

Neuroplastic Responses to Mindfulness Based Stress Management

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Introduction & Background

- Changes in neural regions of the primary motor cortex (PMC) and increased excitability were seen after only one session of repetitive motor practice¹
- Cortical differences seen among participants with varying levels of expertise represented a correlational cortical representation of skill set through neurogenesis and the permanent encoding of neuronal pathways¹
- Chronic stress has been shown to have major effects on the central nervous system including impairment of long-term potentiation (LTP) of hippocampal synapses resulting in disruptive memory capacity²
- Dendritic regression and reduction of both glial and endothelial cells in the medial prefrontal cortex (mPFC) were seen in chronic stress exposure resulting in impairment of typical tasks which rely on mPFC²
- Stress-increased neuronal growth and activity in the amygdala has been observed to have long lasting effects even after exposure to prolonged chronic stress halted²
- Deficits in executive functioning and working memory (WM) associated with neuronal changes in

- the dorsolateral prefrontal cortex (DLPFC) have been analyzed in individuals diagnosed with schizophrenia and found decreased levels of neurotransmitter GABA and GABAergic synapses particularly among the hippocampus³
- Higher hippocampal activation was shown among individuals diagnosed with Post Traumatic Stress Disorder (PTSD) while viewing simple context conditioning tasks indicating deficits in contextual processing which permit an increased return of fear response after extinction; this led to an inability to differentiate among safe and dangerous context⁴
- A selective positive correlation was observed among hypothesized hippocampal-dependent measures (retention, consolidation, retrieval, and discriminability) and hippocampal volume among PTSD diagnosed individuals, supporting the notion that high stress impairs hippocampal activity and size; most specifically at the CA3/dentate gyrus subfield, responsible for context memory.⁴

Definitions

- **Cognitive Resilience:** the ability to overcome negative effects or stress on cognitive functioning; also *psychological resilience*
- **Extinction:** in classical conditioning, the discontinued pairing of stimulus events resulting in a gradual decline in the probability and magnitude of the conditioned response

- **Long Term Potentiation (LTP):** a process of persistent strengthening of synapses based on recent patterns of activity; produces long lasting increase in signal transmission between neurons
- **Mindfulness:** the practice of maintaining a non-judgmental state of heightened or complete awareness of one's thoughts, emotions, or experiences on a moment to moment basis; also *Mindfulness-Based Stress Reduction (MBSR)*
- **Neural Plasticity:** the ability of the nervous system to develop new neural connections and change in response to experience or environmental stimulation; also: *neuroplasticity*
- **Neurogenesis:** the production of new neurons during early nervous system development and throughout the lifespan. The failure or interruption of neurogenesis is implicated in neurological diseases as well as in psychiatric disorders
- **Synaptogenesis:** the formation of synapses between neurons as axons as dendrites grow
- **Research Question**
- Does a higher degree of psychological resilience help high-stress individuals to better adapt to daily stressful situations?
- Are individuals who have a greater degree of psychological resilience less vulnerable to developing a stress related mental-illness than those who have a lesser degree of resilience?
- Can the same neuroplastic construction capabilities responsible for cognitive deficits of stress exposure be utilized through MBSR techniques to promote neuroplastic health,

synaptogenesis, and LTP to reverse and prevent the damaging effects and implications of high stress lifestyles? What are the best practices to do so?

- **Anticipated Outcomes**

- Individuals who perform better on a stress-inducing memory recall test will have a lower mental-illness vulnerability scores, indicating that they have developed strong psychological resilience and ability to deal with stress more effectively than those who perform worse on the stress-inducing memory test.
- Participants who are taught and effectively implement *mindfully-based stress reduction* techniques will strengthen their mental resilience capabilities and will perform better on the stress-inducing memory recall re-test than those who are taught and effectively implement *physically based stress reduction* techniques or the control group who will not be provided a stress management technique.

Methods

- Volunteers of California State University, Stanislaus will be screened to exclude those who have average or less than average anxiety scores
- All eligible participants will complete an initial *mental-illness vulnerability* questionnaire and under go a *stress-induced memory recall test (SIMRT)*
- Higher scores of the SIMRT will indicate a higher capacity for psychological or cognitive resilience
- Participants will randomly be assigned to one of three stress-management learning technique groups:

- *Mindful Group*: taught meditation, deep breathing techniques, positive self-talk, or gratitude practice
- *Physical Group*: taught journaling, exercise practice, or music therapy
- *Control Group*: excluded from stress-management learning techniques
- Participants will be asked to monitor their stress levels and incorporate any applicable stress-management technique over the following four to six weeks before retesting
- Upon return for retesting, participants will complete the same *mental-illness vulnerability questionnaire* and SIMRT
- **Analysis** SIMRT scores will be correlated against mental-illness vulnerability scores to see if those who exhibit greater cognitive resilience are less susceptible to developing mental-illnesses
- **Test and re-test mental-illness vulnerability scores will be compared to determine if stress-management techniques contributed to a decreased vulnerability to mental-illness**
- **Test and re-test SIMRT scores will be compared to see if stress-management techniques increased the participant's resilience capacity to more effectively preform under stress**
- **Significance** Stress is an inescapable part of daily lives and stress-management techniques can always be useful in maximizing performance
- **Mental-illnesses are more prominent than before**

- **Understanding individual vulnerability to disease and capacity of resilience may prove helpful in clinical treatments of mental-illness**
- **MBSR may help reverse the cognitive deficits caused by a high-stress lifestyle**
- **Selected References**
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