

Mechanisms Change: Yoga for Trauma and Eating Disorders



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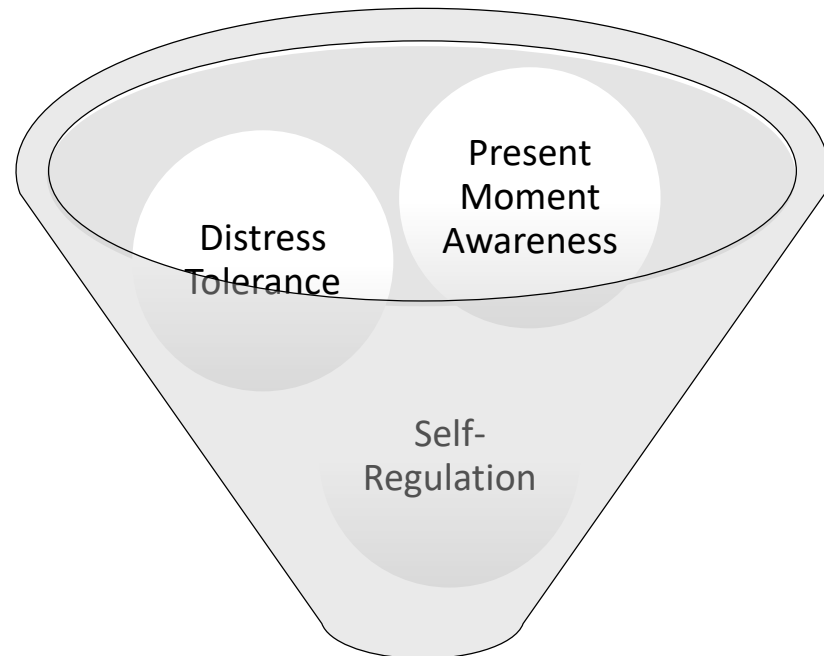


What is a **mechanism of change**?

Yoga Practice



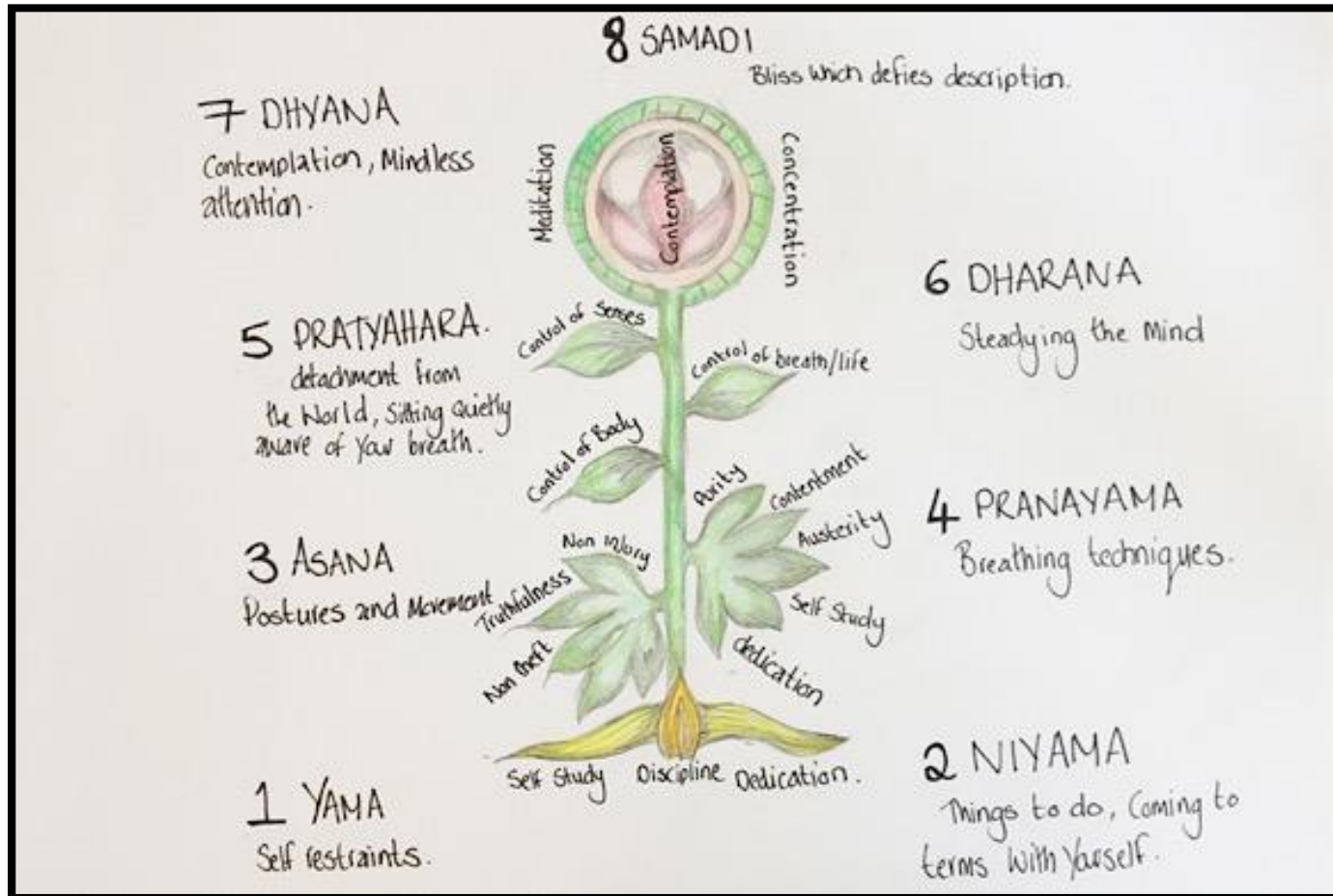
The process
that is
responsible
for change



The How?
and Why?

Yoga Outcomes

Wait... What is yoga practice? (all of it? Some of it?)



Gard et al.,
2014

Potential Self-regulatory Mechanism Of Yoga for Psychological Health

Table 1 | Components of classical yoga (the eight limbs of Patanjali's *Raja yoga*).

ETHICS		MEDITATION	
<i>Yamas</i>	Moral observances	<i>Pratyahara</i>	Sensory withdrawal
Ahimsa	Non-violence		Relaxation techniques
Satya	Truthfulness		Inward-mindedness
Asteya	Non-stealing (not taking from others)		Minimizing sensory input
Brahmacharya	Moderation of senses		
Aparigraha	Non-greedy (not keeping from others)		
<i>Niyamas</i>	Self-disciplines	<i>Dharana</i>	Concentration
Saucha	Cleanliness and purification		Single-pointed, focused attention
Santosha	Contentment		Object-based
Tapas	Literally 'heat' - austerity		Effortful
Svadyaya	Self-reflection and study		
Isvara Pranidhana	Surrender		
POSTURES		<i>Dhyana</i>	Meditation
<i>Asana</i>	Postures		Unbroken flow of attention
	Standing poses		Object-based or not
	Balancing poses		Open monitoring
	Forward bends		Effortless
	Backbends		
	Twists		
	Inversions		
	Restorative poses		
Vinyasa	Breath-linked movement of poses		
BREATH REGULATION		<i>Samadhi</i>	Integration
<i>Pranayama</i>	Breath regulation		Merging of subject & object
Nostril breathing	Slow, deep diaphragmatic		Transcendental consciousness
	Epiglottal constriction		Self-realization
	Altered rate or depth		
	Uninostril		
Mouth breathing	Through curled/flat tongue or teeth		
Breath with sound	Sighing		
	Humming or bee breath		
Retentions	Holding breath in or out		
	Ratios of in, out & retentions		
Legend of Modern Usage			
			Typical modern entry points
			Also in traditional practices
		(no brackets)	Advanced traditional practices

These components are described by their modern usage, and grouped into four operational categories that are used to conceptualize how yoga may influence self-regulatory processes.

School-Based Yoga Practices
(postures, breathing, relaxation, meditation)



Behaviors, Mental State, Health & Performance
↑ Mood, ↑ Well-Being, ↓ Psychological Disorders,
↑ Positive Behaviors, ↓ Negative Behaviors, ↑ Physical Health,
↑ Cognitive/Academic Performance, ↑ Relationships, ↑ Quality of Life

Main Components of Modern Yoga-Based Practices

- **Movement** (Yoga is a movement based contemplative practice)
 - Postures
 - Movement Sequences
 - Interior Muscle Groups
 - Coordinated movement of moderate intensity
 - Expansion of range of motion
 - Tracking bodily sensations
 - Intent of obtaining a state of eutony (a well-balanced tension, Sthira and Sukha)
- **Breath**
- **Attention**
 - To bodily sensations
 - Focused attention and open monitoring
 - Metacognitive awareness
 - Gaze as tool
- Schmalzl et al., 2015



BEHAVIORAL NEUROSCIENCE

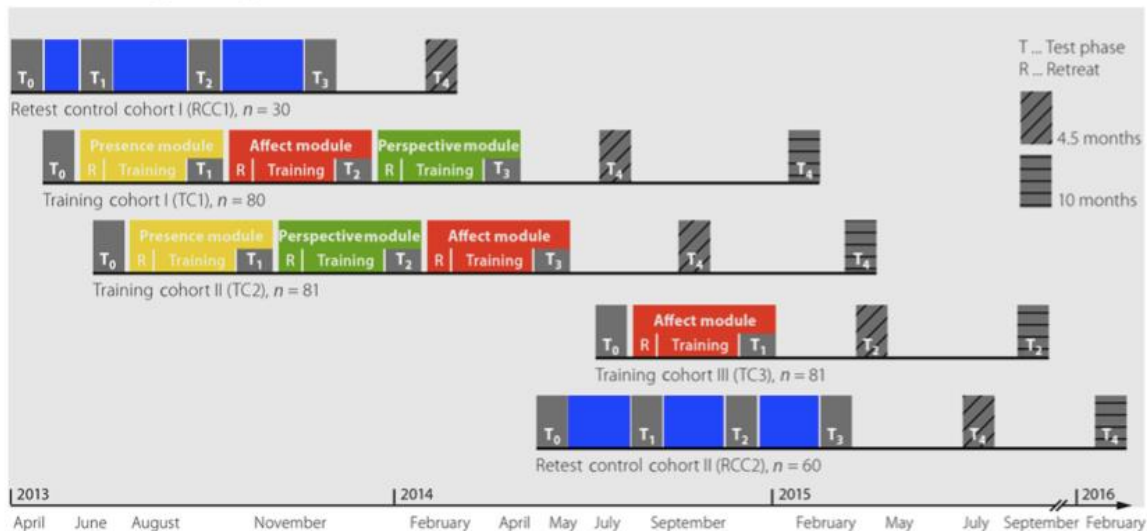
Structural plasticity of the social brain: Differential change after socio-affective and cognitive mental training

Sofie L. Valk,¹ Boris C. Bernhardt,^{1,2} Fynn-Mathis Trautwein,¹ Anne Böckler,^{1,3} Philipp Kanske,^{1,4} Nicolas Guizard,² D. Louis Collins,² Tania Singer^{1*}

Although neuroscientific research has revealed experience-dependent brain changes across the life span in sensory, motor, and cognitive domains, plasticity relating to social capacities remains largely unknown. To investigate whether the targeted mental training of different cognitive and social skills can induce specific changes in brain morphology, we collected longitudinal magnetic resonance imaging (MRI) data throughout a 9-month mental training intervention from a large sample of adults between 20 and 55 years of age. By means of various daily mental exercises and weekly instructed group sessions, training protocols specifically addressed three functional domains: (i) mindfulness-based attention and interoception, (ii) socio-affective skills (compassion, dealing with difficult emotions, and prosocial motivation), and (iii) socio-cognitive skills (cognitive perspective-taking on self and others and metacognition). MRI-based cortical thickness analyses, contrasting the different training modules against each other, indicated spatially diverging changes in cortical morphology. Training of present-moment focused attention mostly led to increases in cortical thickness in prefrontal regions, socio-affective training induced plasticity in frontoinsula regions, and socio-cognitive training included change in inferior frontal and lateral temporal cortices. Module-specific structural brain changes correlated with training-induced behavioral improvements in the same individuals in domain-specific measures of attention, compassion, and cognitive perspective-taking, respectively, and overlapped with task-relevant functional networks. Our longitudinal findings indicate structural plasticity in well-known socio-affective and socio-cognitive brain networks in healthy adults based on targeted short daily mental practices. These findings could promote the development of evidence-based mental training interventions in clinical, educational, and corporate settings aimed at cultivating social intelligence, prosocial motivation, and cooperation.

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A Training design



B Training modules

PRESENCE
ATTENTION AND INTEROCEPTIVE AWARENESS



AFFECT
CARE/COMPASSION, PROSOCIAL MOTIVATION, DEALING WITH DIFFICULT EMOTIONS



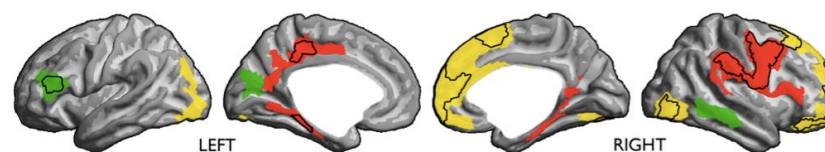
PERSPECTIVE
META-COGNITION, PERSPECTIVE-TAKING ON SELF AND OTHERS



C Overall cortical thinning in retest controls over 9-month period



D Module-specific training-related cortical thickness increases



Wait... What are we trying to change?

- | | | |
|--------------------|--------------------------------------|-----------------------|
| • Stress | Performance | • Back Pain |
| • Eating Disorders | • Social Skills | • Muscle Fatigue |
| • Depression | • Headaches | • Aging |
| • Mood | • Cancer | • Community Isolation |
| • Substance Use | • Side Effects from Cancer Treatment | • Mental Illness |
| • Chronic Pain | • Conduct Disorder | • World Peace |
| • Alcoholism | • ADHD | • |
| • Trauma | • Emotional Outbursts | |
| • PTSD | • Anxiety | |
| • Loneliness | • Drunk Driving | |
| • Obesity | • Family Discord | |
| • Diabetes | • Running Injury | |
| • Poor Academic | | |

WAIT!
HAMMER
NO!

QUIET
NAIL.



Identified
Target for
Change

Today



**Trauma
and
Eating
Disorders**

Mechanisms
of
Risk,
Maintenance,
and Growth

Selected
Yoga
Practice



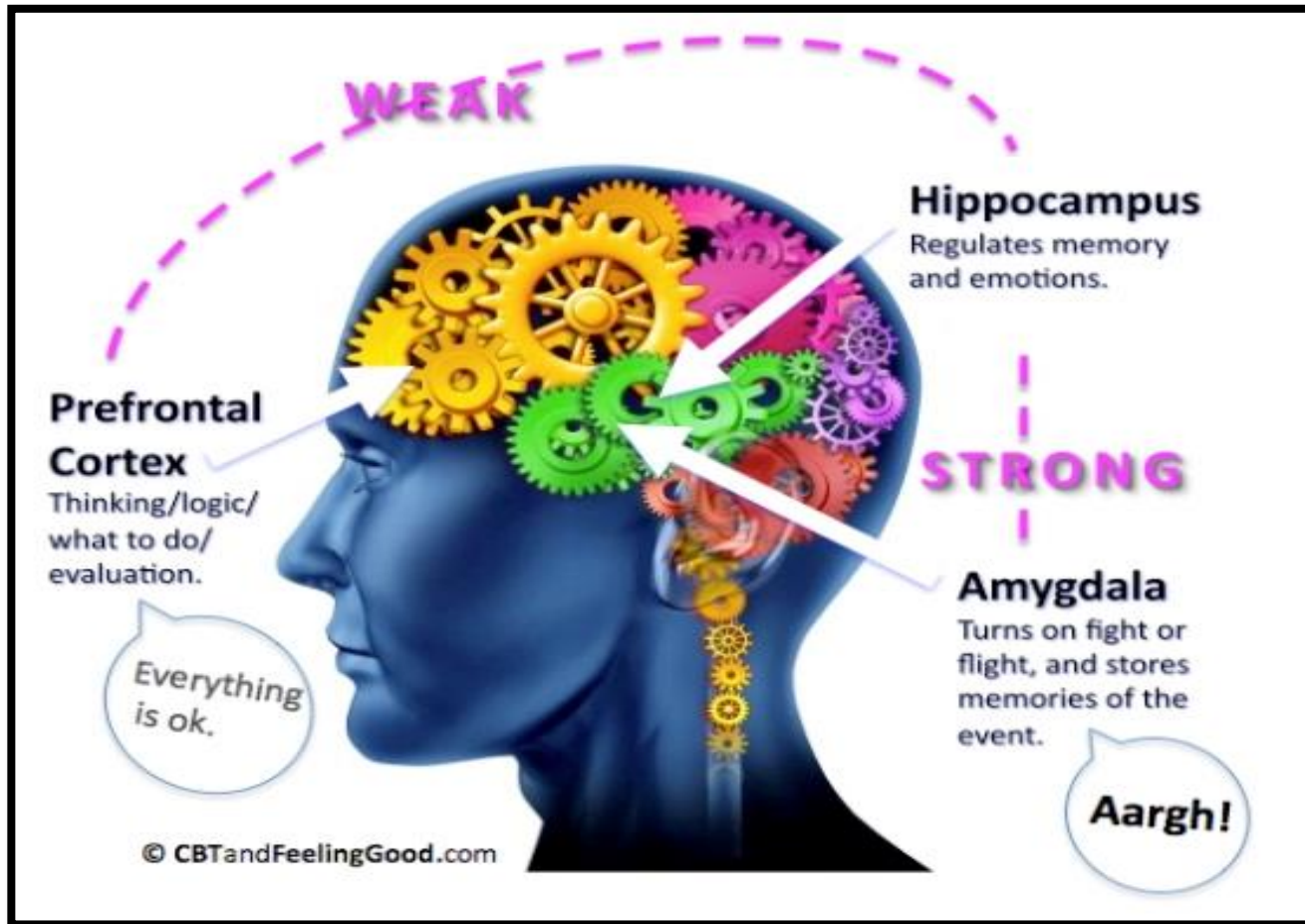
What is Trauma?

- Exposure to a traumatic event
(i.e., *threatened death, serious injury or sexual violation*)
 - Direct experience
 - Witness the traumatic event in person
 - Learns of traumatic event
 - Experiences first hand repeated or extreme exposure to aversive details
- Overwhelms a person's ability to cope
- Can result in feelings of terror, helplessness, and powerlessness (prolonged stress response)
- Interferes with sense of control, connection and meaning



<https://safesupportivelearning.ed.gov>, DSM-5
(2013)

Trauma and the Brain



Survival Mode

- **Competing Demands**

- Survival vs. Learning
- Difficult to learn, grow, and connect when your resources are dedicated to surviving



Sequence of Intra- and Interpersonal Engagement:

- Survival Mode: Regulate- Relate- Reason
- Typical Mode: Reason- Relate- Regulate



Eating Disorders

- Anorexia Nervosa
- Bulimia Nervosa
- Binge-Eating Disorder
- Other Specified Feeding or Eating Disorder
 - 1. Atypical AN
 - 2. BN low frequency or limited duration
 - 3. BED low frequency or limited duration
 - 4. Purging Disorder
 - 5. Night Eating Syndrome



Disorder and Rates



- Anorexia Nervosa
 - Less than 1% of population
- Bulimia Nervosa
 - About 1% of total population (some ages 3-5%)
- Binge eating with a sense of being out of control
 - 1-5% of the population
- According to a study done by colleagues at the *American Journal of Psychiatry* (2009), crude mortality rates were:
 - 4% for anorexia nervosa
 - 3.9% for bulimia nervosa
 - 5.2% for eating disorder not otherwise specified
- Crow, S.J., Peterson, C.B., Swanson, S.A., Raymond, N.C., Specker, S., Eckert, E.D., Mitchell, J.E. (2009) Increased mortality in bulimia nervosa and other eating disorders. *American Journal of Psychiatry* 166, 1342-1346.; <http://www.anad.org/get-information/about-eating-disorders/eating-disorders-statistics/>

Identified
Target for
Change

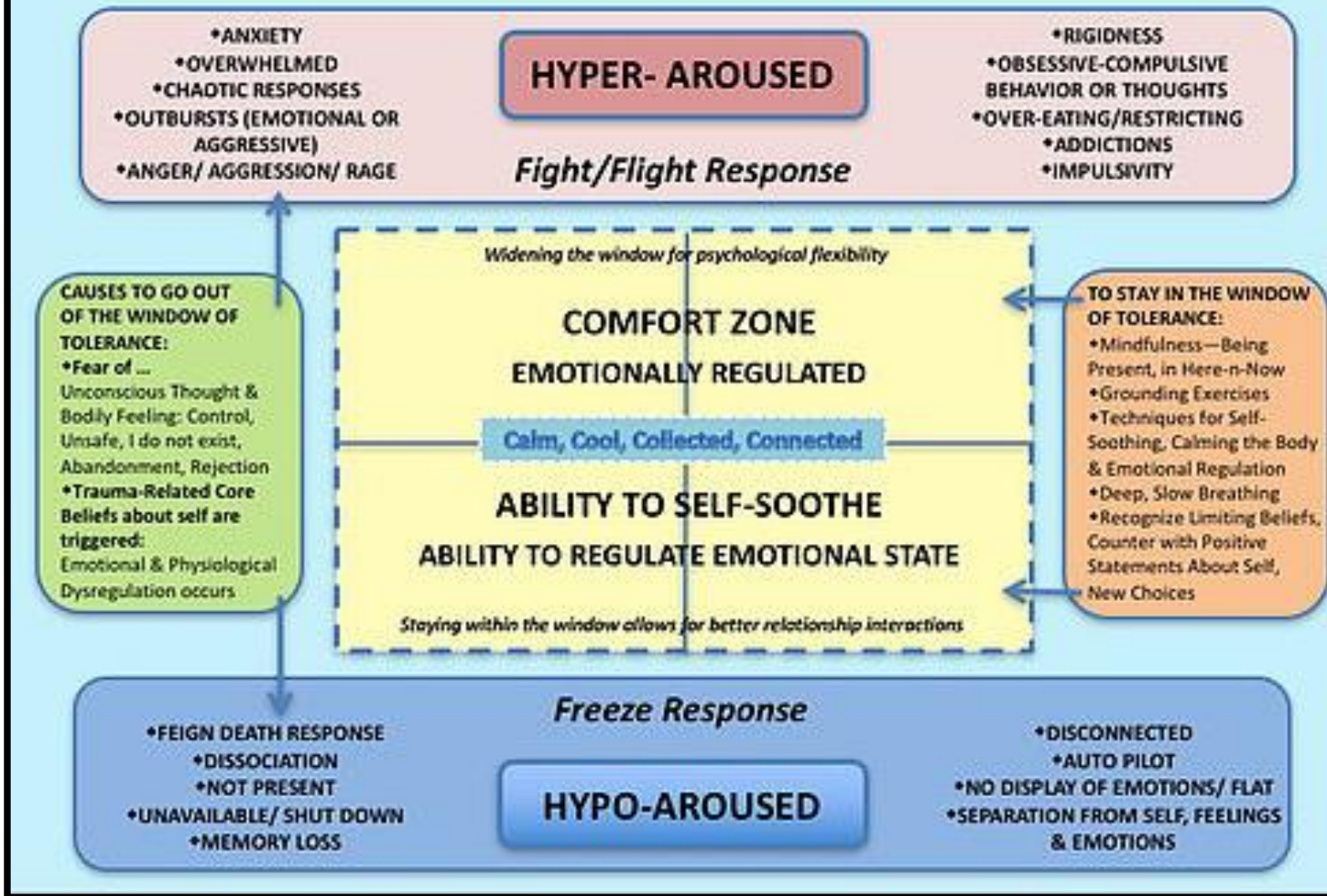
Today
↓
Trauma
and
Eating
Disorders

Mechanisms
of
Risk,
Maintenance,
and Growth

Selected
Yoga
Practice



WINDOW OF TOLERANCE- TRAUMA/ANXIETY RELATED RESPONSES:
Widening the Comfort Zone for Increased Flexibility

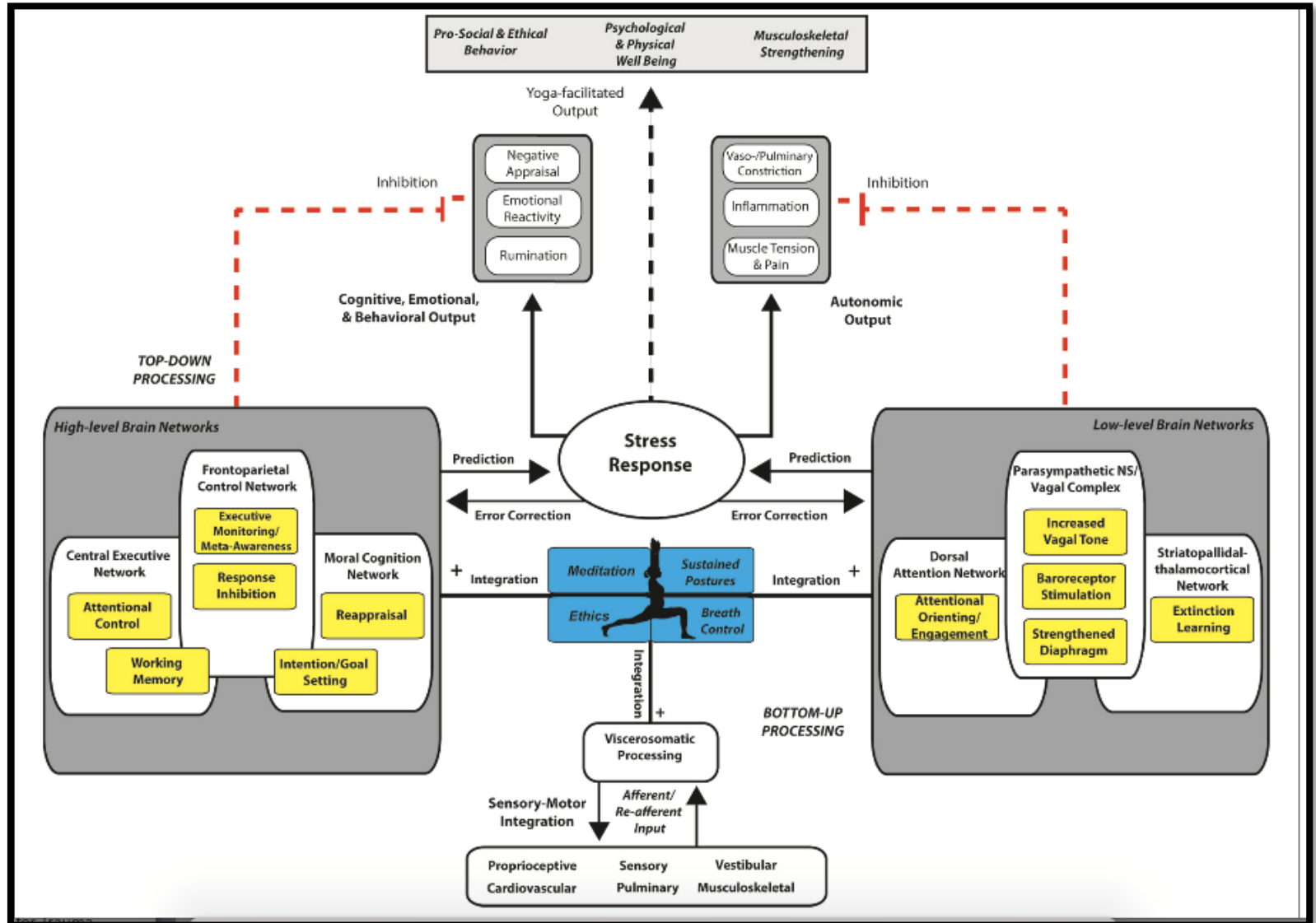


“I am not in front of my body, I am in my body or rather I am my body.” Merleau-Ponty, 1996



Mechanisms: Yoga for Self-Regulation

(Gard et al., 2014)



Mechanisms: Yoga for Self-Regulation

(see Gard et al., 2014)

Table 2 | High-level and low-level brain networks.

Central executive network		
Dorsal parietal cortex	Superior parietal lobe (sPL)	Dorsal frontal cortex
Frontoparietal control network		
Frontopolar cortex	Dorsolateral prefrontal cortex (dlPFC)	Dorsomedial prefrontal cortex (dmPFC)
Anterior cingulate cortex (ACC)	Anterior inferior parietal lobe (aiPL)	Anterior insular cortex (AIC)
Temporo-parietal junction (TPJ)	Ventrolateral prefrontal cortex (vlPFC)	
Moral cognition network		
Ventromedial prefrontal cortex (vmPFC)	dmPFC	Posterior cingulate cortex (PCC)
Precuneus	Middle temporal gyrus (MTG)	TPJ
Dorsal attention network		
Frontal eye fields (FEF)	Ventral premotor cortex (vPMC)	sPL
Dorsal parietal cortex	Supplementary motor area (SMA)	Ventromedial posterior nucleus–thalamus (VMpo)
Pulvinar	Superior colliculus (sc)	
Striatopallidal–thalamocortical network		
Orbitofrontal cortex (OFC)	ACC	Dorsal striatum
Thalamus	Pallidum	VTA/SN

Top-Down Mechanisms: Yoga for Self-Regulation

(Gard et al., 2014)

- Yoga as Meditation in Motion

- Focus

- Intentional, attention engagement
- Breath
- Gaze
- Disengagement from distractions
- Stability in the face of stressors



- Meta-Awareness (i.e., witness consciousness)

- Sensory, Interoceptive, and proprioceptive experience
- Psychological distancing, decentered perspective
- Uncouple sensory experience from the narrative self
- Impermanence, suffering, not self (Grabovac et al., 2011)
- Accurately assess present
- Improve behavioral correction processes when regulating emotional responses to stress

Top-Down Mechanisms: Yoga for Self-Regulation (Gard et al., 2014)



- Rapid Cognitive Recovery from Emotional Perturbation
- Positive Reappraisal (upward spiral)
 - Learning to reframe (e.g., from discomfort to sensation)
 - Move to objective, observational, nonjudgmental stance to one's experience
- Yoga On and Off the Mat
 - Readiness/willingness to change
 - Practice changing on the mat for off the mat life
- Decision Making
 - Integrating ethics such as ahimsa and santosha (contentment) when working through postures (e.g., Krilau yoga)
 - Meta-awareness and discernment to choice

Bottom-up Mechanisms: Yoga for Self-Regulation (Gard et al., 2014)

- Embodiment
 - Sensory and perceptual faculties sharpened
 - Greater phenomenological intensity
- Early Attention Filtering
 - Primary receptive networks for interoception and sensations are re-conditioned to facilitate engagement with body sensations, reduce bias and be more functionally integrated with viscerosomatic input, executive control, and adaptive motor output.
- Attenuated Emotional Reactivity
- Parasympathetic Responsiveness
- Breath Regulation in Connection to Emotional States



Bottom-up, Top-Down Mechanisms: Yoga for Self-Regulation (Gard et al., 2014)

- From effortful doing to effortless being (Automaticity)
 - Adaptive responses move from explicit and effortful to implicit and effortless
- Increased integration of afferent information
 - decreased reliance on top-down, increased integration of bottom-up



Mechanisms of Change in Yoga for Trauma

- **Changes in the Brain and Neurotransmitter Systems** (Review by Telles et al., 2012)
 - Increased alpha and decreased theta activity
 - Increased activation of the anterior prefrontal cortex
 - Underactive Serotonergic system (5-HTT)
 - Imbalance in ascending dopaminergic tracts (mesolimbic and mesocortical dopamine systems, which alter control of midbrain defenses)
 - Levels of plasma catecholamines
 - Gamma Aminobutyric Acid (GABA)
- **Affect Changes** (Review by Telles et al., 2012)
 - Reduced negative affect (Dopamine, 5-HTT)
 - Reduced anxiety (GABA)
 - Higher positive affect (Dopamine, 5-HTT, GABA)
 - Stress reduction (Dopamine, 5-HTT)



Mechanisms of Change in Trauma

- Embodiment (Cook-Cottone, et al., 2017)
- Present Moment Awareness (Cook-Cottone et al., 2017)
- Interoceptive, Proprioceptive, and Emotion Awareness (Cook-Cottone et al., 2017)
- Distress Tolerance and Experiential Avoidance (Cook-Cottone, 2017; Dick et al., 2014)
 - Aversive internal stimuli leads to
 - Narrowing of behavioral repertoire (psychological inflexibility)
 - Expressive suppression of inhibiting emotion-expressive behavior when emotionally aroused
- Body as a Resource (Cook-Cottone et al., 2017)
- Emotion Regulation (Cook-Cottone et al., 2017)
- Integrative Decision Making (Cook-Cottone et al., 2017)
 - Body and Mind as Source
 - Based on cognitive, emotional, sensational, interceptive, and prop information

Example iREST

iREST is a secular practice consisting of 15-35 minute sequences, which emphasize:

- (1) Awareness of the physical body and breath
 - Present Moment Awareness
- (2) Systematic desensitization to neutralize and resolve negative sensation, stress, emotion, belief, cognition, image and memory;
 - Embodiment
 - Distress Tolerance
 - Experiential Avoidance
 - Emotion Regulation
- (3) An experience of joy and well-being;
 - Emotion Regulation
- (4) The embodiment of equanimity amidst the ever-changing circumstances of life.
 - Embodiment
 - Body as a Resource
 - Integrative Decision Making

Mechanisms of Change in Yoga for Eating Disorders

- **Anxiety and Depression**

- ➔ Attempts to control anxiety and depression
 - exercise and compensatory behaviors (purging, fasting)
 - Food restriction and binge eating
- ➔ Food Preoccupation (cognitions about food)

- **Emotion Regulation**

- **Present Moment Awareness**

- **Awareness of Internal States**

- Interoception, Proprioception Awareness, Emotion Identification

- **Experiential Avoidance and Distress Tolerance**

- **Embodiment**

- Self as subject, not object;
- lived experience of and from the body

- **Body as a Resource**

- source for coping and stress reduction

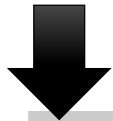
Carei et al., 2010; Cook-Cottone, 2015; Hall et al., 2016; Pacanowski et al., 2017

Does Your Program Deliver Active Ingredients?



Sample Logic Model

Reaction
To Traumatic
Exposure

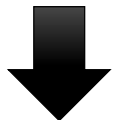


Yoga and
Mindfulness
Practice



- (a) Hyper-arousal
- (b) Avoidance/Re-experiencing
- (c) Alterations in Cognition

- (a) Embodied Practice
- (b) Engagement in the Present Moment
- (c) Re-mapping Cognitions



**Risk for Unhealthy
Behaviors To Self-
Regulate**

From: Cook-Cottone, 2017

Acceptance and Change Dialectic

(Balance between Non-directional Relational Space and Directionality in the Methodological Sequence)

Safe and Accepting Relational Space

(Non-directional; Continuously Fostered)

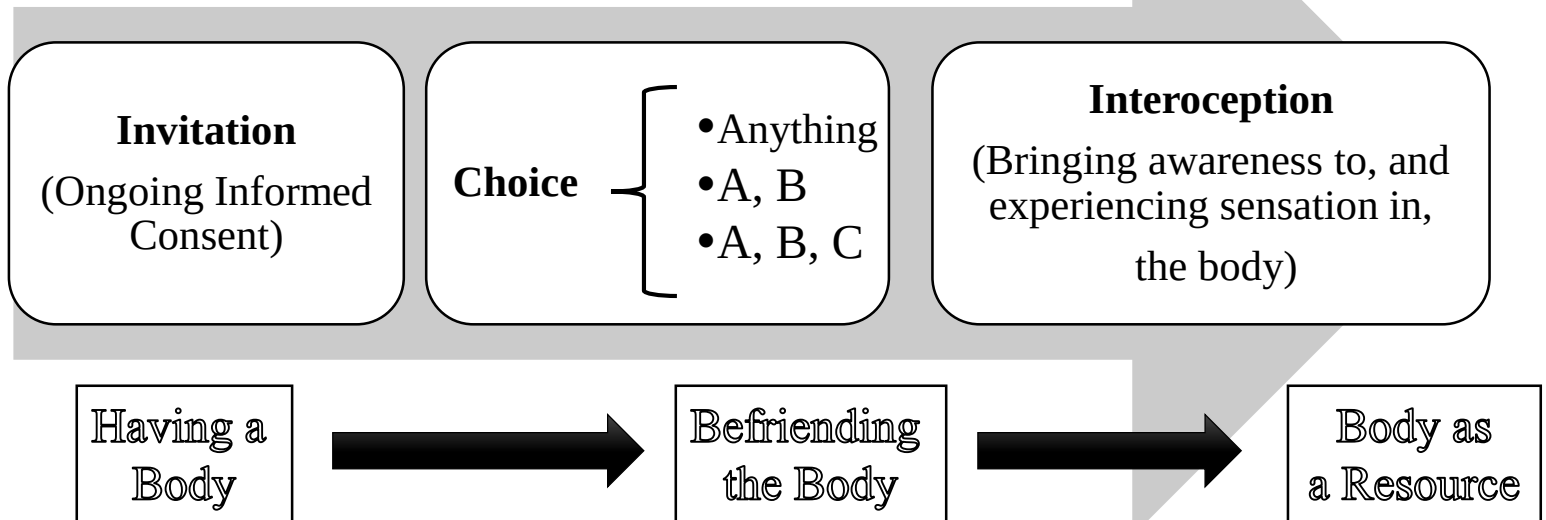
Shared Authentic Experience in the Present Moment

Prioritize- Client Agency/Safe Relationship over Form

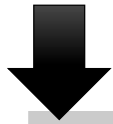
Methodological Sequence (Practice of Forms) →

(Directionality; Step-by- Step Process)

Agency through Choices and Embodied Experience



Eating Disorder



Yoga and Mindfulness Practice

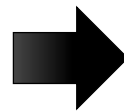


Sample Logic Model

- (a) **Disordered relationship with the body** (body image disturbance, poor interoceptive awareness)
- (b) **Difficulties with present moment awareness and distress tolerance** (mood, body sensations)
- (c) **Self-regulation** through symptoms
- (c) **Alterations in Cognition**

- (a) Embodied Practice
- (b) Tools for present moment awareness and distress tolerance
- (c) Self-regulation through body and breath (body as a resource)
- (c) Re-mapping Cognitions

Body objectified and seen as a source of distress that must be controlled



Positive Embodiment
the body is experienced as a resource

Sample Delivery of Self-Regulation Tools

Skills Developed in the Yoga Class

- Step 1: **BE HERE-** Cultivate present moment awareness
 - Practice being in the here and now
 - Developing the witness and coach
- Step 2: **SEE-** Notice what you are experiencing
 - Inner and outer sensations
 - Emotions
 - Thoughts
- Step 3: **FEEL-** Feel what you feel
 - Interceptive awareness: muscle tension, heart beat, breath
 - Emotions
 - Changes in what you feel
- Step 3: **PRACTICE-** Practicing awareness-driven self-regulation
 - Stay with the moment
 - Physical tools to down-regulate or calm the nervous system
 - Physical tools to effectively engage the nervous system



- (see Cook-Cottone et al., 2017)

Nature of Delivery of Self-Regulation Tools

Sample of Support Provided by Yoga Teacher

- **INSTRUCTION**- Presence, awareness, and skills
- **SAFETY**- Prioritizes safe practice for positive embodiment (“I deserve to be safe”)
- **CHOICE** and **AGENCY**- Emphasizes choice and agency- personal ownership of growth (“I can choose”)
- **EMPOWERMENT**- Emphasizes personal empowerment (“I can”)
- **COLLABORATION** and **SUPPORT**- Encourages collaborative and supportive context (distinction between help and support)

- See Cook-Cottone et al., 2017

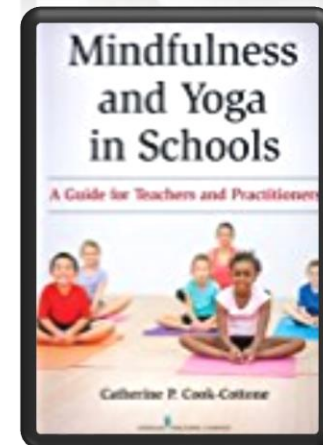
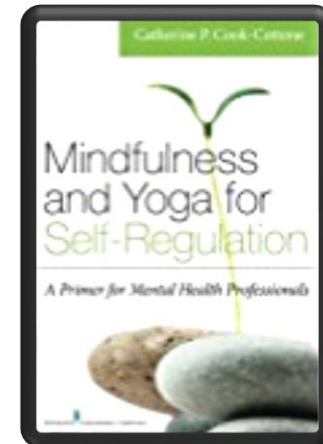


Concluding Questions

- More intentional protocols explicitly addressing the causal chains (as in CBT, Mindfulness, MBSR Mechanisms Research)
- Does mechanism of action change for age group, in risk category for the yoga protocol?
- Can there be specifically designed protocols to address specific mechanism?
- Should we keep aspects of the yoga protocol not directly identified to affect a mechanisms of change?
- Should we be more prescriptive ?
- What other mechanisms have we not considered?
 - Embodiment of the Teacher
 - Is yoga a form of bonding- connection with self, the teacher, (like the substance or the disorder). Does yoga affect attachment systems?

Books

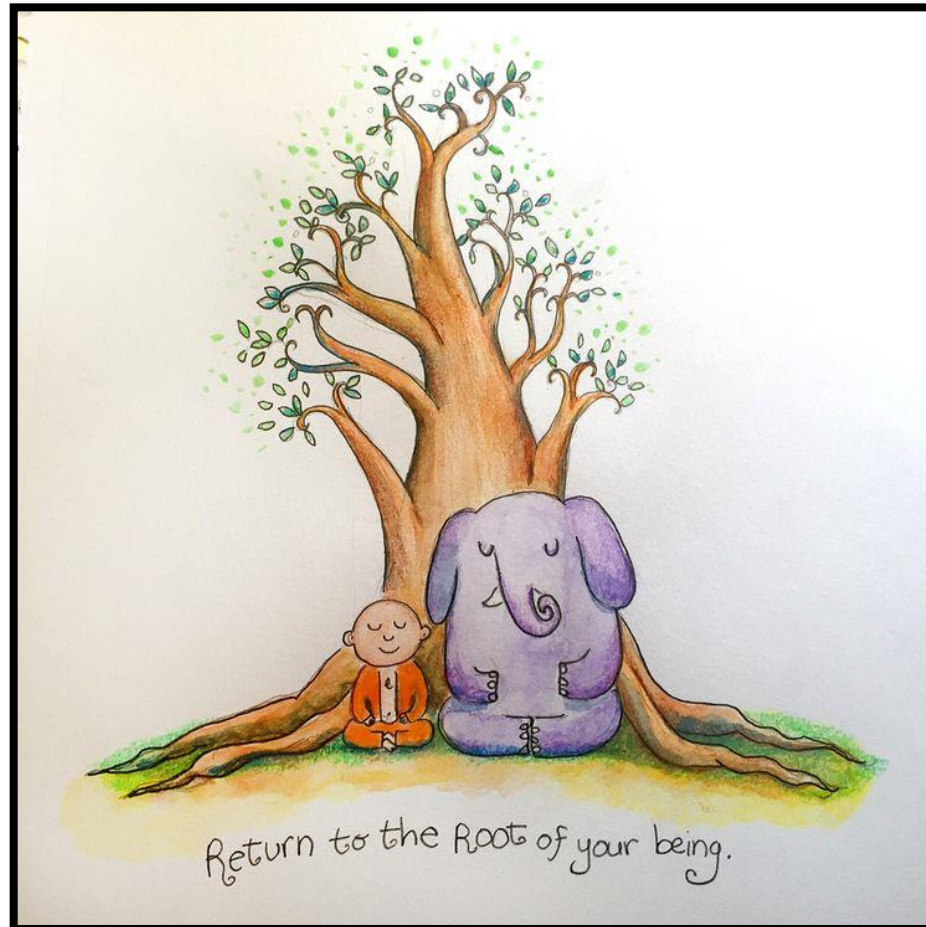
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Additional Notes on Yoga and Mindfulness



Mechanisms of Change for Yoga-Based Practice: Changes in neuro-circuitry

- Physiological Effects of Breath
- Body-Focused Attention
- Interoceptive Awareness
- Mind wandering and metacognition
- Gaze Training

RESULTS

- Regulation of allostatic load
- Integration of bottom-up and top-down processing

See schmalzl, et al., 2015

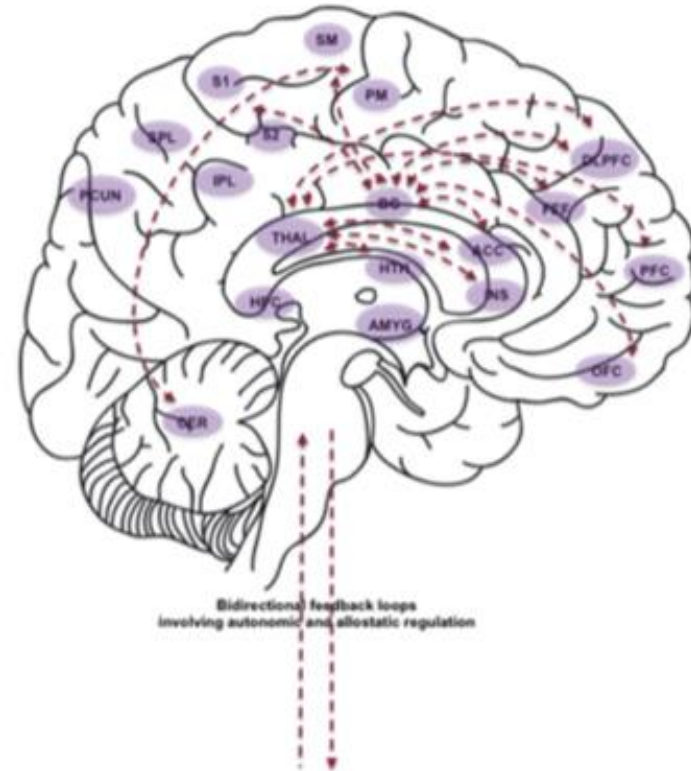


FIGURE 2 | Schematic depiction of some of the brain areas, neural circuits and physiological processes proposed to be affected by YBP.

Abbreviations (in alphabetical order): ACC (Anterior Cingulate Cortex); AMYG (Amygdala); BG (Basal Ganglia); CER (Cerebellum); DLPFC (Dorsolateral Prefrontal Cortex); FEF (Frontal Eye Fields); HPC (Hippocampus); HTH (Hypothalamus); INS (Insula); IPL (Inferior Parietal Lobule); OFC (Orbitofrontal Cortex); PCUN (Precuneus); PFC (Prefrontal Cortex); PM (Premotor Cortex); S1 (Primary Somatosensory Cortex); S2 (Secondary Somatosensory Cortex); SM (Supplementary Motor Cortex); SPL (Superior Parietal Lobule); THAL (Thalamus). **The role of BG and cerebellar circuits:** BG circuits involving PM and SM support the coordination of complex movements. BG circuits involving the DLPFC, OFC and ACC support executive functioning and procedural learning implicated in the planning and learning of motor sequences. BG circuits involving the DLPFC additionally support working memory required for the execution of motor sequences. BG circuits involving S1, S2, DLPFC, and ACC support somatosensory processing as well as the perception of noxious stimuli. BG circuits involving FEF support voluntary eye movements and gaze control. Lastly, CER circuits involving PM and SM support motor coordination and action execution. **Brain areas and neural circuits supporting**

body-focused attention and interoceptive awareness: The INS is the key neural structure for the processing of both exteroceptive (somatic) and interoceptive (physiological) information for bodily awareness and autonomic regulation. The ACC supports the processing of noxious stimuli as well as error detection and conflict monitoring. S1 and S2 are the core regions for the processing of tactile and proprioceptive sensations. The PCUN supports higher-order body awareness, self-related processing and attentional shifting. The IPL and SPL are involved in the computation of body size and shape, and in the integration of multimodal spatial information in body-centered coordinates. The PFC supports executive control and self-referential processing. **Integration of bottom-up and top-down processes:** The breath employed in YBP putatively promotes synchronization of cortical areas via stimulation of THAL nuclei, with a consequent positive impact on alertness and executive functioning. In addition, slow and rhythmic breathing is known to promote vagal tone and in turn reduce allostatic load. The THAL mediates vagal afferent information to the INS, ACC and PFC, which are all involved in self-regulatory processes. The AMYG supports fear-detection, and consequent modulation of autonomic states. The HPC contains stress hormone receptors that can influence the evaluation and memory of stress-related events.

Mechanisms of Action Mindfulness for Psychological Distress

(Alsubaie et al., 2017; Coffey et al., 2010; Grabovac et al., 2011)

- **Emotional Regulation (Emotions)**

- the ability to manage negative affect through increased insight and decreased reactivity (Coffey et al., 2010)
- Awareness of impermanence and concept of not self (Grabovac et al., 2011)
- Decreased cognitive and emotional reactivity (Alsubaie et al., 2017)
- MBSR group showed improved functioning in brain regions associated with reduction in social anxiety (see Alsubaie et al., 2017)

- **Rumination (Thoughts)**

- Through mindful attention to the present moment, focused attention (Alsubaie et al., 2017)
- Nonattachment (not suffering through attachment and aversion; Grabovac et al., 2011)
- Through decentering (Alsubaie et al., 2017)

- **Self-Compassion**

- Associated with decreased rumination and worry (Alsubaie et al., 2017)

