappraisal ability.

When the Pediatric Traumatic Stress Scale scores are used as a covariant with the data, it appears that the seclusion group is unable to effectively engage in reappraisal. This is indicated because the data shows that there is no significant difference between the mean amygdala BOLD signal response between the aversive and reappraisal conditions as they continue to remain high (Figure 7). Additionally, the data shows that there is no significant change in the mean prefrontal cortex BOLD signal response between the aversive and reappraisal conditions as they continue to remain low (Figure 8). This suggests that the prefrontal cortex is unable to downregulate the amygdala during the reappraisal condition when this measure is controlled for. This is in line with what is expected of the seclusion group.

Taken together, this means that the PTSS score a child receives does not have a significant effect on the results obtained in the study. This indicates that kids in both conditions may have clinical disorders; however, when they are controlled for there are still effects of seclusion practices on neural regulation in the amygdala and medial prefrontal cortex. This is in line with the prediction of the statistical analysis because all these children exist in high-adversity conditions making them equally susceptible to stress related disorders.

This measure is used to generally evaluate if a child is experiencing traumatic stress. If this is ruled out, then it can be ruled out that these effects are observed because the seclusion group has a psychiatric disorder and the non-seclusion group does not. From these results, it is assumed that if a child has been put in seclusion in the past then this is what is leading to the reduced ability to reappraise a stressful stimulus.

iii. assessing mean BOLD signal response in the amygdala adjusting for CRIES-8 score

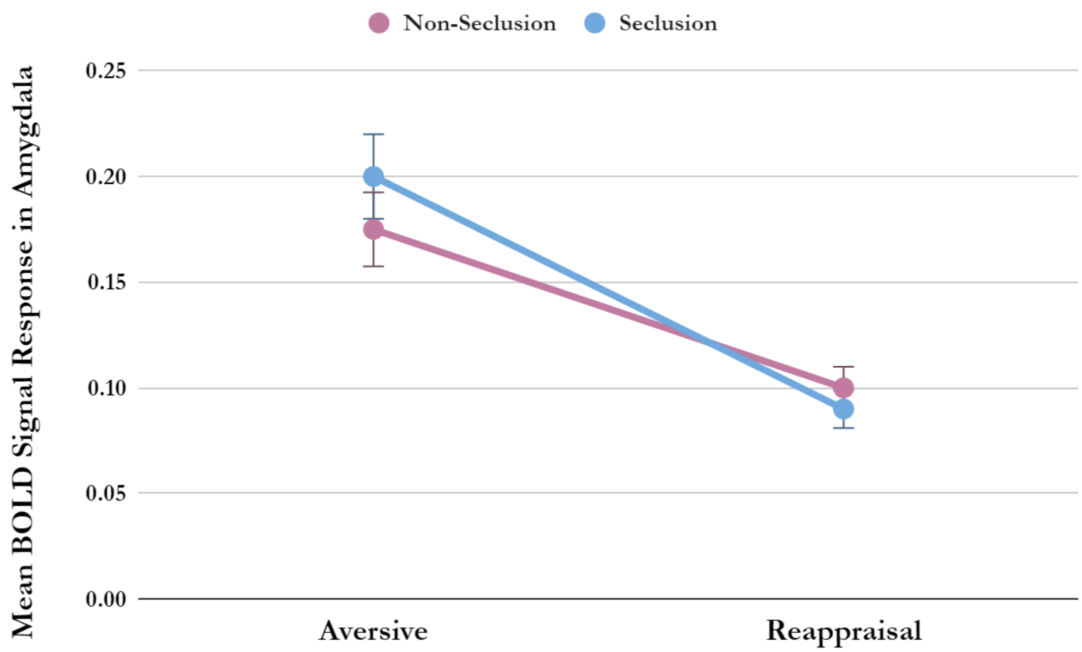


Figure 7. BOLD fMRI signals during the aversive and reappraisal conditions in the amygdala holding CRIES-8 score constant. All groups n=50

This figure shows that there is decreased amygdala activity during reappraisal for both groups (non-seclusion and seclusion). This data shows that when the trauma (specific to a seclusion incident; CRIES-8 score) is held constant then the expected results are not observed. This indicates that a child's CRIES-8 score has a significant effect on the expected results of the study.

iiii. assessing mean BOLD signal response in the medial-prefrontal cortex adjusting for CRIES-8 score.

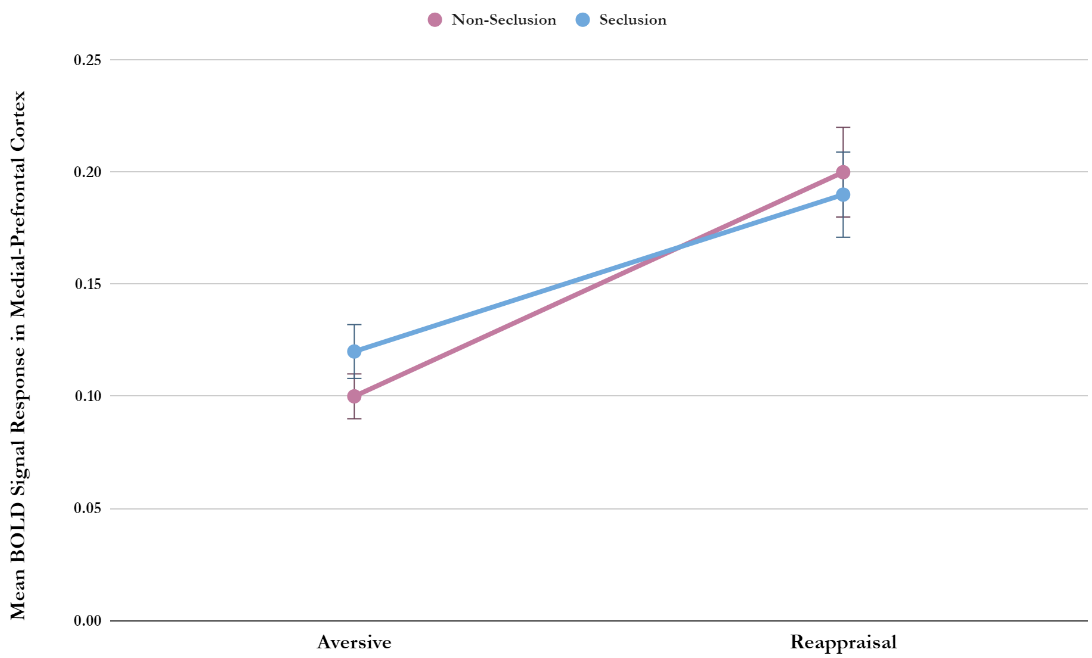


Figure 8. BOLD fMRI signals during the aversive and reappraisal conditions in the medial-prefrontal cortex holding a child's CRIES-8 score constant.

This figure shows that there is increased medial prefrontal cortex activity during reappraisal for both groups (non-seclusion and seclusion). This data shows that when the CRIES-8 score is held constant as a covariate then the expected results are not observed. This indicates that what a child scores on the CRIES-8 scale has a significant effect on the expected results.

When the Childhood Revised Impact of Events Scale scores are used as a covariate, it appears that the seclusion group is still able to effectively engage in reappraisal. This is indicated because the data shows that there is a significant difference between the mean amygdala BOLD signal response between the aversive and reappraisal conditions as they go from high to low (Figure 9). Additionally, the data shows that there is a significant change in the mean medial-prefrontal cortex BOLD signal response between the aversive and reappraisal conditions because it goes from low to high (Figure 10). Moreover, there appears to be no significant difference between the non-seclusion and seclusion group as there are overlapping error bars for that data of each brain area (Figure 9, Figure 10). When this measure is controlled for then the data shows that the seclusion group can effectively reappraise a stimulus through the down-regulation of the amygdala by the prefrontal cortex.

Taken together, this means that seclusion induces trauma on children which leads to this pattern of results. Since children will be asked to think about their experiences with seclusion prior to filling out this clinical questionnaire, these results show that the expected results of this study occur because of the long-lasting trauma of a seclusion incident. As this clinical measure has been linked to PTSD development, these results suggest that the long-lasting trauma of seclusion may induce the toxic stress response leading to emotional dysregulation (inability to effectively reappraise).

To further test the hypothesis, fMRI data must be analyzed.

BEHAVIORAL DATA ANALYSIS

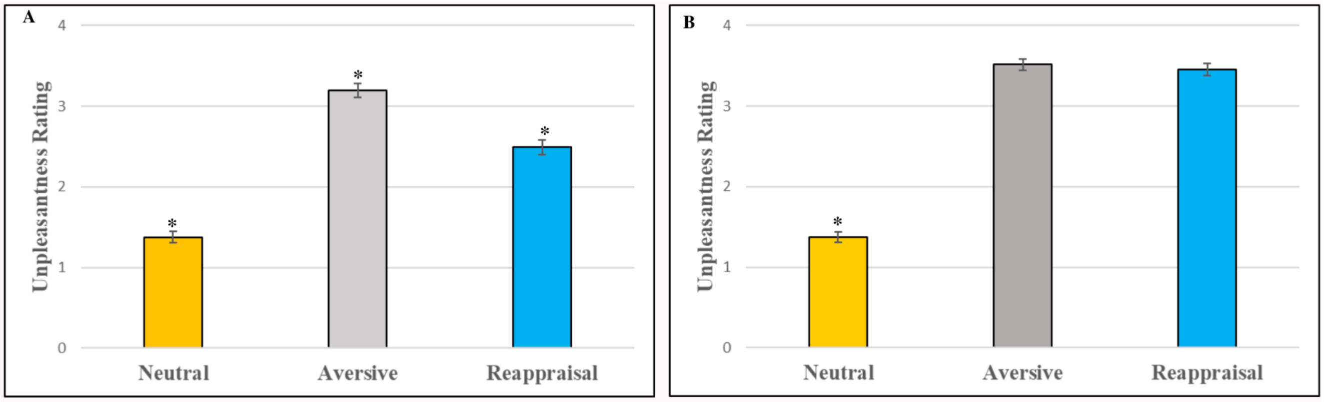


Figure 9. Mean Unpleasantness Rating. A) Control Group (Non-Seclusion Group) B) Experimental (Seclusion Group) *p <.05 (statistically significant difference between conditions)

The figure shows that there is a significant difference between the means of the unpleasantness ratings in each condition for the non-seclusion group. The significant difference between the reappraisal and aversive conditions indicate reappraisal success (Figure 9A). On the other hand, (Figure 9B) shows that children with a past history of seclusion only show a significant difference between the neutral condition and the other conditions. Moreover, there is no significant difference between the reappraisal and aversive condition unpleasantness ratings indicating reappraisal failure. Further fMRI analysis can provide more insight into the significance of this behavioral data.

FMRI ANALYSIS

I. Brain Activity During the Different Conditions

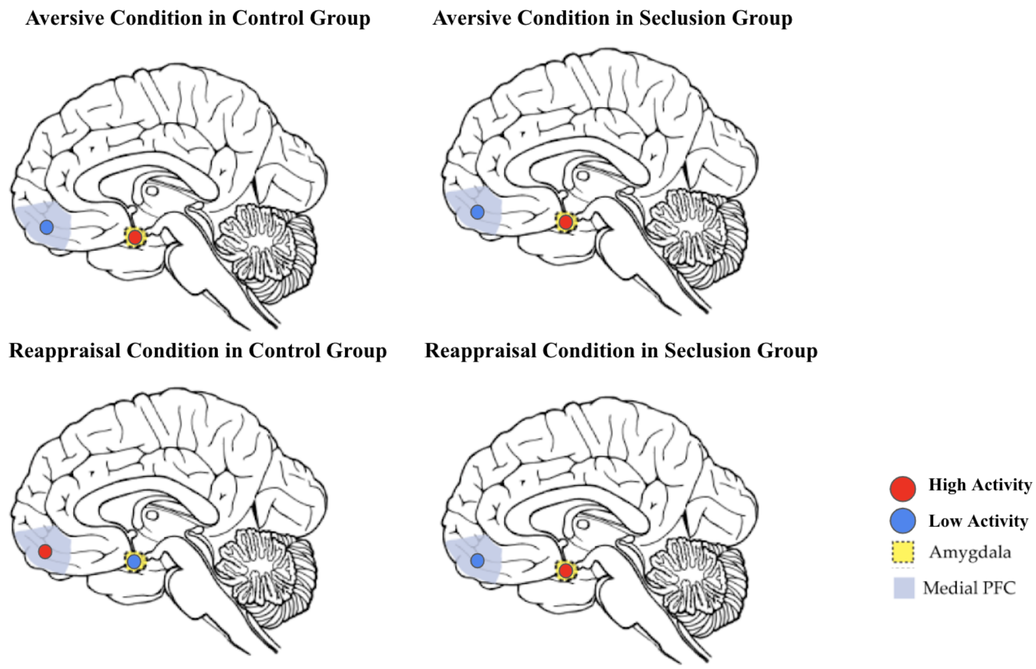


Figure 10. Differential Brain Activation During Fear Condition vs. Reappraisal

Adapted from (Young, Sandman, Craske, 2019)

This figure shows that during the aversive condition both the control group and the seclusion group will be expected to experience high activity in the amygdala and low activity in the prefrontal cortex. During the aversive condition, researchers would expect this result in both groups because they are unconsciously processing the fear-evoking picture leading to increased activity in the amygdala because both the seclusion group and the non-seclusion control group would be frightened by the image.

In the non-seclusion group, there is high activity in the prefrontal cortex and low activity in the amygdala during appraisal. This indicates that the non-seclusion group is able to effectively reappraise the fear-evoking picture.

On the other hand, if a child has experienced seclusion researchers would potentially see that during reappraisal there isn't a significant difference in the brain activity when compared to the activity in the aversive condition. The difference between the reappraisal and aversive conditions would still be less for the seclusion group when compared to the non-seclusion group. This indicates that if a child has experienced seclusion then they would be less able to reappraise a stimulus.

Although the results show that in both the seclusion and non-seclusion groups, the amygdala exhibits higher activity during the aversive condition, the extent of the activity will need to be established to see if the seclusion group experiences hyperactivity in response to a negative stimulus.

II. Hypothesis I Analysis

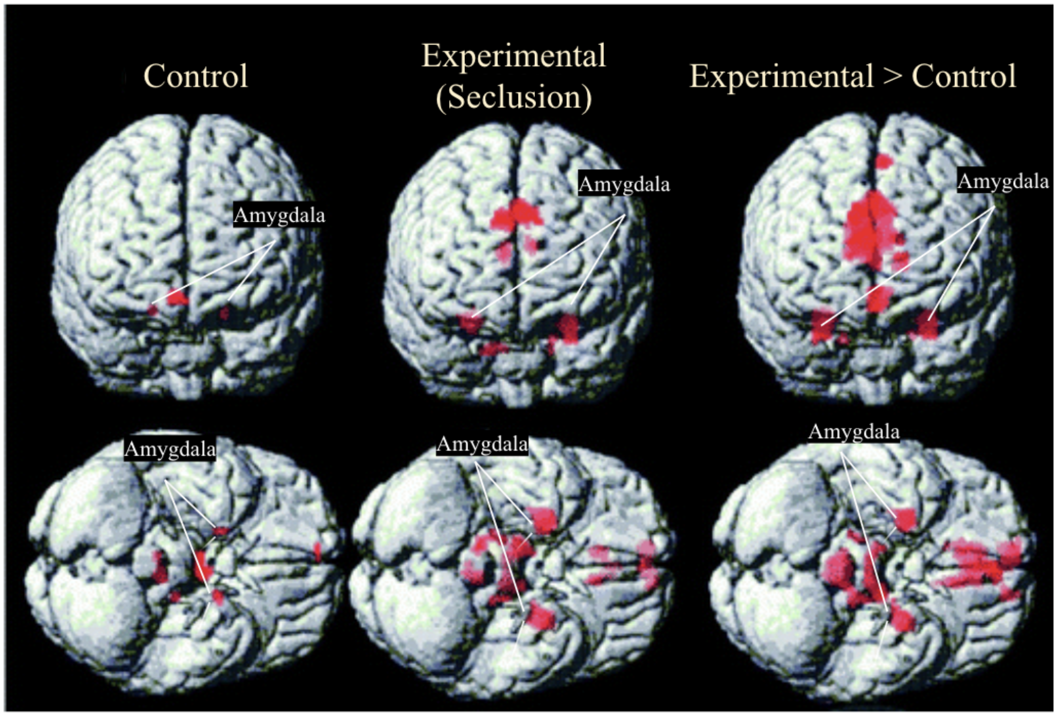
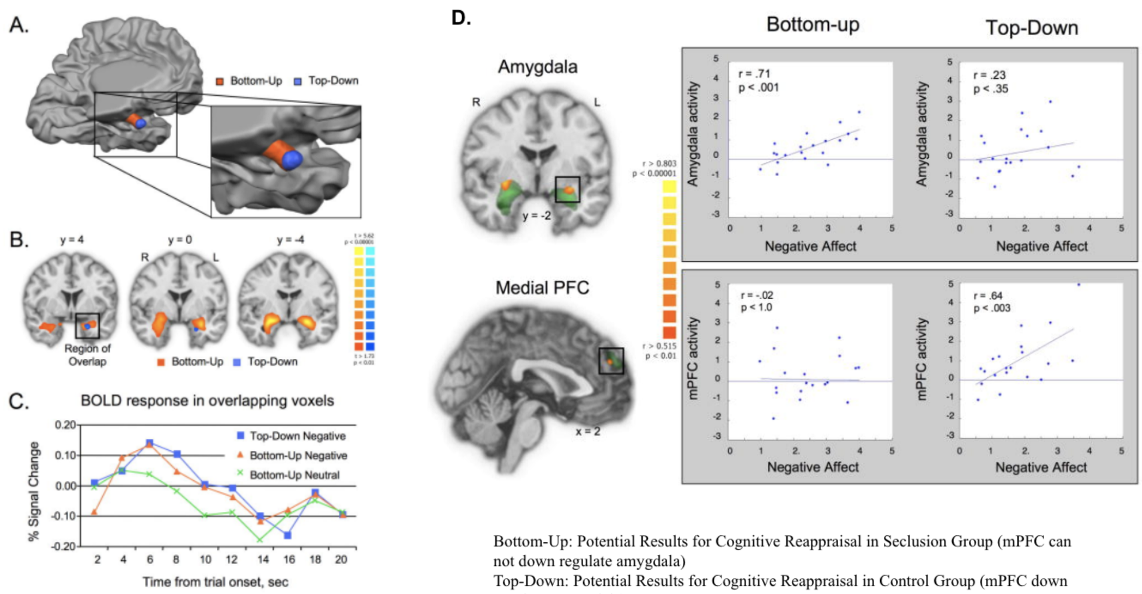


Figure 11. Hyperactivation of Amygdala in Seclusion Group During Viewing of Fear Condition Adapted from (Gordon, 2007)

This figure shows the activity in the amygdala during the aversive condition for the control group and the experimental group. This figure indicates that compared to the control group, the seclusion group has elevated levels of amygdala activity in response to the threat/stress stimulus.

After determining that there is hyperactivity in children with a past experience with seclusion as opposed to children with no past history of seclusion then further investigation would lead to answers about how this affects the prefrontal cortex.

III. Hypothesis II Analysis



Bottom-Up: Potential Results for Cognitive Reappraisal in Seclusion Group (mPFC can not down regulate amygdala)
Top-Down: Potential Results for Cognitive Reappraisal in Control Group (mPFC down regulates amygdala)

Figure 12. BOLD fMRI signals indicate amygdala-mPFC causal interaction

(Ochsner et al., 2009)

Researchers will use a conjunction analysis which will show them that during the reappraisal process for the seclusion and the control group the left amygdala is the area commonly involved in the reappraisal process (Figure 12A and 12B; Ochsner et al., 2009). The time courses of activation for both reappraisal in the seclusion group (bottom-up) and the non-seclusion group (top-down) will be extracted by looking at the average % signal change in BOLD responses over the course of the experiment (Figure 12C; Ochsner et al., 2009). The results show that amygdala activity difference for first two BOLD measurements is greater during the reappraisal process for the seclusion group versus control indicating that the amygdala is more active at the start of reappraisal for children who have experienced seclusion in the past.

This will confirm previous findings in this experiment (Figure 11). As this is during the reappraisal process a higher activity in the amygdala of the seclusion group as compared to the control group at the beginning of the experiment will indicate that during the reappraisal process the prefrontal cortex is not able to down-regulate the amygdala. This is why the activity of the amygdala is higher in the seclusion group as compared to the control group, because in the control group the prefrontal cortex is down-regulating amygdala activity. However, researchers will need to do further investigation to posit this.

Therefore, negative affect or unpleasantness ratings will be correlated with brain activity during reappraisal for the seclusion and non-seclusion group. The correlations between self-reported unpleasantness and brain activity during reappraisal for the seclusion group indicates that the medial prefrontal cortex is unable to down-regulate the amygdala; however, the opposite is seen in the control group (Figure 12D; Ochsner et al., 2009).

SUMMARY OF DATA ANALYSIS

In summary, these results indicate that seclusion induces trauma which leads to hyperactivity in the amygdala when there is a fear-evoking (stress inducing) stimulus present (Figure 7, Figure 8, Figure 11) . Moreover, this hyperactivity decreases the amygdala-mPFC connectivity which allows the mPFC to downregulate the amygdala during emotional regulation (Figure 12). This causes emotional dysregulation in children who have experienced seclusion.

CHAPTER 4: DISCUSSION

The purpose of this proposed study is to determine the effects that seclusion discipline in schools has on neurodevelopment. There are three key findings of the proposed research. First, a past experience with seclusion is a stressful life event which induces trauma which has an effect on the emotional processing of children. Second, the trauma of a seclusion event leads to hyperactivity in the amygdala in response to a fear-evoking stressful stimulus. Third, children who have experienced seclusion are less able to engage in the reappraisal process of fear stimuli because the medial-prefrontal cortex is unable to down-regulate the amygdala effectively.

These results support the hypotheses that if children have experienced seclusion then there will be hypoactivity in the prefrontal cortex and hyperactivity in the amygdala when processing fear-evoking stimuli and that they will be less able to reappraise fear-evoking stimuli.

These results indicate that the trauma of a seclusion experience impedes brain development of the areas primarily responsible for normal emotional regulation. One interpretation of these findings is that trauma induces a toxic stress response in children which leads to abnormal subcortical processing causing emotional dysregulation. The present conclusion is consistent with research on uncontrollable stress (toxic stress response) in animal models (Minor et al., 1984; Amat et al., 2006) which shows that uncontrollable (toxic stress) and not controllable stress (positive stress) impair the function of the prefrontal cortex, making it unable to suppress stress response. Therefore, the results of the study are reflective of a toxic stress response in children. Moreover, literature on the effects of trauma induced stress on neurodevelopment (Bremner, 2006; Gee 2013; McLaughlin et al., 2019) shows that childhood trauma and early stress exposure cause the amygdala to become hyperactive which strengthens the synaptic connections from the amygdala to the prefrontal cortex, disrupting the normal circuitry that exists between them. Furthermore, Marusak et al. (2015) and Thomsan et al. (2015) identified that early trauma exposure prevents the development of connections between the prefrontal cortex and the amygdala, which are critical for emotional response. This study supports the literature that seclusion has negative neurodevelopmental consequences for the brain because during a critical period these traumatic experiences can lead to the strengthening of neural networks in the amygdala, causing amygdala hyperactivity. This triggers the toxic stress response impeding the cortical control the prefrontal cortex is meant to have on emotional regulation.

Besides the interpretation of the proposed data, an additional explanation warrants comment. This study is one of the first to propose a mechanism for studying the effects of seclusion and restraint on the neurodevelopment of emotional regulation. However, no single study can address the issue in totality as there are a multitude of factors that this proposed study will not investigate. One outcome of this study could be that we do not find interactions between group and condition. A lack of interactions might indicate that seclusion practices do not influence emotional regulation in the brain. However, this finding may also point to limitations of the study design. One potential limitation might be the way that groups were assigned, indicating that the questionnaire was not an effective way to group individuals because its limited variability in the population. Another potential limitation in the proposed study design is the instrumentation used, as the fMRI may not be a strong enough instrument to draw conclusions from. Lastly, the reappraisal paradigm itself may not be sensitive enough to identify a distinct difference in the data of children who have experienced seclusion in the past and those who have not.

To expand on these populations, future directions in regard to group assignment will be discussed with the purpose of aiding researchers hoping to implement this study. The population chosen for the study has significant effects on how a child interprets a seclusion experience. Factors such as culture, family, socioeconomic differences, race, disability, access to mental healthcare services, a supportive caregiver, age, the onset/recency of seclusion and many more variables can impact the level of trauma a child undergoes in response to a seclusion experience. These kinds of factors should be taken into consideration and questions about them should be asked in the seclusion questionnaire, prior to the study. It is important that in future studies, researchers take a more extensive prior history.

Moreover, statistical analyses can determine how these factors play a role in children's experiences with seclusion. It would be important to succeed this study with future research that has the most significance for a public policy debate. One such study would investigate whether the onset of seclusion or the age at which a child experiences seclusion has an impact on emotional regulation. This is important to investigate as a follow-up to this study because age has a significant effect on a child's ability to comprehend a situation, especially in terms of neurodevelopmental changes that occur between age groups.

Another aspect of seclusion that was not accounted for in this study was that there are different forms of seclusion rooms with different names and structures. The results could be affected by the type of seclusion room a student was put into in the past and what it is called. In the future, researchers could group seclusion room types into categories based on different factors such as their name, how they look, etc. They can then group children into different seclusion room types to see if this has a significant effect on the results.

On the second implication, alternative measures could be used to analyze the results of the study, these measures could be taken in conjunction with or instead of solely fMRI scans. These alternative measures could be autonomic stress responses which would be measured either in conjunction with or instead of fMRI scans. Some examples of autonomic stress response measures include using indexes such as respiratory sinus arrhythmia [RSA], pre-ejection period [PEP] and electrodermal activity [EDA] as used by Morris et al. (2020) in an experiment that tested emotional regulation via the autonomic nervous system in children with ADHD (Morris et al., 2020). Integrating these into the experiment would allow future researchers to see how children's stress responses differ in the aversive and reappraisal conditions if they have experienced seclusion in the past.

On the third implication, another choice is to integrate The Montreal Imaging Stress Task [MIST] which consists of a series of computerized mental arithmetic challenges (Dedovic et al., 2005). The MIST triggers stress as the challenges get harder, and it includes a component where participants evaluate social stress components built into the program, which can be used to process the effects of perceiving and processing psychosocial stress during fMRI (Dedovic et al., 2005). If this was used in conjunction with fMRI processing then this would serve as the "emotional regulation task", and the fMRI would measure how children regulate stress. A researcher could assess whether children who have experienced seclusion react differently to stressful situations. This approach could be used instead of the emotional regulation task itself.

In summary, future researchers may want to take autonomic stress measures, a more extensive family history, or manipulate alternative variables. Despite the limitations of this proposed study, the proposed results suggest several important public health and public policy implications.

First, the proposed results suggest that experiencing seclusion has a significant effect on the brain architecture that is built when children interact with the environment (Zhang & Meany, 2010). During childhood the brain is susceptible to pressures in its environment, meaning the neural circuits are highly sensitive to elevated levels of stress (National Scientific Council on the Developing Child, 2020). The brain develops through the response of subcortical areas to the environment which send neural signals to cortical areas by creating connections, these connections inform higher level functions later in life (National Scientific Council on the Developing Child, 2020).

The proposed results found that in response to toxic stress, the emotional regulation network experiences dysfunction due to deficits in the amygdala and medial prefrontal cortex, a loss of connectivity from the amygdala to the prefrontal cortex, as well as hyperactivity in the amygdala (Amat et al., 2006; Minor et al., 1984;). When the toxic stress response is triggered, the systems involved in the stress response activate more easily and do not turn off as easily as they should (National Scientific Council on the Developing Child, 2020). The effects of toxic stress on the prefrontal cortex can lead to dysregulation of other executive functions outside of emotional regulation, such as higher levels of cognitive function, impulse control, and attention (Eiland et al, 2012; McEwen et al. 2016). Therefore, the effects of seclusion on the neurodevelopment of emotional regulation can lead to further behavioral problems due to deficits in attention and impulse control. This suggests that this disciplinary policy is actually more harmful than it is beneficial because it has a significant effect on a child's ability to regulate their emotions. This then impacts the child’s ability to become a productive member of society because not being able to control oneself has a significant impact on social relationships, work, school, and more.

Second, taking into consideration the disproportionate use of seclusion policies on minority populations links these neurodevelopmental consequences to systemic oppression. These policies are disproportionately used on disabled, Black, and Brown children in public schools (U.S. Department of Education Office of Civil Rights, 2014). In terms of neurodevelopmental deficits, a seclusion experience can trigger a toxic stress response. Moreover, toxic stress leads to dysregulation in the executive functions controlled by the prefrontal cortex, including impulse control and attention. If seclusion is used more on marginalized children, they are more likely to be less able to control their impulses and pay attention in school. In fact, research (Lansford & Dodge, 2008; Weiss et al., 1992; Patterson, Dodge & Bates 1992; Bailey et al., 2009) has shown that harsh discipline, including seclusion, leads to high levels of aggression and delinquency– exhibiting the link between seclusion, neurodevelopmental deficits, and behavioral disruptions. If these disruptions are built into the architecture of the brain, this leads to the repetition of a behavior that a child may not be able to control. To this point, a study of Chicago Public Schools found that for 25% of students, being disciplined actually led to an increase in disruptive behavior and these students preferred being kicked out of the classroom (Atkins et al, 2002). Seclusion use in public schools indirectly pushes students away from the classroom and into the prison system leading to the over-representation of marginalized individuals in prisons, jails, and juvenile detention facilities (Tolley, 2021; Lansford & Dodge, 2008).

Third, from a public health perspective the toxic stress response in children has been linked to significant physiological consequences. Toxic stress in children can lead to the persistent activation of the inflammatory system which can cause damage to body organs and weaken the immune system, making it less efficient in fighting diseases (Staurb, 2014, Wolf 2008). This means that children who are secluded in schools may develop chronic inflammation, which growing evidence suggests is linked to chronic diseases such as heart disease, diabetes, depression, arthritis, autoimmune disorders, and many more (Cohen et al, 2012). Furthermore, research has shown that toxic stress induces chronic inflammation which has been linked to the development of diabetes and obesity (Hackett, 2017; Dallman 2010). This link between neurodevelopment, neuroendocrinology, and disease development sheds light on how this disciplinary practice can manifest into physiological consequences for children who experience them. Therefore, the toxic stress response is a fundamental risk factor for the development of chronic stress-related illnesses; as such, seclusion as an inducer of this response can likewise contribute to the development of chronic illnesses.

Most importantly, the results of the study explain why seclusion has been cited as relatively ineffective for mitigating disruptive behavior, because the neuroscience underlying this process exemplifies that this experience may actually lead to a child having a harder time regulating their emotions (Jones, 2002). Instead of mitigating the problem, it may actually make it worse. From a policy perspective the implications of this proposed research study display that seclusion is an ineffective policy for helping children regulate their emotions. Moreover, the neurodevelopmental consequences of seclusion on children, as well as its broader implications, cannot be ignored. These findings should push policymakers to develop non-punitive means to help mitigate children's behavioral issues in public schools. One such approach that has been studied in-depth is the collaborative problem-solving approach.

The Collaborative Problem-Solving Approach differs from conventional forms of discipline because it focuses on facilitating adult-child problem solving rather than forcing and teaching children to comply with adult commands through punishment and reward (Greene, 2004). It is based on the premise that behavioral problems are due to a lack of skills that a child possesses and aims to target this through a supportive problem-solving approach (Greene & Ablon, 2006). This approach treats behavioral problems as a disability in terms of behavior, citing that children would do better if they were equipped with better skills. In this model, behavioral problems are seen as "incompatibility episodes" meaning that the expectations that an educator has for a student are incompatible with the skills the student possesses (Greene & Ablon, 2006). In this model, the caregiver and the child work collaboratively to solve issues in behavior– the school staff teaches the child the skill they are lacking and the child works with the school staff by displaying that they have learned the skill through a series of drills (Greene & Ablon, 2006). In this way, both educators and children can work together to solve behavioral problems. Moreover, this model actually builds skills to address behavior, which has a positive effect on neurodevelopment. This is because high cognitive skills get integrated into the prefrontal cortex which increases its connectivity to other brain areas, positively influencing higher level cognitive functions like attention, problem solving, and decision making later in life (Nelson, de Haan & Thomas, 2015).

This proposed study can be seen as a first step towards integrating two lines of research: neurodevelopment and seclusion discipline in schools, which have not been directly linked in the literature. The present research, therefore, contributes to a growing body of evidence suggesting that seclusion as a disciplinary policy in public schools is an ineffective means of regulating students' behavior. I hope that this analysis pushes policy makers to 1) pass laws that will protect children from the use of both seclusion and restraint in public schools, and 2) create laws implementing less-punitive policies for the most vulnerable children.

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A. SECLUSION QUESTIONNAIRE

Copy of Determining How Discipline Impacts Emotional Regulation-Seclusion Questionnaire

The W.M. Keck Science Department of the Claremont Colleges (Keck Science) is conducting this survey to see if your child qualifies to participate in clinical research about the impact seclusion has on the development of a child's brain. for find out how prevalent the use of seclusion and restraint is in South Dakota schools, and whether there is a need for state laws and rules to regulate the use of seclusion and restraint. We are looking for information from parents/guardians whose child currently attends a Public School in the U.S. and is enrolled in the fifth grade. Whether your child was/is placed in seclusion please feel out this survey so we can find participants.
This survey has 10 questions and should take approximately 10-15 minutes to complete.

We thank you for your time in completing this survey. Please contact Keck Science if you have any questions.
This survey is adapted from the South Dakota Advocacy Services - Seclusion/Restraint Questionnaire.

* 1. Please list your name, contact information, and fill out demographic information about your child.

Name __________

Phone Number __________

Email __________

Child's Age __________

Child's Grade in School __________

Child's School District= __________

2. Please Check All That Apply for Your Child

- ☐ My child has been placed in a seclusion room because of his or her behavior
- ☐ My child has been placed in a seclusion room because of his and her behavior in the past year
- ☐ My child has not experienced a seclusion incident before

3. If your child has experienced seclusion in the past year, how many times have they been placed in a seclusion room?

- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5+

4. If your child was placed alone in a room (seclusion) please indicate all that apply

	Yes	No
Could your child leave the room if he/she wanted to?	○	○
Was the door locked or held shut?	○	○
Was someone monitoring your child in the room?	○	○
Was the room ventilated, lit, and clean?	○	○
Was there a way to visually monitor the child?	○	○

5. If your child was placed alone in a room (seclusion) please estimate the amount of time they spent in seclusion during each indecent

	Less that 45 Minutes	More than 45 Minutes
Incident 1	○	○
Incident 2	○	○
Incident 3	○	○
Incident 4	○	○
Incident 5	○	○

Done

B. PEDIATRIC TRAUMATIC STRESS SCREENING TOOL

Pediatric Traumatic Stress Screening Tool

11 years and older

Sometimes **violent** or **very scary** or **upsetting** things happen. This could be something that happened to you or something you saw. It can include being badly hurt, someone doing something harmful to you or someone else, or a serious accident or serious illness.

Has something like this happened **recently**? ❑ Yes ❑ No

If 'Yes,' what happened? ______________________________

Has something like this happened **in the past**? ❑ Yes ❑ No

If 'Yes,' what happened? ______________________________

If you checked 'yes' on either question above, please continue below.

Select how often you had the problem below in the past month.
Use the calendars on the right to help you decide how often.

FREQUENCY RATING CALENDARS

	How much of the time during the past month...	None	Little	Some	Much	Most
1	I have bad dreams about what happened or other bad dreams.	0	1	2	3	4
2	I have trouble going to sleep, waking up often, or getting back to sleep.	0	1	2	3	4
3	I have upsetting thoughts, pictures, or sounds of what happened come into my mind when I don't want them to.	0	1	2	3	4
4	When something reminds me of what happened I have strong feelings in my body, my heart beats fast, and I have headaches or stomach aches.	0	1	2	3	4
5	When something reminds me of what happened I get very upset, afraid, or sad.	0	1	2	3	4
6	I have trouble concentrating or paying attention.	0	1	2	3	4
7	I get upset easily or get into arguments or physical fights.	0	1	2	3	4
8	I try to stay away from people, places, or things that remind me about what happened.	0	1	2	3	4
9	I have trouble feeling happiness or love.	0	1	2	3	4
10	I try not to think about or have feelings about what happened.	0	1	2	3	4
11	I have thoughts like "I will never be able to trust other people."	0	1	2	3	4
12	I feel alone even when I'm around other people.	0	1	2	3	4

13	*Over the last 2 weeks, how often have you been bothered by thoughts that you would be better off dead or hurting yourself in some way?	Not at all	Several days	More than half the days	Nearly every day

*Adapted from Patient Health Questionnaire (PHQ-A)

Clinicians, please indicate actions taken:

☐ **No Action Taken**

Referrals: (check all that apply)

- ☐ Child Protection (DCFS / CPS)
- ☐ Crisis Evaluation / Emergency Department
- ☐ Trauma Evidence-Based Treatment
- ☐ Mental Health Integration (MHI)

In-office Interventions: (check all that apply)

- ☐ Sleep Education
- ☐ Belly Breathing
- ☐ Guided Imagery
- ☐ Progressive Muscle Relaxation

Patient Name: ______________________ Patient DOB: __________ EMPI__________

Intermountain Healthcare

Pat Qst 50113

C. CRIES-8 SCALE

CRIES–8

Date: ☐☐ / ☐☐ / 20☐☐ **Time:** ☐☐ h ☐☐ m

Below is a list of comments made by people after stressful life events. Please mark each item showing how frequently these comments were true for you <u>during the past seven days</u>. If they did not occur during that time please mark the 'not at all' box.

	Frequency during the last week:	0	1	3	5
1	Do you think about it even when you don't mean to?	Not at all	Rarely	Sometimes	Often
2	Do you try to remove it from your memory?	Not at all	Rarely	Sometimes	Often
3	Do you have waves of strong feelings about it?	Not at all	Rarely	Sometimes	Often
4	Do you stay away from reminders of it (e.g. places or situations)?	Not at all	Rarely	Sometimes	Often
5	Do you try not to talk about it?	Not at all	Rarely	Sometimes	Often
6	Do pictures about it pop into your mind?	Not at all	Rarely	Sometimes	Often
7	Do other things keep making you think about it?	Not at all	Rarely	Sometimes	Often
8	Do you try not to think about it?	Not at all	Rarely	Sometimes	Often

NHS ID: ....

Service allocated case ID ....

Intrusion subscale total
QUESTIONS: 1,3,6,7

Avoidance subscale total
QUESTIONS: 2,4,5,8

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