THE EMERGING NEUROBIOLOGY OF RESILIENCE: IMPLICATIONS FOR PSYCHOTHERAPEUTIC INTERVENTIONS

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Impact of Acute and Chronic Stress

1. Prolonged Stress and accompanying negativity are taxing to the body and can take a toll called **Allostasis**, which refers to changes in the biological system. **Allostatic load** refers to changes in biological functioning from cumulative effects of chronic stress. **Resilience** is the capacity to minimize allostatic load (Feder et al., 2011; Malta, 2012).

2. One of the responses to chronic stress and threat perception is to stimulate the HPA system (hypothalamic-pituitary-adrenal axis) which coordinates the body's response to stress. Exposure to chronic stress leads to excessive cortisol exposure that increases vulnerability to a variety of physical diseases (hypertension, immunosuppression, cardiovascular diseases) and mental disorders (anxiety, PTSD and depressive disorders). (Handwerger, 2009).

3. More specifically, chronic stress alters 5HT receptor functioning and affects secretion of Dopaminergic (DA) brain regions that are associated with reward sensitivity and approach behaviors. The dopamine-related reward circuitry includes the nucleus accumbens, amygdala, ventral striatum and anterior cingulate cortex.

4. Findings of neuroimaging of individuals with PTSD have revealed structural and functional abnormalities in the amygdala, hippocampus, anterior cingulate cortex, medial prefrontal cortical pathways, neuroendocrine systems and polymorphisms in genes associated with norepinephrine functioning. These neurobiological alterations can contribute to the development of conditioned threat responses, hyperarousal, insomnia, anger/aggression and dissociative behaviors.

5. The amygdala is the engine that mobilizes threat responses. It receives input about threat cues and activates the release of corticotrophin-releasing factor (CRF) and norepinephrine (NE) in the brain and the secretion of the peripheral nervous system stress hormones. In addition to the amygdala, the stress circuit includes the hippocampus, hypothalamic-pituitary axis (HPA) and the brain stem locus coeruleus (LC). The amygdala has been called the brains "smoke alarm system".

6. Excessive release of NE and CRF during memory encoding prevents memories from fading and conditioning responses from extinguishing contributing to the development of PTSD re-experiencing symptoms and also disables the hippocampus which is critical in developing episodic memories. This contributes to fragmented, sensory-driven memories. Such poor contextualization of traumatic memories and accompanying sensitivity to threat-related cues undermine the integration with neutral autobiographical contextualized memories and the retrieval of positive recollections. This contributes to such symptoms as a restricted range of positive emotions, avoidance, loss of interest, withdrawal, estrangement, self-referential thinking and to the perception of others as being unsupportive.

7. Research on the cumulative impact of early childhood stressors, (abuse, neglect, exposure to family and community violence, inadequate parental care) as reported in the Adverse Childhood Experiences ACE) studies by Edwards et al (2005), indicate that the experience of three or more of such adversities can result in long-term far-reaching effects such as various disorders (cardiovascular and autoimmune diseases), and to a poor health-related quality of life, as well as, to behavioral difficulties such as substance abuse, depression, suicide attempts, teen pregnancy. As Vander Kolk (2014), observes, "the body keeps score."

   The research by Caspi, DeBellis, Moffitt, Perry, Pynoos and Yehuda indicate that traumatic adversive events can influence neurological development. These changes in the developing brain are further exacerbated if accompanied by poverty (overcrowding, noise, substandard housing, exposure to violence, family turmoil, separation from parents) and other forms of extreme stress that can ne "toxic". For example, children from poverty have 6% less brain surface and a less voluminous hippocampus and a compromised brain circuitry, relative to children from higher SES levels.

   Consider the following findings of the impact of ACE on children's development.

   - Physical abuse and neglect, but not sexual abuse have been associated with the reduction in the volume and activity levels of major structures of the brain, including the corpus callosum (midsagittal area of connective fibers between the left and right hemispheres) and the limbic (emotional regulation) system, including the amygdala and hippocampus.

   - Trauma has been found to affect the HPA Axis (Hypothalamic Pituitary Adrenal axis) contributing to its hypersensitivity to cortisol and can contribute to an increased vulnerability to depression.

   - Trauma exposure can contribute to increased sympathetic nervous system activity which is especially evident under conditions of stress (e.g., increased heart rate and increased blood pressure). This may be manifested as exaggerated startle responses.

   - Among children who have been abused, there is a greater likelihood of cerebral lateralization differences or asynchrony. For example, abused children are seven times more likely to show evidence of left hemisphere deficits. This can contribute to the failure to develop self-regulatory functions, especially language and memory abilities. **Self-regulatory processes** are internalizing organizing functions that filter, coordinate and temporally organize experience. Self-regulation includes attentional controls, strategic planning, initiation and regulation of goal-directed behaviors, self and social monitoring abstract reasoning, emotional regulation and interpersonal functioning. Trauma has the

most impact when its onset occurs during early childhood and is recurrent or prolonged.

- ❖ Early and prolonged victimization impacts the communication between the Prefrontal Cortex (PFC) ("upper portion of the brain") and the amygdala (lower part of the brain). The PFC is normally in balance with the amygdala response to life stressors. This "top-down" regulation of executive skills can be compromised by perceived threats and stressors. The bottom-up emotional processes can "hijack" the PFC.

- ❖ Trauma exposure results in elevated levels of circulating catecholamines and in abused boys it also results in elevated growth hormone.

- ❖ Trauma exposure can have a negative impact on the development of attachment behaviors. For example, abused teenage girls are more likely to hide their feelings and have extreme emotional reactions. They have fewer adaptive coping strategies and have problems handling strong emotions, particularly anger. Moreover, they have limited expectations that others can be of help. They show deficits in the ability to self-soothe and modulate negative emotions. They show evidence of problems with behavioral impulsivity, affective lability, and aggression and substance abuse. For example, Kendall et al. (2000) found that in a twin study, the twin who had been exposed to childhood sexual abuse had consistently an elevated risk for drug and alcohol abuse and bulimia when compared to the unexposed twin. Sexual abuse also contributes to increased susceptibility to sexually transmitted disease and can compromise the immune system.

- ❖ In order to compensate for the deficits that arise from multiple victimization experiences and to bolster resilience, special efforts are needed to bolster the abused and neglected children's and youth's **self-regulatory systems** and to provide them with "**cognitive and emotional prosthetic devices**" that can help in their development (e.g., metacognitive supports of planning, monitoring, language, memory, as well as social supports).

More specifically, the neurodynamics of early cumulative child maltreatment results in:

a. accelerated loss of neurons;
b. delayed myelination;
c. abnormalities in developmentally appropriate pruning;
d. inhibition of neurogenesis;
e. chronically elevated cortisol levels and increases in NE over time;
f. changes in brain structure;
g. less integration of the left and right sides of the brain's hemispheres;

h. smaller left frontal lobes and to hippocampus shrinkage;
i. elevated risk of dysregulated HPA function;
j. hyperarousal;
k. shorter telemore length which impacts the integrity of DNA.

In summary, stress hormones damage brain structures when stress is early and prolonged. The resultant damage impacts various stages of development.

THE NATURE OF RESILIENCE

Resilience is the ability to adapt and thrive despite experiencing adversities. It reflects the ability to "bounce back" following traumatic and victimizing experiences.

Resilience and posttraumatic stress can coexist. Individuals may be resilient in one domain and not in others, or they may be resilient at one time period and not at other periods of their lives.

Such psychological processes as positive emotions, optimism, active coping, social supports and prosocial behaviors, meaning making, humor, and exercise can foster and support resilience and reduce the intensity and duration of stress responsivity. Such positive activities are associated with reduced HPA axis reactivity. The impact of positive emotions is cumulative; repeated positive emotional experiences over time prime the system for optimal response to negative stimuli by expanding physical, psychological, intellectual and social resources (Fredrickson, 2001). There is a protective capacity of positivity.

NEURO-PSYCHOLOGICAL MECHANISMS THAT NURTURE RESILIENCE

1. Reframing/Reappraisals is the ability to frame events in a relatively positive light. Functional MRI studies have shown increased activation in the lateral and medial prefrontal cortex regions and decreased amygdala activation during reappraisal. The increased activation in the lateral prefrontal cortex (the "executive" center) helps modulate the intensity of emotional responses and keeps the amygdala in check. Resilient individuals are better able to extinguish and contextualize traumatic emotional memories and can more readily retrieve positive memories.

2. Use of Humor is a way to engage in cognitive reappraisal and emotion regulation. A network of subcortical regions that constitute core elements of the dopaminergic reward system are activated during humor.

3. Optimism is the inclination to adapt the most hopeful interpretation of the events which influences emotion regulation, contributes to life satisfaction, and increases psychological and physical health. An optimistic future-oriented outlook has been associated with increased activity in the amygdala and anterior cingulated cortex. For instance, optimists have lower rates of dying after cardiovascular disease over 15 years, compared to pessimists.

   As Southwick and Charney (2012, p. 25) observe, "optimism serves as the fuel that ignites resilience and provides energy to power the other resilience factors". But it is realistic optimism that works best, whereby individuals pay close attention to negative information, and not blind optimism that does not work.

4. Active goal-directed problem focused coping of taking direct actions when stressful life events are potentially changeable can increase neurotransmission in the mesolimbic dopaminergic pathways that increase pleasurable feelings and that stimulate reward

centers such as the ventral striatum. Dopamine release in the brain leads to "openness to experience", exploratory behaviors, and to the search for alternatives. A form of active coping is to engage in Behavioral Activation (physical exercise) which has positive effects on mood such as depression and that promotes resilience and neurogenesis. Exercise increases the level of serotonin, norepinephrine, dopamine and by stimulating the reward circuits in the brain. Exercise has also been shown to increase the size of the hippocampus and serum levels and increase brain volume (prefrontal cortex), especially among the elderly.

In some instances, when stressful events are <u>not</u> changeable, the use of emotional-palliative coping strategies such as acceptance, distraction, spirituality are the best ways to cope.

5. <u>Prosocial behaviors and social supports</u> and social competence, altruistic behaviors, helping others, and empathetic capacity facilitate resilience. The neuropeptides oxytocin, and vasopressin have been found to increase trust, compassion and enhance the reward value of social stimuli. Cortical "mirror neurons" have also been implicated in the regulation of positive emotions and can reshape the circuitry responsible for resilience. They play a role in facilitating social interactions by promoting shared understanding and empathy.

   For example, compassion contributes to an increase in the level of endorphins, endogenous cannabinoids, endogenous morphine, dopamine, vasopressin, nitric acid, and oxytocin. In addition, the stimulation of the Autonomic Nervous System (ANS) engenders compassion, as compared to negative emotional distress. Compassion also triggers an orientation response and accompanying heart rate deceleration tied to respiratory sinus arrhythmia, heart rate variability and reduced startle responses and skin conductance (vagus nerve response), as well as triggering "mirror neurons". Resilient individuals are better able to bond with others and attract social support.

   Low levels of social support have been linked to increased rates of depression, anxiety and PTSD. In a 9 year prospective study, individuals with no or few social supports had 1.9 to 3 times the risk of dying from a variety of illnesses, including cancer, cerebrovascular and cardiovascular diseases, as compared with those who had optimal social supports (Malta, 2012). Among the elderly, loneliness is a strong predictor of early morbidity and has the same predictive power of smoking and lack of exercise.

   Helping individuals increase their social supports and engaging in caregiving activities trigger the immune system to respond positively and stimulate the reward circuits along the medial forebrain bundle and engages dopaminergic neurons. Various hormones and neuropeptides like oxytocin and vasopressin facilitate social engagement and increase adaptation to stress by increasing empathy, eye contact, social cognition and problem-solving skills. Such positive attachment relationships buffer physiological stress responses.

6. Meaning-making is another strategy that can buffer against negative feelings and is associated with resilience. Having a role model who provides a "guiding light" and developing and following a personal "moral compass", holding spiritual beliefs, and engaging in religious faith-based practices bolster resilience and facilitate recovery. For example, consider the experiences of Jerry White (2008), who lost limbs to landmine explosions and who founded Landmine Survivors Network, which later became the Survivor's Corp. It is designed to foster a mindset of "Survivorship", which he defines as "choosing to live positively and dynamically in the face of death, disaster and disability; a form of meaning making. His approach is designed to combat the development of a "victim mentality" where individuals tend to pity themselves, resent their circumstances, live in the past and blame others. White believes that a victim-minded person is generally inflexible, stuck in his or her grievances, and is seemingly unable to let go, find hope, or move forward. Over time, a victim's intense focus is on their own personal suffering which can interfere with his or her ability to take positive action, relate to others in a healthy manner, or participate more fully in daily life.

   White proposes five steps to help trauma survivors to tap their innate resilience and grow stronger.

   1. Face facts: acknowledge and accept what has happened, the suffering and loss. Find a way to live with it and piece together a "personal story".

   2. Choose life: live for the future, not in the past.

   3. Reach out: connect to others who have "been there". Reach out to peers, friends and family.

   4. Get moving: set goals and take action for a healthy recovery. Develop an individual action plan and identify your life priorities. Each step engenders hope and builds self-confidence. Regularly evaluate your progress and when needed re-evaluate and change one's objectives. Such individual action plans are a contract of sorts with oneself and with others.

   5. Give back: be thankful for what you do have. Contribute to others and to your community. Express gratitude - - thanking people who have helped. Express generosity - - giving back more than taking. Move from being a beneficiary to a benefactor.

In summary, the experience of positive-balanced emotions such as optimism, joy, pride, contentment, compassion, love, forgiveness, gratitude, humor have been associated with distinct neurobiological and psychological changes that provide a protective capacity. The positive emotion of awe, which reflects positive feelings of being in the presence of something vast that transcends our understanding of the world contributes to altruistic behaviors and to a sense of community. Awe helps shift one's focus from a narrow self-interest to the interests and well-being of a group to which individuals belong. Sights and sounds of nature, collective rituals,

artistic events of music and dance elicit positive emotions that have behavioral and physiological sequelae. These neurobiological responses include:

> Increase of neurotransmitters like cortisol levels that facilitate pathway communication between Prefrontal Cortex (PFC) and subcortical systems like the amygdala. For instance, GABA (gamma amino butyric acid) which is an inhibiting neuropeptide made in the orbitomedium PFC (OBPFC) when released "turns down" the alarm system of the amygdala. The left PFC, a site associated with positive emotions such as happiness, is more activated during Compassion Meditation.

These positive emotions reduce physiological arousal and broaden and build an individual's focus of attention, allowing more creative inclusive, flexible, integrative perspective taking, engenders positive reappraisal of difficult situations, fosters problem-focused coping, and facilitates the infusion of ordinary events with meaning. Fredrickson et al. (2002, 2008), in her Broaden-and-Build Theory, highlights that the impact of positive emotions is cumulative. Repeated positive emotional responses to negative events expands and builds psychological and behavioral resources. (Also see Carl et al., 2013; Fava and Ruini 2003, Well-being therapy; James et al., 2013, McEwen, 2007; Ochner and Cross, 2008; Russo et al, 2012; Southwick et al., 2011).

IMPLICATIONS FOR CONDUCTING PSYCHOTHERAPY

The research on neurobiology of resilience underscores the value of conducting psychoeducation on neuroplasticity (the power of the human brain to change and repair itself) and the potential recovery from experiencing traumatic and victimizing experiences. The therapist can help clients learn a variety of skills and engage in activities that bolster positive emotions and improve resilience and health (Ray, 2012).

When discussing with clients the lingering impact of traumatic and victimizing experiences, the therapist can convey examples of how the body "keeps score" and the enduring impact on the clients brain and behavior. The good news, however, is that the brain is a remarkable resilient organ and clients have the potential ability to reverse this process. Clients can learn to capitalize and build upon what is called neuroplasticity, and moreover, even begin to "turn on" and "turn off" the genes in their body (neurogenesis).

The therapist can say: "***Let us begin by having you better appreciate the possible impact that traumatic and victimizing experiences may have on your brain and behavior. Traumatic events and losses can lead the lower part of your brain that is the emotional center to:***

> ***"hijack; overwhelm; flood; overshoot; ramp up; exceed; trigger action pathways; overactivate and have a spiraling, cascading snowball effect; prime or kindle; shorten your fuse; and undermine and shut down the upper part of your brain, the frontal lobe executive control center."***

When conducting this psycho-education, the therapist should choose one or two of these illustrative verbs to describe the impact of traumatic and victimizing experiences and accompanying losses. Do not overwhelm the client. The therapist should then solicit personal examples from the client that reflects that activity.

> ***"Can you give me an example of how you did X?" (Choose one of the following).***

> ***"Magnified your fears; time slide back to your old ways of coping that once worked for you; went into a kind of autopilot mode of survival; engaged in safety behaviors; were hypervigilant and constantly on the lookout for possible threats; repeatedly conducted a kind of after action analysis in the form of ruminating; had difficulty sleeping; sought an adrenaline-rush by engaging in high-risk behaviors; used booze or drugs to self-medicate?"***

The therapist can convey to the client that he/she noticed, and wondered if the client also noticed, these behavioral patterns and "What is the impact, toll and price that resulted?" After discussing such consequences and how they may interfere with achieving the treatment goals, the therapist can convey that the therapy can help the client learn how to: (**Choose one**)

> ***"regulate, modulate, control, strengthen, regain, restore, reprogram, reshape, re-right myself, re-establish, re-define, mobilize, adapt, calibrate, blunt, improve their error detection skills; soothe, down-regulate, label and tame emotions, surmount your fears, orchestrate, get accustomed, accepted, organize your***

traumatic memories into a narrative account, develop coherent redemptive stories that have a beginning, middle and ending, note what you have done to survive, contextualize and put the landmark traumatic events into a larger autobiographical account."

The therapist can highlight that attention and increased awareness are the key first steps in the ability of the brain to repair itself. The client can learn how to "talk back" to the amygdala or the lower part of the brain and take charge once again. For instance, clients can learn emotion-regulation skills and they can come to tell themselves (and others):

"I can rewire my brain."

"I can talk to my amygdala (the alarm center) and train my emotional brain."

"Not allow my amygdala to hijack my frontal lobes."

"I can use the upstairs part of my brain to calm down the downstairs part of my brain."

"My positive emotions can Re-shape my brain."

"Positive relationships that I have can switch on and off different gene contributions and leave a positive chemical signature on my genes that affect my brain development."

"By being kind I can raise my level of oxytocin which curbs stress-induced rises in heart rate and blood pressure and that reduces feelings of depression. Being kind protects my heart."

"I can reduce my heart rate by 6 to 10 beats per minute by taking slow deep (diaphramatic) breaths."

"I remind myself that my brain is not fixed, nor static. It is highly plastic and flexible. It can repair itself, with my help."

"As with other parts of my body, I need to use my brain or lose it."

"If I don't stimulate my brain, my brain cells will die and be pruned away."

"I have the capacity to bend, but not break."

"I can see the big picture and find the silver lining, and develop a new normal."

"I can get myself to do what I do not feel like doing and get myself out of my comfort zone."

INTERVENTION STRATEGIES THAT BOLSTER RESILIENCE

(See Meichenbaum's Roadmap to Resilience book for examples)

Use Physical exercise - - Behavioral Activation and use Active Coping Strategies (See McNally, 2007).

Use Emotional Regulation and Tolerance Skills and Increase the Protective Capacity of Positivity that Buffers Negative Feelings (See Kim & Humann, 2007).

Focus and savor positive emotions and ruminations, past (reminiscence) and anticipate positive emotions (anticipating). Engage in goal setting and affective forecasting in the form of positive future-oriented imagery that nurtures hope. Avoid "dampening" or minimizing positive events ("*I don't deserve this*." "*This won't last*").

Engage in Mindfulness Exercises - - pay attention in a particular way, on purpose in the present moment, and nonjudgmentally (See Chiesa et al., 2013; Salzberg, 2011).

Engage in Loving-kindness Meditation and engage in Acts of Kindness

Engage in gratitude exercises ("Give back and pay forward").

Engage in Forgiveness exercises Toward others and Toward One-self - - Compassion is the awareness of the suffering of others and oneself, coupled with the wish and effort to alleviate it.

Engage in Meaning-making Activities and Cognitively Reappraisal ("Healing through meaning")

Use Spiritual-related Activities- - Use of One's Faith and engage in communal religious activities (See Meichenbaum "Trauma, spirituality and recovery" on Melissa Institute Website)

Increase Social Supports - - keep interpersonally fit by participating in positive activities; selectively choosing and altering situations, improving self-presentation (smiling, dressing up), improving communication skills and accessing social networks (See Uchina et al., 1996).

Use humor, Have fun and build-and-broaden Positive Emotions ("Bucket List Activities")

Each of these Activities will help bolster resilience by increasing the accompanying neurobiological processes. There is increasing data that a course of psychotherapy- even without medication- had measureable physical consequences in the brain.

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