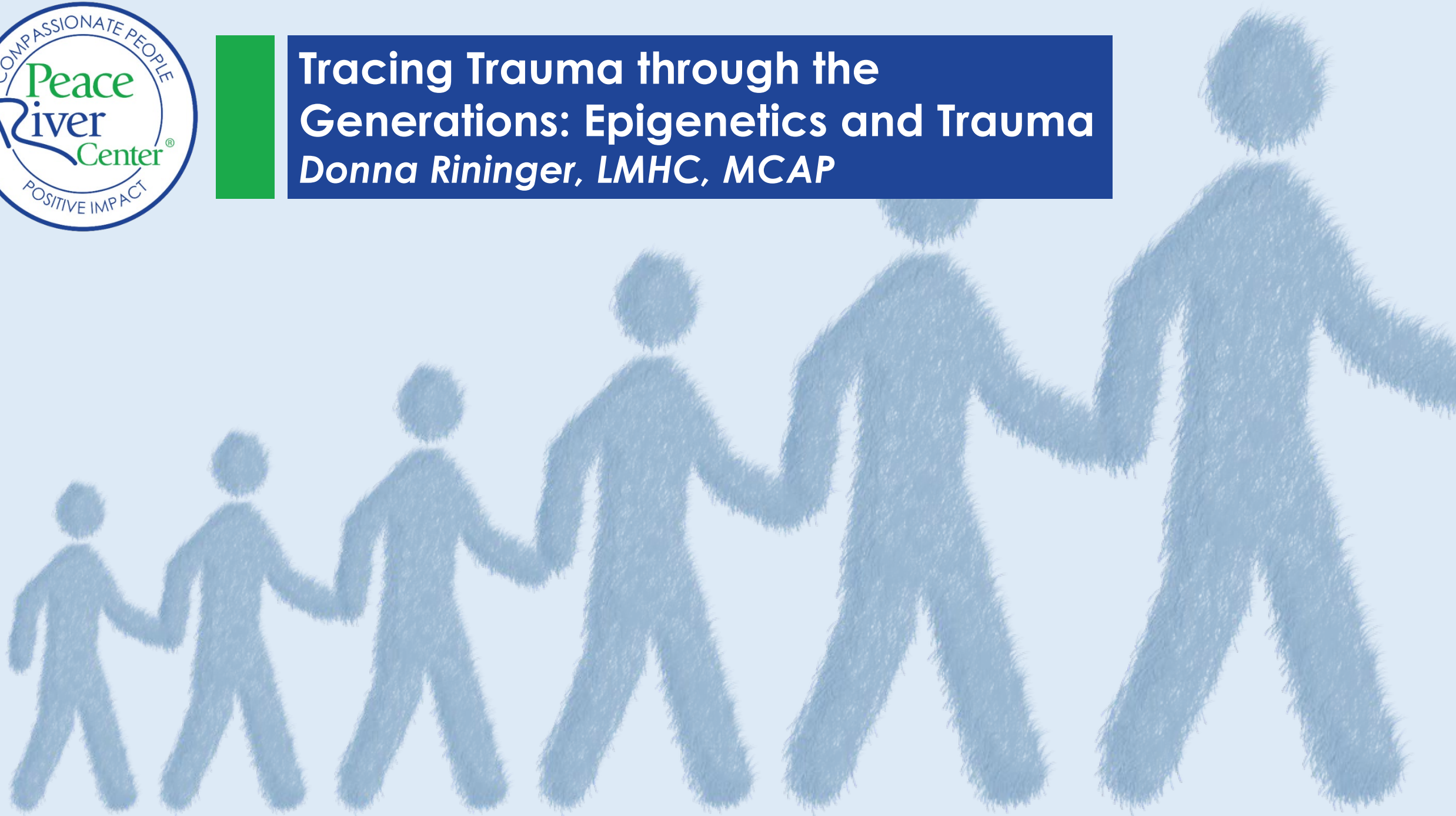
Tracing Trauma through the Generations: Epigenetics and Trauma

Donna Rininger, LMHC, MCAP



Questions We Will Explore

How does trauma affect our brains, body, and behaviors?

What is this new branch of science- epigenetics?

What do the current research findings tell us?

How does trauma affect families through the generations?

How can we use this information to help our clients?

How does trauma affect our brain and body?

Responsible for survival instincts and autonomic body responses

Reptilian (brain stem)

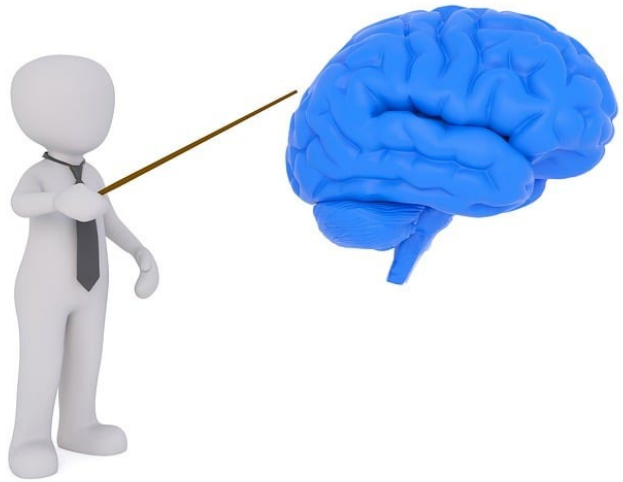
Neommalian (cortex, forebrain)

Mammalian (limbic, midbrain)

Thinking Center controls decision-making, learning, memory, cognitive processing

Processes emotions-anterior cingulate and amygdala (fear)

During a traumatic experience, the reptilian brain takes control, shutting down all non-essential body and mind processes. In a normal situation, when immediate threat ceases, the brain shifts the body into restorative mode. **In 20% of trauma survivors, that shift never occurs and remains in a constant reactive state.**

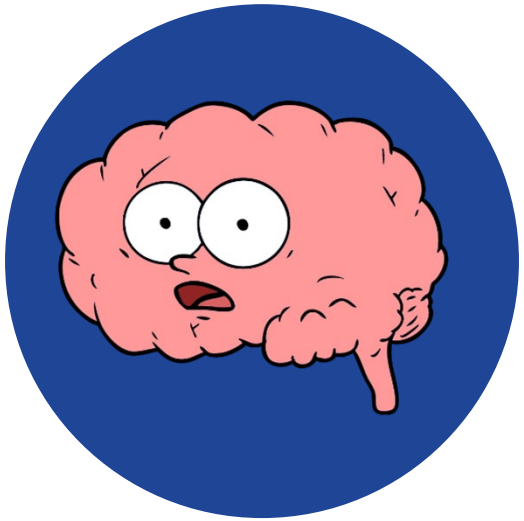


As introduced by Neuroscientist Paul D. McLean

The Traumatized Brain

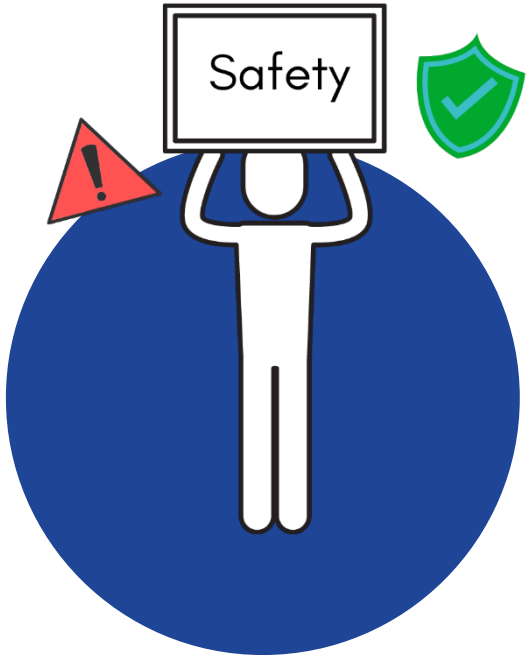
Prefrontal Cortex deactivates and person loses a sense of time, becoming trapped in the moment.

Thinking center is under activated.



Amygdala makes no distinction between past and present.

The Emotion Regulation center is under activated.

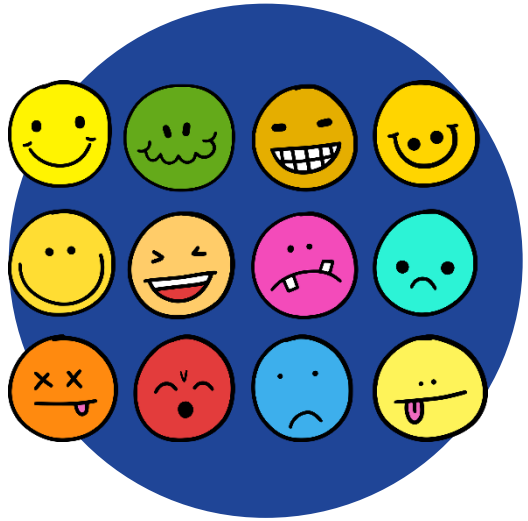


Thalamus can no longer distinguish what information is relevant and what can be safely ignored.

The Fear center is over activated.

Trauma Impact

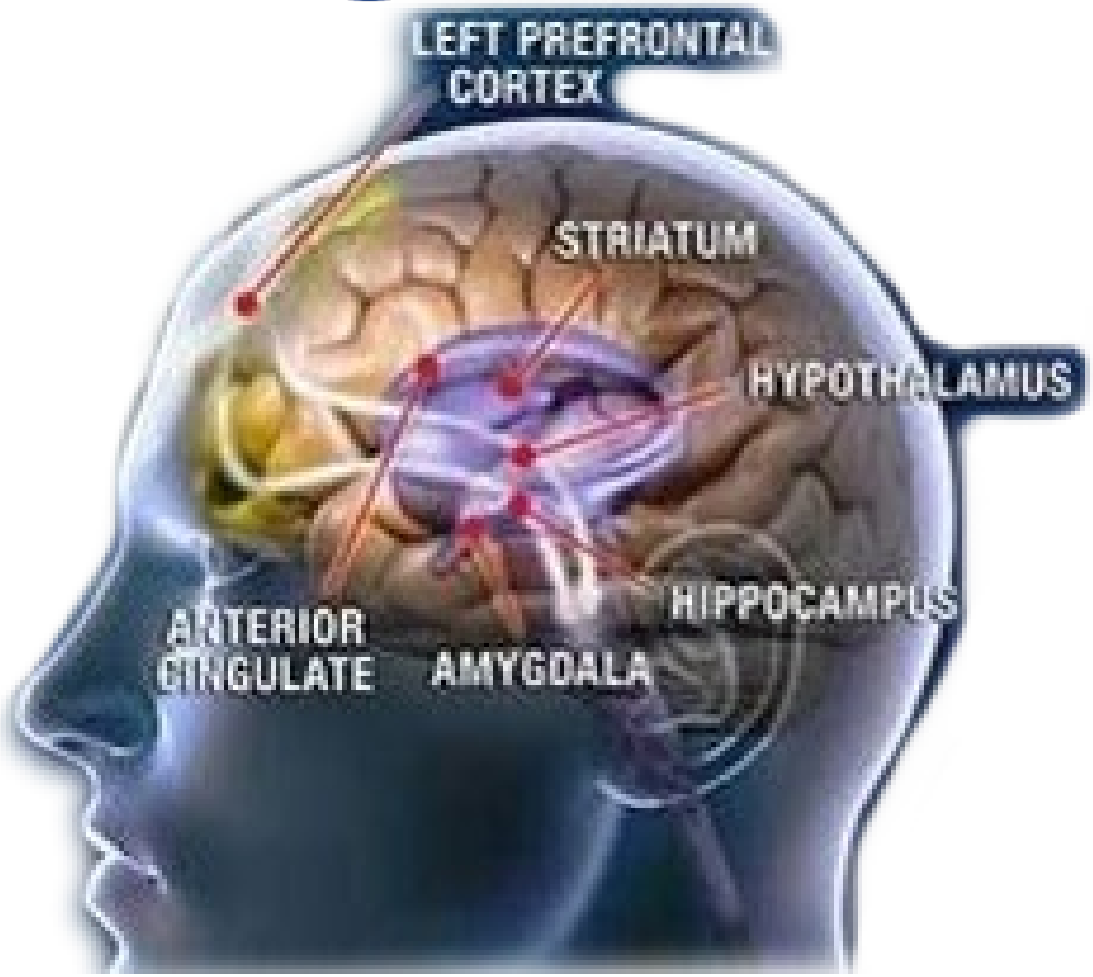
Our brains stop processing memory fully, leaving us with fragments of what happened.



Our ability to manage a range of emotion decreases.

We become stifled and stuck, unable to plan for the future.

Amygdala

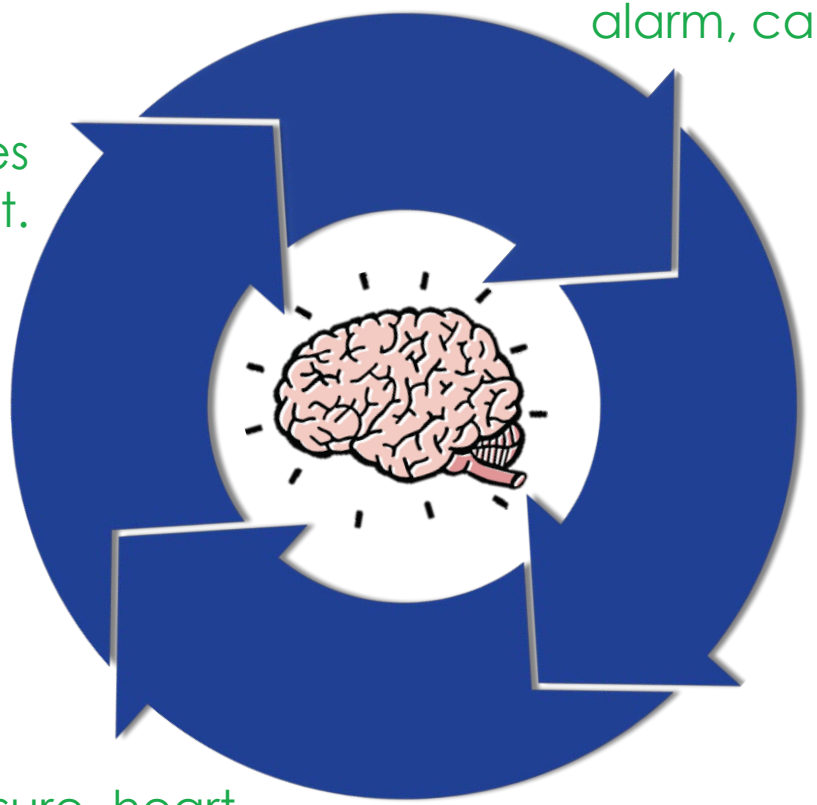


The Amygdala is a cluster of brain cells that determines whether a sound, image, or body sensation is perceived as a threat.

Brain imaging scans show that when people are presented with images or sounds related to their trauma experience:

The amygdala triggers alarm, causing fear.

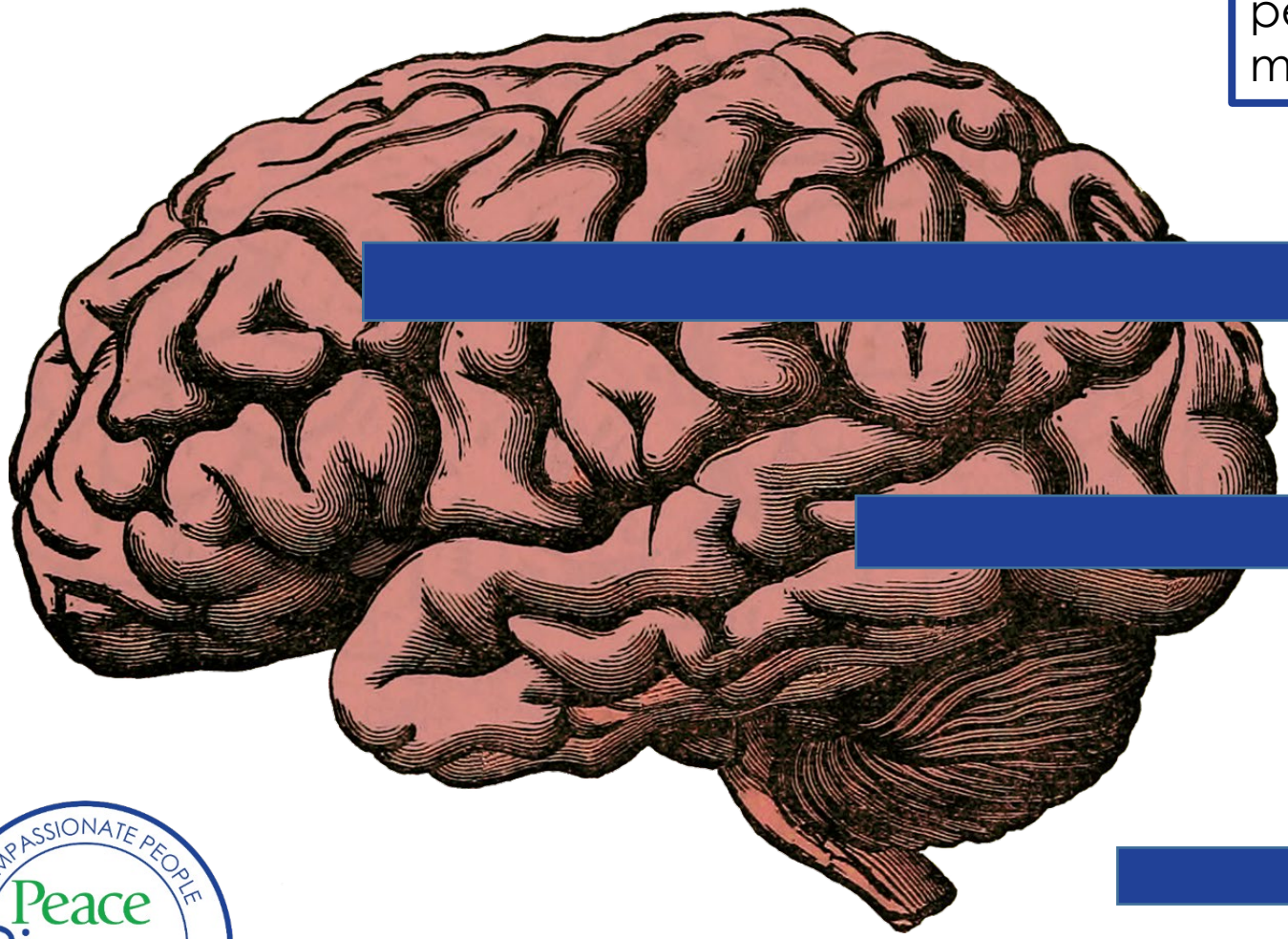
Body prepares for fight or flight.



Activation of fear center triggers release of stress hormones.

Blood pressure, heart rate, and oxygen intake increases.

Without some degree of regulation, it is difficult to relate or connect to another person, and without connection, there is minimal reasoning.



Cortex- **REASON**

Limbic- **RELATE**

Brainstem- **REGULATE**

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What We Have Learned About Trauma and the Brain

- Trauma leaves an imprint on our brains that **affects our capacity to think clearly**, changing how we think and what we think about.
- Traumatized people have **trouble learning from their experiences.**
- Traumatized people tend to **superimpose their trauma** on everything around them.
- Traumatized people **keep secreting large amounts of stress hormones** long after the actual danger has passed to escape a threat that may no longer exist.

Four Common Consequences of Exceeding Our Stress Capacity

- More likely to behave in ways that work against our values and goals.
- More likely to fall back into freeze mode.
- More likely to engage in faulty neuroception—perceiving danger in safe situations or vice versa.
- More likely to engage in maladaptive coping choices.

Trauma produces:

1. Physiological changes
2. Increase stress hormonal activity
3. Inability to filter between relevant and irrelevant information (thalamus)

How does trauma affect our bodies and behaviors?

Insomnia

Constipation

Sleep disruption

Extramarital affairs

Lack of concentration

high blood pressure

CHRONIC PAIN

Dissociation

Hypervigilance

Compromised immune system

Physical illness

Bullying

ANGER OUTBURSTS

Workaholic

Startle reflex

Addiction

Flashbacks

Sexual dysfunction

Domestic violence

Overachievement

Self-harm

Adrenaline-seeking behaviors

Eating disorders

Trauma-informed Care

SAMHSA's Concept of Trauma and Guidance for a Trauma-Informed Approach, developed in 2014, provided the first framework for the provision of services in the field. Trauma-informed care has become a standard practice across all of health and human services.

Leading the World…in Stress and Trauma

The US is one of the most stressed and traumatized countries in the world. 89% of adults in the US report having experienced at least one traumatic event in their lives, with most adults reporting exposure to multiple traumatic events.

Incarceration rates:

- Norway 71 per 100,000
- Netherlands 81 per 100,000
- US 781 per 100,000
- The US spends $84 billion/year to incarcerate people. European countries spend only a fraction of that.

European countries' universal health care, ensures a minimum wage, paid parental leave for both parents after the birth of a child, and high-quality childcare for all working mothers.

European crime rate lower, cost of medical care is half that of US, academic test scores higher.

Brain Structure Reflects Our Lives

The US is the most violent, stressed, and traumatized country in the world. Only Yemen, embroiled in a civil war, has a higher **mass shooting rate** than we do. (2019) We also hold the world's **highest drug-death rate.**


Today, Americans:
• Have fewer marriages,
• Participate less in social groups,
• Volunteer less, and
• No longer entertain in their homes.
Young people are replacing real-world interactions with their smartphones.
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Knowledge Explosion

Interpersonal Neurobiology- The study of how our **behavior influences** the emotions, biology, and mindsets of those around us.

Developmental Psychopathology-The study of the **impact of adverse experiences** on the development of the brain and mind.

Neuroscience- The study of how the brain supports **mental processes**.

Somatic Psychology- The study of interactions among brain, mind, body, and behavior and how this directly affects **psychological and physical health**.

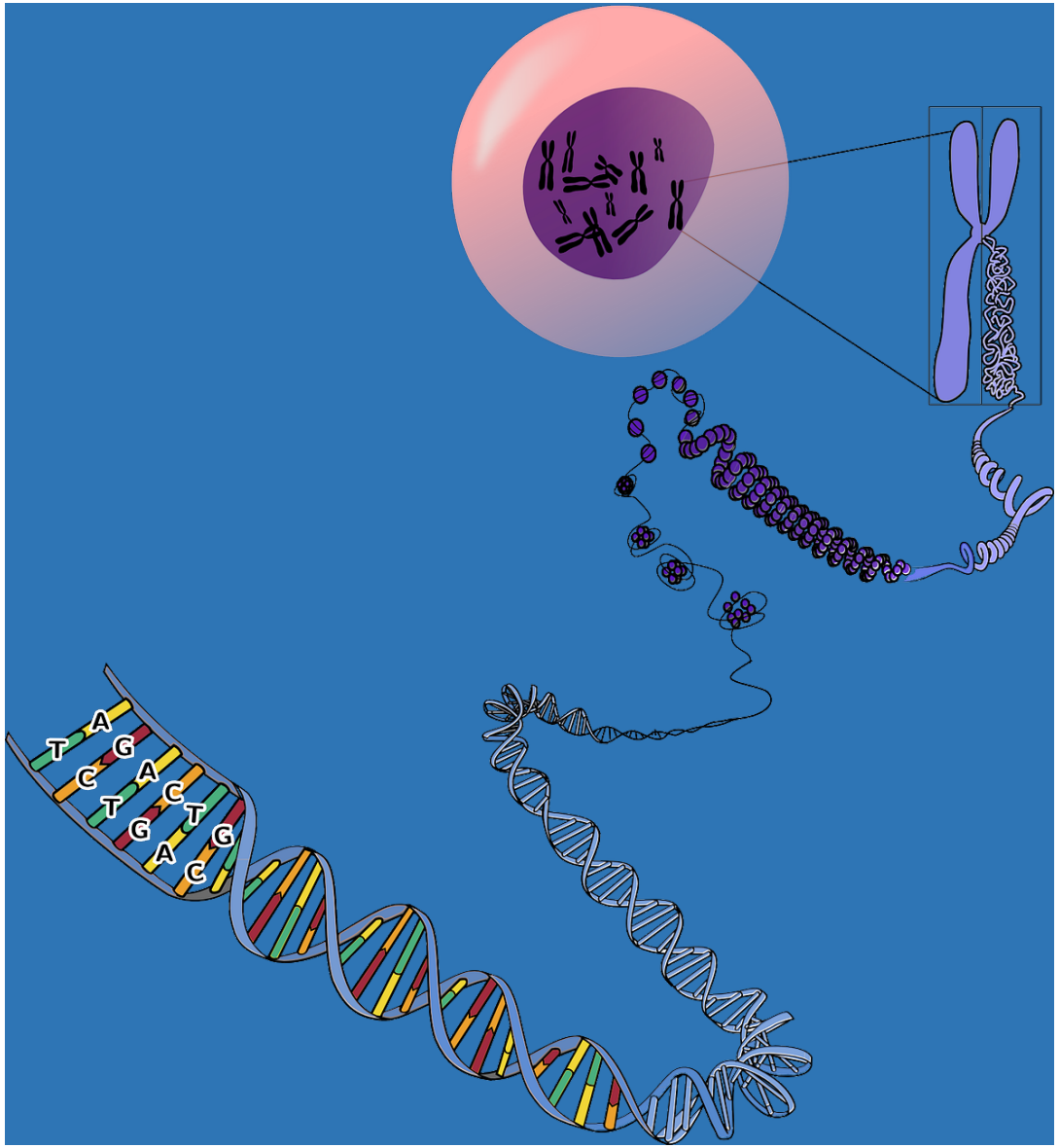
Epigenetics- The study of changes in organisms caused by **modification of gene** expression rather than alteration of the genetic code itself.

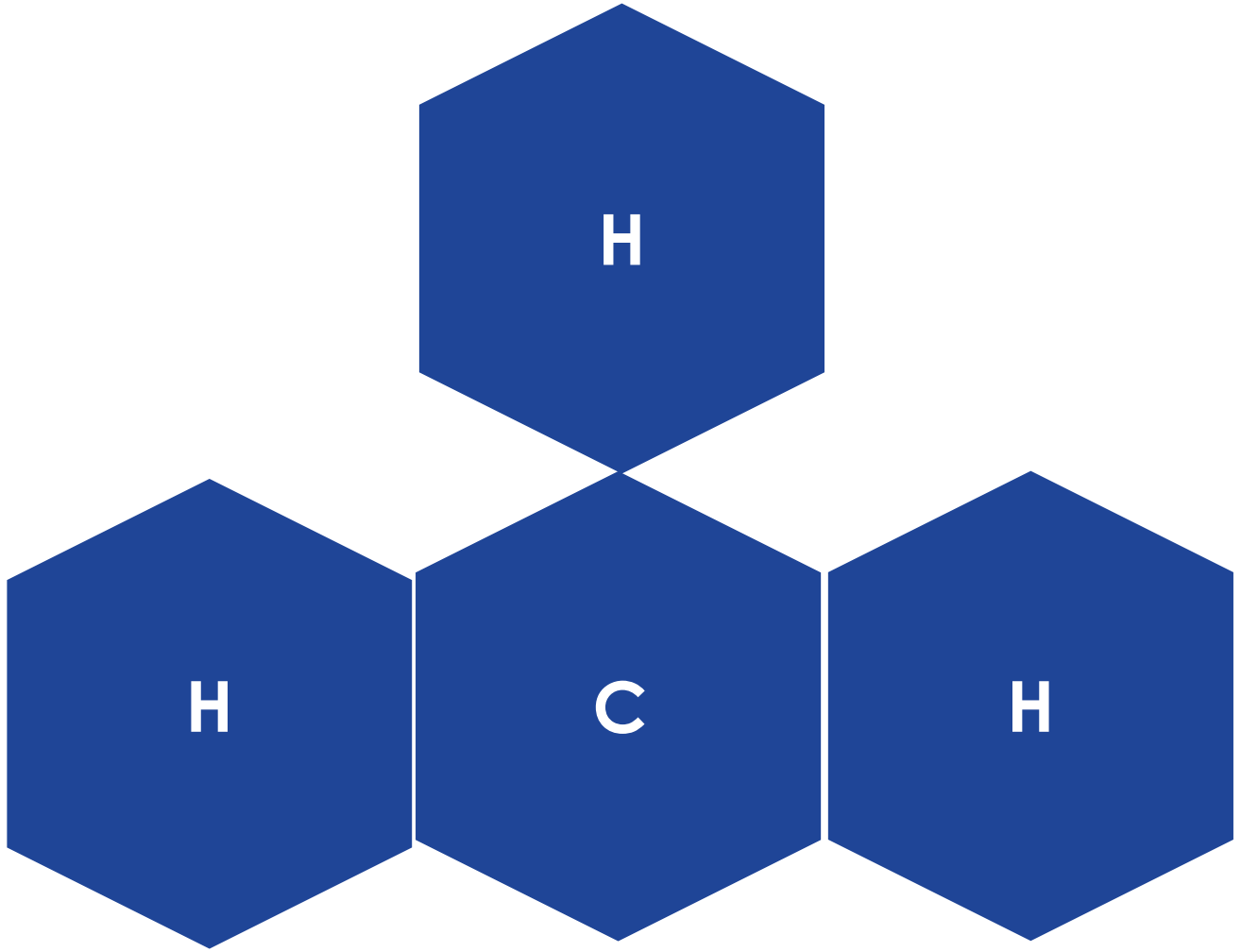
What is Epigenetics?

Epigenetics is a scientific field of study that involves changes in our genes that can occur due to external factors. Most commonly, these changes happen as a result of something that is occurring in our environment, and our body is forced to adapt by changing certain DNA sequences.

The concept of epigenetics emerged in the 1940s, but the intense research that shows its wide-ranging effects has only been done in the last 20 years.

Genes are made up of DNA. DNA is made up of long strings of molecules called bases A, C, G, and T. These bases connect with each other in various combinations. Two long strings of DNA intertwine to form the famous double helix structure we all recognize. If pulled out in a straight line, the DNA contained in a single cell would be about 5' long.





The genes in our cells are clothed in organic molecules that are chemically attached. The most common attachment is called a methyl group—one carbon atom bonded to three hydrogen atoms. The more methylated a gene is, the more active it is. Chemical signals tell the cell to activate or silence a specific gene.

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There's something in the external environment that affects the internal environment, and before you know it, a gene is functioning in a different way.

Dr. Rachel Yehuda, Director, Traumatic Stress Studies Division, New York City, NY

What does the research tell us?

In a study involving 12 women incest survivors and 12 women who have never been traumatized, their cells were analyzed for any difference.

A difference was noted between the cells that can recognize known toxins and those that can't. The Immune system cells in the incest survivors were oversensitive to threats and attacking the body's own cells.

The imprint of past trauma consisted not only of distorted information coming from the outside, but the organism itself could not distinguish between danger and safety.

Prenatal Stress

When a pregnant woman is subjected to intense prolonged stress, **excessive levels of cortisol** can disrupt the development of the unborn child's brain. The changes in fetal brain circuitry can lead to a **hypersensitivity to stress** later in life.

Jill Goldstein, professor of psychiatry and medicine at Harvard Medical School, recently published a study in *Proceedings of the National Academy of Sciences* which reported that middle-aged people who had been exposed to in-utero abnormal levels of pro-inflammatory markers due to stress had **poor stress regulation** up to 45 years later.

High levels of stress hormones, if sustained for a long time, **can harm the body** by weakening the immune system and increasing susceptibility to medical problems such as hypertension. It has been found that in acute trauma, cortisol may also have a **protective factor**. In order to reduce harm to body organs and the brain, cortisol can shut down the release of stress hormones, including itself, resetting the cortisol thermostat to a lower level, a feature researchers were coming to associate with PTSD.

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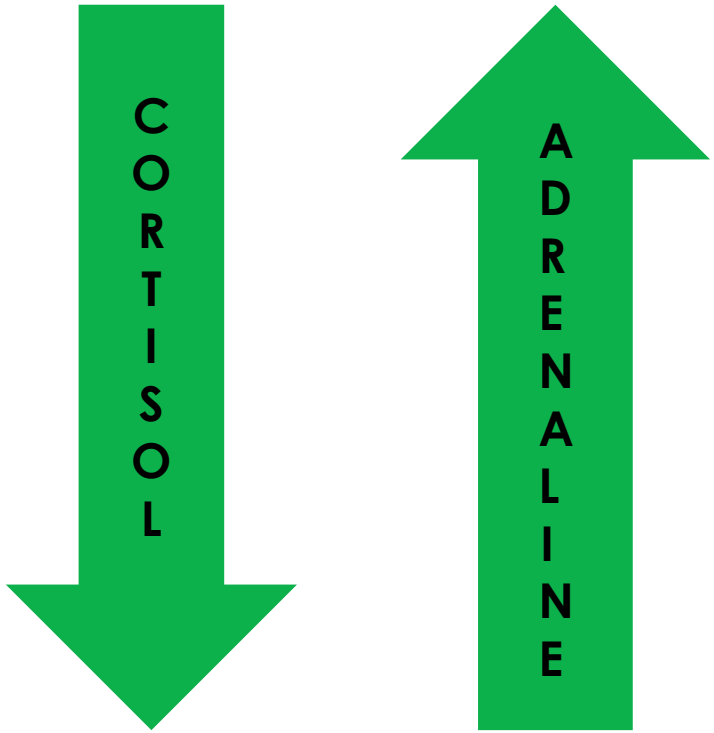

As Cortisol levels drop too low, the body compensates by increasing Adrenaline levels. If someone with low cortisol levels and high Adrenaline levels is subjected to a traumatic experience, the high Adrenaline sears the memory of any new trauma into the brain where it can later surface as flashbacks or nightmares.

World Trade Center Study

Following the collapse of the World Trade Center, the babies of pregnant women survivors were born smaller than usual, the first sign that the trauma of the attack had reached the womb. 38 women and their babies were examined nine months later. Those with PTSD had unusually low levels of stress-related cortisol. The saliva of the babies also showed low cortisol. The effect was most prominent in babies whose mothers were in their third trimester on that fateful day. Their children also showed increased distress to new stimuli. **When cortisol levels are compromised, so is our ability to regulate emotions and manage stress.**

Rachel Yehuda, et al., 2005, 2009

Holocaust Survivor Study

In August 2015, Rachel Yehuda published a study in *Biological Psychiatry, which* concluded that gene changes could be transmitted from parents to their children. Yehuda and her team found that Jews who experienced the Holocaust trauma, and their children, shared a similar genetic pattern. They compared the results with Jewish families who were living outside of Europe during the war and did not experience trauma. **The gene changes in the children could only be attributed to the trauma the parents experienced.**

Yehuda, Rachel, 2015.

Stressed Male Mice Study

Mice in one generation were trained to fear a cherry blossom scent. Each time they were exposed to the smell, they simultaneously received an electric shock. After a while, the shocked mice had enlarged brain areas devoted to the receptors associated with that scent. Researchers were also able to identify changes in the mice's sperm. The mice's pups and grandpups, when exposed to the blossom odor, became jumpy and avoided the smell, despite never having experienced it before. The mice **appeared to inherit not only the sensitivity to the scent but also the fear response associated with it.**

Emory University School of Medicine, 2013

How does this affect families through the generations?

- Childhood exposure to trauma has implications for the next generation.
  (Narayan, Bucjo, Rivera,& Lieberman, 2016)
- Offspring of mothers who experienced early life trauma and PTSD are at greater risk for adverse mental health outcomes.
  (Collishaw, Dunn, O'Connor, & Golding, 2007)
- Women with a history of childhood abuse before age 11 had elevated third trimester hair cortisol concentrations.
  (Schreier & colleagues, 2015)

Adult offspring of stressed parents often experience:

- Increased hormone secretions
- Altered immune function
- High blood pressure
- Altered metabolic function
- Increased risk of Diabetes

Dutch Famine Birth Cohort Study

An extended period of famine in the Netherlands took place towards the end of World War II when the Nazis blocked food supplies in October 1944. Scientists found that those who had been in utero during the famine were heavier than average. When the children reached middle age, **they had higher cholesterol and triglyceride levels, and higher rates of obesity, Diabetes, Cardiovascular Disease, and Schizophrenia**. They found that these children carried a chemical mark—an epigenetic signature—on one of their genes.

How can we use this info to help clients?

Isabelle Mansuy is a Professor in Neuroepigenetics at the Medical Faculty of the University of Zürich and the Department of Health Science and Technology of the Swiss Federal Institute of Technology in Zürich. Her lab is part of the **Center for Neuroscience** in Zurich. She is known for her work on the mechanisms of epigenetic inheritance in relation to childhood trauma.

Mansuy's Mice

Mansuy designed a mouse intervention that re-creates some aspects of childhood trauma. She separated mouse mothers at unpredictable intervals from their pups, placing the mothers in tubes or dropping them in water to create stress. When the mothers were reunited with their pups, they often ignored the pups in their stressed state. The pups of stressed mothers displayed altered behaviors as adults. These behavioral changes persisted in the offspring of the grown mice.

Mansuy's Mice

Mansuy took the traumatized mice and put half in a standard wood-chip cage. She put the other half in two-story cages with running wheels and mazes meant to stimulate their senses and engage them in play. The traumatized mice raised in the enhanced environment did not pass the symptoms of trauma on to their offspring.

This suggests that environmental enrichment given at the right time could help correct alterations induced by trauma. That would further suggest that negative environmental effects are likely reversible.

Once we realize how different environmental triggers affect the individual epigenetic processes, we may be able to develop new prevention measures to improve the lives of the people in our community. If trauma can trigger epigenetic changes in people, the alterations could serve as biomarkers to identify individuals at risk for mental illness or other mental health problems.

Community-Based Treatment Programs

Family Intensive Treatment (FIT) Team

FIT integrates substance use and mental health treatment for substance using parents who are **involved in the child welfare system**. In-home interventions and Family Mentors are used to achieve parental engagement in services and improve safety and well-being for children.

Community Action Treatment (CAT) Team

CAT provides comprehensive, intensive community-based treatment to families with youth or young adults who are at risk of out-of-home placement due to a mental health or co-occurring substance use disorder or other related **complex issues**.

Resiliency Team

This team works together with children and their families to strengthen overall emotional functioning for children diagnosed with a **serious emotional disturbance** and who have not experienced measurable progress through less intensive therapeutic treatment.

Community-based outpatient programs are a great resources for our community families, but families are in a dysfunctional state to be referred to these programs. Imagine if we could utilize epigenetic factors to identify families at risk and provide comprehensive services as a preventive measure and avoid crises and dysfunction on the front end?

For every positive change you make in your life, something else also changes for the better – it creates a chain reaction."

— Leon Brown

Questions?

References

Collishaw, Dunn, O'Connor, & Golding, "Offspring of mothers who experienced early life trauma and PTSD are at greater risk for adverse MH outcomes," 2007.

Dias and Ressler, "Parental Olfactory Experience Influences Behavior and Neural Structure in Subsequent Generations," 2013.

Ennis, Cath & Pugh, Oliver; Epigenetics: A Graphic Guide, Icon Books Ltd., London, 2017.

Francis, Richard C., Epigenetics: How Environment Shapes Our Genes, W. W. Norton & company, NY, 2011.

Golden, Ronald, Epigenetics and Trauma, Youcanprint, August 2021.

Narayan, Bucjo, Rivera,& Lieberman, "Childhood exposure to trauma has implications for the next generation," 2016.

Perry, Bruce & Winfrey, Oprah; What Happened to You?, Fltiron Books, NY, 2021.

Schreier & colleagues, "Women with a history of childhood abuse before age 11 had elevated third trimester hair cortisol concentrations," 2015.

Williamson, Laura, "Prenatal Stress Can Program a Child's Brain for Later Health Issues," *American Heart Association News,* May 6, 2021.

Wolynn, Mark, It Didn't Start With You, Penguin Books, NY, 2016.

Yehuda, Rachel, et al., "Transgenerational Effects of Post Traumatic Stress Disorder in Babies of Mothers Exposed to the World Trade Center Attacks During Pregnancy," *Journal of Clinical Endocrinology & Metabolism* 90(7) (July 2005): 4115-18, p. 4117, doi:10.1210/jc.2005-0550, www.ncbi.nlm.nih.gov/pubmed/15870120.

References

Yehuda, Rachel, et al., "Gene Expression Patterns Associated with Posttraumatic Stress Disorder Following Exposure to the World Trade Center Attacks," *Biological Psychiatry* (2009): 1-4, esp. p. 3, doi:10.1016/j.biopsych.2009.02.034.

Yehuda, Rachel, et al., "Holocaust Exposure Induced Intergenerational Effects on FKBP5 Methylation," *Biological Psychiatry,* August 12, 2015, www.biologicalpsychiatryjournal.com/article/S0006-3223(15)00652-6/abstract, doi:10.1016/j.biopsych.2015.08.005.

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