

HEALING CENTERED YOGA –
AN ADJUNCT CLINICAL INTERVENTION PILOT STUDY:
TRAUMA AND CHEMICAL DEPENDENCY

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Master of Public Health – Promotion and Policy

by

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The undersigned, appointed by the dean of the Graduate School,
have examined the thesis entitled

HEALING CENTERED YOGA –
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TRAUMA AND CHEMICAL DEPENDENCY

presented by Heather Saxon,

a candidate for the degree of Master of Public Health – Promotion
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and hereby certify that, in their opinion, it is worthy of acceptance.

Professor Maithe Enriquez

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DEDICATION

I'm leaving here a different person than when I arrived, and so many have shaped who I am today, who I have yet to become, and what I choose to put back out into the world. This thesis is dedicated to all those in my life who supported me during graduate school, albeit in drastically different ways. No one knew what was *really* going to happen when I came to graduate school. It's been some of the best and worst years of my life, but I would do it all again. I learned and taught and failed and succeeded and loved and lost and cried and laughed and bled and broke and healed and felt super highs and super lows and everything in between – experiencing what felt like every facet of human experience and emotion. That itself is enough to be grateful for. But, even during the times when I was *this close* to throwing it all away, I chose to stay. I chose dedication. To my work. To making my work actually...work. And those I love sacrificed for my dedication.

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LIST OF ABBREVIATIONS

| | |
|---------------|-----------------------------------------------------------|
| ACE/ACEs..... | Adverse Childhood Experience(s) |
| ACTH..... | Adrenocorticotrophic Hormone |
| ADH..... | Antidiuretic Hormone (also Arginine Vasopressin; see AVP) |
| ANS..... | Autonomic Nervous System |
| ASA..... | Against Staff Advice |
| AVP..... | Arginine Vasopressin (also Antidiuretic Hormone; see ADH) |
| BPQ..... | Body Perception Questionnaire |
| BTC..... | Bambu Treatment Center |
| C&C..... | Choice and Community Survey |
| CBT..... | Cognitive Behavioral Therapy |
| CIDI..... | Composite International Diagnostic Interview |
| CN..... | Cranial Nerve |
| CNS..... | Central Nervous System |
| CRH..... | Corticotrophin-Releasing Hormone |
| DBT..... | Dialectical Behavior Therapy |
| DID..... | Dissociative Identity Disorder |
| DMNX..... | Dorsal Motor Nucleus |
| DSM..... | Diagnostic and Statistical Manual of Mental Disorders |
| DV..... | Domestic Violence |
| EBI/EBIs..... | Evidence Based Intervention(s) |
| EIA..... | Enzyme-Linked Immunosorbent Assay |

ENS Enteric Nervous System

E-RYT-200 Experienced Registered Yoga Teacher, 200 Hours

HCYHealing Centered Yoga
*(Healing Centered Yoga (HCY): An Adjunct Clinical Intervention Program and Practice
for Healing Trauma©)*

HIV Human Immunodeficiency Virus

HPA/HPAA..... Hypothalamic-Pituitary-Adrenal Axis

IP₃..... Inositol trisphosphate

IPV Intimate Partner Violence

IRB Institutional Review Board

iREST..... Integrative Restoration

IT..... Isotocin

IV Intravenous

LC-MS-MS Liquid Chromatography with Tandem Mass Spectrometry

mRNA..... Messenger Ribonucleic Acid

MT..... Mesotocin

MU University of Missouri

NA..... Not Applicable

NA..... Nucleus Ambiguus

NF IL-6 Nucleofactor Interleukin-6

NH..... Neurohypophyseal

NTS Nucleus Tractus Solitarius

OTOxytocin

| | |
|------------|---------------------------------------------|
| OTR..... | Oxytocin Receptor Gene |
| PI..... | Principal Investigator |
| PNS..... | Peripheral Nervous System |
| POMC..... | Pro-Opiomelanocortin |
| PSNS..... | Parasympathetic Nervous System |
| PTSD..... | Post-Traumatic Stress Disorder |
| PVN..... | Paraventricular Nucleus |
| RIA..... | Radioimmunoassay |
| RSQ..... | Responses to Stress Questionnaire |
| SE..... | Somatic Experiencing |
| SEL*F..... | Social Emotional Learning and Facilitation |
| SES..... | Socioeconomic Status |
| SNS..... | Sympathetic Nervous System |
| VT..... | Vasotocin |
| WHO..... | World Health Organization |
| YACEP..... | Yoga Alliance Continuing Education Provider |

ABSTRACT

Introduction: Healing Centered Yoga (HCY) is a multidisciplinary practice and program offered as an adjunct clinical intervention for individuals experiencing complex, acute, and/or treatment-resistant trauma and related stress. Research on the contemplative practices, including yoga and its relationship to trauma, physiologic regulation and overall wellbeing has grown exponentially. However, with poor reporting, colonization of yoga, lack of community-partnered studies as well as lack of understanding regarding the evolutionary, neurophysiological and neurobiological mechanisms of trauma and yoga, clinical applications have been difficult or limited.

Methods: Facilitate *Healing Centered Yoga (HCY): An Adjunct Clinical Intervention Program and Practice for Healing Trauma*© as an academic-community partnership.

Using a pre/post design, analyze: a) autonomic nervous system reactivity and body awareness; b) perception of choice and connection; c) involuntary and voluntary cognitive and neurophysiologic processes and coping strategies associated with stress responses; d) trends among individual and aggregate numbers of trauma exposure.

Results: Adult female participants (n=25) experiencing residential-based treatment for chemical dependency recovery enrolled in the study. Trends in feasibility are low, acceptability is high, other results are mixed with data analysis in process for manuscript.

Conclusion: The overall trends of this study reflect 1) high acceptability to the priority population; 2) low feasibility affecting therapeutic efficacy, but with opportunities to increase feasibility with changes to the program; 3) successful community-partnered study with mutually perceived co-learning and shared power; 4) trends in trauma and chemical dependency as comorbid.

1. INTRODUCTION

Within the evolved human brain, dynamic and plastic neural circuitry molds, monitors, calibrates and coordinates reality and perception, and ultimately, our entire lives. The brain determines what is threatening and stressful, regulates physiological, behavioral, cognitive, and emotional reactions and responses, and deploys coping mechanisms for perceived threats (or stressors) (Garland & Howard, 2009; NRCIM, 2000). The brain's responses during and after stressful or traumatic experiences are largely an interaction of autonomic reactivity, cognition and emotion; however, one significant mediating factor of respective reactions and responses is social support (Flinn, 2006; Forbes and Dahl, 2010; Khalsa et al., 2018; McEwen & Gianaros, 2011).

Stress is simply a reaction to a stimulus that alters our physical and psychological processes. Acute stress, such as a competitive video game or planning an upcoming wedding, *can* be exciting. It keeps us on our toes. Chronic and/or traumatic stress, however, can cause functional and structural remodeling of the brain, which may be ontogenetically adaptive under circumstances or contexts where safety is lacking or compromised (e.g. chronic childhood abuse). However, it can lead to damage when excessive or long-term; long-term health and cellular energy are at risk through resource diversion from immune response, autoimmune protection, metabolic function, cellular repair and other necessary health functions (Flinn, Nepomnaschy, Muehlenbein, & Ponzi, 2011; Sherwood, 2010).

Stress research suggests the “fight, flight, or freeze” response (stimulation of the sympathetics) is stimulated by *uncertainty that is perceived as significant*, and for which behavioral responses will have unknown effects (Flinn et al., 2011; McEwen, 2007; McEwen & Gianaros, 2011). Associated with this response may be chronic or traumatic stressors, which are often associated with unpredictability or uncertainty (Flinn et al., 2011); examples include, but are not limited to, socio-structural features such as historical trauma, segregation, sexism, racism, dislocation, LGBTQIA+-related violence and socioeconomic-status disparities as well as experiences such as homelessness, chronic poverty, chemical dependency or substance abuse, ongoing home or neighborhood violence, including intimate partner violence (IPV) and domestic violence (DV), and physical, sexual, emotional, and psychological assault and abuse (Kelly & Johnson, 2008; Ragavan, et al., 2019). All of these experiences are strongly linked to health outcomes (Buckner-Brown et al., 2011; Dressier, 2001; Estrada, 2009; Felitti, et al., 1998), and, therefore, defined as social determinants of health; they are all also features or products of social relationships and social behavior, which has implications for trauma exposure(s) and respective treatment or healing modalities.

Trauma is widespread and prevalent, from global and community levels to families and individuals. In one study across 21 countries, the World Health Organization (WHO) revealed that more than 10% of participants had experienced trauma; of those 10%, almost 20% witnessed violence or experienced IPV, and about 12-15% experienced exposure to war or trauma to someone they love (WHO, 2019). Recommended is psychological first aid, stress management, and supportive individuals – and their identified communities – to discover effective coping skills/strategies and strengthen them in addition to

strengthening social/psychosocial support in general (i.e. a sense of community connection, belonging or social support) (Flinn et al., 2011; WHO, 2019). However, societal characteristics, such as those listed previously (e.g. experiences of low or poor social support, socio-structural violence, domestic violence, homelessness), are powerful determinants of the health of a population and the individuals within it. In fact, Galea and researchers (2011) found the following associations of such social health determinants and deaths in the U.S.: “176000 [deaths] to racial segregation, 162000 to low social support, 133000 to individual-level poverty, 119000 to income inequality, and 39000 to area-level poverty” (parenthesis added). The academic literature is growing to acknowledge yoga as one of these supports (Sullivan et al., 2018); however, as with any intervention, needs such as food, water, rest, safety and shelter must be met first; this is congruent with the commonly used Maslow’s Hierarchy of needs. Evidence continues to compound quickly on yoga as complementary practice within integrative healthcare and as an adjunct clinical intervention after basic needs are met (Sullivan et al., 2018).

Carefully developed and empirically supported interventions with community partners as indicated, administered over time, such as certain evidence-based yoga interventions, may contribute to base tiers of Maslow’s Hierarchy via, for example, increasing *perceived* safety in the body and brain (second tier from the bottom of the hierarchy), which is as important after actual, secured, physical safety is achieved (first, bottom tier); you can be in the safest place in the world, but if you don’t *feel* or *perceive* safety, then it isn’t *actually* safe as perceived and processed by the brain and body and resultant outputs (e.g. sensitive startle response; hypervigilance). Not being in a safe

place and *feeling* like you are not in a safe place (even if it is measurably safe) is processed similarly physiologically. This itself has important implications for socio-structural violence and disparities, historical trauma, and more as relevant to policy and population health.

Unfortunately, with heterogeneous practices across *both* similar and disparate sample populations in the literature research, alongside the colonization of yoga (where yoga facilitation is homogeneous in a way that perpetuates trauma; the contrast of homogeneous and heterogeneous practices are discussed in detail later), poor reporting, and a broad lack of understanding regarding the possible evolutionary processes and neurophysiological and neurobiological mechanisms of how yoga intersects with healing trauma, clinical applications can be difficult and/or limited (Sullivan et al., 2018). In addition, community-partnered and community-based research seems to be severely lacking across yoga implementation at large, with few exceptions (Ragavan et al., 2017); this thesis research seeks to contribute to filling this lacuna among others.

Though yoga research is lacking in context to community partners, the overall body of literature on various forms of contemplative practices, including yoga, and their relationship to trauma, stress, healing, wellness and overall wellbeing has grown exponentially (Sullivan et al., 2018). A proposed definition of meditative practices in Western medical and clinical contexts, of which yoga is one form, is, “[a] form of mental training that aims to improve an individual’s core psychological capacities, such as attentional and emotional self-regulation” (Tang, 2015), though many other processes

are, or may be, involved as described herein. Meditation encompasses a complex group of practices, including yoga, tai chi, breathing techniques, and more (Tang, 2015).

While Healing Centered Yoga (HCY) is clinically applied (as a current adjunct clinical intervention) with a foundation of multiple scientific disciplines, and some participatory feedback from previous research on yoga developed specifically for trauma (Clark et al., 2014; Miller, 2015), it combines and expands usual approaches of yoga to healing trauma, in addition to inclusion of yoga ethics (Adele, 2009; Clark et al., 2014; Miller, 2015); for example, HCY facilitation combines bottom-up (e.g. body- and somatic-based techniques) (Khalsa et al., 2018) and top-down (e.g. interoceptive attention; cultivating perceived autonomy and choice; aspects of Cognitive Behavioral Therapy (CBT)) approaches, rather than focusing on just one or the other. As another example, concepts of community connection/social support, social justice and equity are essential to HCY's foundation, because evidence reflects the necessity of community and social support in mediating measures of *individual* resilience (which invariably include aspects of interpersonal relationships, social justice and equity) and healing associated with trauma exposure.

The following objectives and research questions are rooted in the theory of evolution as the theoretical underpinning, and seeks to identify how yoga intersects with health and wellbeing, during or after trauma exposure and chemical dependency recovery, and possible health effects across multiple axes.

1) Objectives of the Study

PRIMARY OBJECTIVES

1. Iteratively modify Healing Centered Yoga (HCY) facilitation, a form of evidence-based yoga developed for healing trauma, during a community-partnered study as a 6-week adjunct clinical intervention program.
2. Analyze health measures and well-being before and after the study, across individual self-report scales (some as proxy for physiological reactivity), with a focus on trends, especially as relative to number of reported trauma exposures by individuals in the community and in aggregate.
3. Evaluate feasibility, acceptability and therapeutic efficacy of the intervention in the priority population.

SECONDARY OBJECTIVES

1. Move toward health equity in yoga through offering an accessible and sustainable health modality (yoga) to a sample population with low access or perceptions of non-belonging in yoga.
2. Contribute to the literature on yoga as an adjunct clinical intervention, through offering a) detailed teaching methods of yoga facilitation in communities, and individuals within those communities, experiencing trauma (past or present), b) data on physiologic measures and individual health and wellbeing trends before and after yoga intervention through survey proxy, c) a community-partnered yoga program developed to work toward narrowing social health disparities associated with yoga, and d) contribute to the scarce literature on yoga as an adjunct clinical intervention in a sample population experiencing chemical dependency recovery.

2) Research Questions

1. Are there trends, from pre-to-post HCY program intervention, on: a) autonomic nervous system reactivity and body awareness as measured by the BPQ questionnaire – modified; b) perception of choice, autonomy and community connection or belonging as measured by the Choice and Community Survey; c) involuntary and voluntary cognitive and neurophysiologic processes, during individual responses to stressful situations, that may associate with trends in involuntary and voluntary coping strategies as measured by the RSQ questionnaire – modified; d) trends from a, b, or c, that correspond with number of traumas exposures experienced by an individual, as measured by the ACEs questionnaire, both intra-individually and in aggregate among the sample population.
2. Is the *Healing Centered Yoga (HCY): An Adjunct Clinical Intervention Program and Practice for Healing Trauma*© intervention feasible, acceptable, and therapeutically efficacious to the priority population, as measured by: a) percent of participants who attend each session; b) number of total sessions each volunteer attends; c) field notes; d) participant verbal feedback; e) trends across physiological and psychosocial axes derived from proxy surveys.

2. TRAUMA IN MEDICINE AND CLINICAL PRACTICE

1) Trauma Prevalence, Outcomes, And Intervention: An Overview

A. Prevalence

Evidence-based interventions (EBIs) are increasingly gaining attention across mental health fields as well as respective clinical applications and have significant implications for patients with past or present trauma (Katon et al., 2006; Reeves, 2015). Despite recent growing attention of the importance of recognizing trauma and its applicability to medicine, implementation of trauma-informed and -sensitive care has been extremely slow across medical and clinical applications. Trauma exposure is *the* defining risk factor for PTSD (posttraumatic stress disorder), and individuals who experience traumatic events are more vulnerable to additional, subsequent traumatic experiences or re-traumatization and resultant increases in severity of PTSD across several axes (Flinn et al., 2011; Khalsa et al., 2018; Kimerling, Allen & Duncan, 2018).

Over 20 years ago, Kessler et al. (1995) (n=5877) found trauma and PTSD is significantly more prevalent than previously thought, in medical and clinical settings, and is often persistent; supporting this conclusion, just 3 years later, Switzer et al., (1998) evaluated trauma in an urban outpatient clinic (n=170), and found 94% of patients reported at least one major traumatic event (physical assault, rape or threat with a weapon were the three top-reported). In a study evaluating number and types of trauma associated with suicide, findings show, overall, the highest rates of suicide ideation *and* attempt are associated with childhood maltreatment and sexual assault exposures (LeBouthillier et al., 2015).

Though certain types of trauma are more common on cis-gender-based comparative analyses (e.g. cis-females more commonly experience various forms of sexual assault; cis-males more commonly experience physical assault), previous findings indicated the prevalence of trauma and diagnosable PTSD (posttraumatic stress disorder) was essentially comparable between genders (Switzer et al., 1998); however, current research shows the contrary: trauma is approximately twice as high in females (Kimerling, Allen & Duncan, 2018). This stark contrast varies, in part, based on which version (DSM-III-R, DSM-IV, DSM-V) of the DSM (Diagnostic and Statistical Manual; used for diagnosing psychiatric conditions) was used as guidance for diagnoses throughout prior research; it appears earlier DSM versions lack the scope and specificity of items that apply to trauma exposures and lack the characteristics of a comprehensive diagnostic tool, which significantly influenced previous exposure rates and attenuated gender differences (Kimerling, Allen & Duncan, 2018; Mills et al., 2011).

In fact, research to evaluate empirical evidence for potential trauma exposure events comparing adult males and females doesn't appear to have been published until 2011 (Mills et al., 2011). Age-matched, cross-cohort samples were compared to analyze exposure prevalence rates using two surveys: Composite International Diagnostic Interview (CIDI) (11 items) and World Mental Health CIDI (29 items). By combining the surveys, the number of possible event types (i.e. potential trauma events) increased from 11 to 29, which did increase the overall population prevalence by 18% in context to prevalence of exposure; however, this increase in types of events also led to increased precision, which reflected the prevalence of traumatic exposure events have been significantly underestimated, *especially* among females (Kimerling, Allen & Duncan,

2018; Mills et al., 2011). Potential traumatic events that were not listed, or conflated with other events, in previous epidemiological surveys, elucidate how it is imperative to implement comprehensive assessments when estimating prevalence of trauma, which may influence diagnostics and treatment (Kimerling, Allen & Duncan, 2018; Mills et al., 2011).

When evaluating service utilization patterns, patients with past trauma had higher service-use (i.e. sought a greater variety of service/medical professionals and used services more frequently than non-trauma-identifying counterparts) with reported lower satisfaction (Switzer et al., 1998). In addition, patients with recent trauma were more likely to experience inpatient hospitalization, and prescribed psychotropic medications (Switzer et al., 1998).

More recent findings substantiate and expand on older studies' conclusions: Many primary care patients suffer from trauma-related experiences and have PTSD, usually concurrent with major psychological distress (Taubman-Ben-Ari et al., 2001); PTSD or past trauma has a direct negative relationship with physical health, which is associated with more frequent use of primary health care services (Deykin et al. 2001; Felitti et al., 1998); There are recognized associations between quantifiable disadvantage (i.e. poverty, homelessness, abuse, discrimination), current stressors, trauma and adverse health outcomes (McEwen & Gianaros, 2011; Pascoe & Richman, 2009); Mental health disorders, including those associated with trauma, often promote or imitate development of ongoing physiologic imbalance (chronic homeostatic and allostatic disturbances) (Khalsa et al., 2018). Research also shows evidence of altered brain functioning as a result of traumatic early abuse and neglect; behaviorally, this translates to higher risk for

severe anxiety, depression, cognitive deficiencies, low self-esteem and diagnosable PTSD and comorbid trauma-related diagnoses, such as substance abuse or chemical dependency, in children and adults (Glaser, 2000; Haber, 2004; Ryan, 2000).

B. Intervention and Outcomes

However, recent findings also show promising action steps providers can take for increased probability of improved care and outcomes for patients with past or present trauma: 1. Clinic providers who pay attention to patients' trauma histories may improve detection, intervention and referral to treatment (Liebschutz et al., 2007); 2. Simply asking about trauma, listening and accepting is shown to be a major intervention in itself (Felitti & Anda, 2014); 3. Implementing trauma-informed and -sensitive care and interventions (whether primary or adjunct clinical interventions such as certain forms of yoga), which address the unique needs of patients, ensures needs of trauma survivors are met, mitigates barriers to care, helps to close health disparities and increases equity, as well as promoting wellness across the lifespan (Phillips & Shonkoff 2000; Reeves, 2015).

2) The Problem of Standalone “Individual Resiliency” Measures

It is important to note the problem of only focusing on ‘individual resiliency’ in trauma (or any other context). First, resiliency and healing are not the same thing. This is crucial to understand. And we ought to call for addressing both with humans who have experienced trauma and are working toward recovery and health, rather than confounding them.

The first two definitions of healing are as follows: 1) “to make free from injury or disease : to make sound or whole”, 2) “to make well again : to restore to health”

(Merriam-Webster, 2019). Second, the problem is a semantic one: resilience often refers only to the *individual* and their ability to “bend but not break”, to bounce back, and “to adapt well in the face of adversity, trauma, tragedy, threats or even significant sources of stress” (Southwick et al., 2016). By definition, then, we may be able to bounce back (be resilient) but not be well (not be healing/healed), which does not seem to be the most holistic, empirical or effective approach to trauma, health and wellness. We would be wise not to confuse modes of resilience and modes of healing; while some interventions or practices may include or incorporate both, some may not, and it is our responsibility to cultivate both (and much more) for the wellness of the patients we may serve. Third, if we only focus on an *individual’s* resilience, we are explicitly ignoring the surrounding environmental factors that are interwoven with trauma exposure and measures of resiliency aptitude, such as psychosocial, interpersonal and socio-structural characteristics. Such characteristics should be integral within any given measure of individual resilience – social support or lack thereof, and the relationships involved in social support, is crucial in our overall wellbeing and in healing trauma.

For example, all else equal, if a person is experiencing 1) frequent violence in a community that is *not supportive*, how might their outcome measures for individual resilience vary compared to a person who has 2) a *supportive* and non-violent community, or, 3) a violent but *supportive* community? While the answer to this may vary, and it is rhetorical, the point is that environmental factors, especially those related to sociality and close-other relationships (e.g. intimate partner; children; parents/caregivers) have huge impacts on our health and physical and mental wellbeing

(which are often one in the same, since our literal brains and bodies are not disconnected), including resiliency measures.

To be clear: this is not an argument for cultural determinism (just as in later discussion, there is no argument for biological determinism, either). It is simply noting that environmental and social factors comprise much of the stimuli we all process each moment, and that these stimuli and respective reactions or responses must be accounted for in *individual* measures if we are to wholly understand the person, their trauma experiences, and how to best intervene, treat or know what to offer to support resilience and healing. While this may seem obvious, it can be helpful to expand this thinking into how we perceive any given human behavior from a theoretical perspective, specifically, through the theoretical lens of evolution by natural selection.

3. EVOLUTION AS A THEORETICAL FOUNDATION

1) Evolutionary Medicine

Every human is the product of evolution. We already have a solid theoretical foundation, and respective frameworks, from which to ask novel medical research questions and which unifies several fields of science: Darwin's evolution by natural selection. Biologists and anthropologists have been studying evolution as applied to human behavior for decades. Fundamental misunderstandings of Darwin's evolution by natural selection, specifically as conflated with Social Darwinism (e.g. "fitness" doesn't mean "stronger, smarter, etc."; evolution is not linear such that humans are not becoming "super human" as in television or movies; evolution acting for the "good of the species" is demonstrably false), still propagate among the public and otherwise well-educated scientists alike, despite underlying shameful and horrific research avenues associated with Social Darwinism, such as eugenics (McGee & Warm's, 1996; Nesse, 2006). However, in contrast, Darwin's theory of evolution by natural selection is an established fact that, when understood and applied appropriately, can robustly enhance our understanding of human health and wellness, as in Evolutionary Medicine.

The father of evolutionary medicine, Randolph Nesse, describes best why evolution matters in questions of medicine, public health and applicable research, which is well known and studied by biological (and/or evolutionary) anthropologists and biologists:

"Many well-educated scientists are unaware of revolution in biology initiated by recognition that selection *rarely* acts for the good of the species (Williams, 1966) [...] The notion that pathogens and hosts coevolve is widespread, but not all scientists recognize the ubiquity of arms races and how selection defenses and counterdefenses leaves both host and pathogen vulnerable to new

problems [...] Machines inevitably wear out and break, and organisms age and die, but the reasons are fundamentally different. Machines cannot replicate their parts, so eventually things break. Bodies can make new parts; lizards grow new tails, and we can replace damaged skin and liver cells. But we cannot regrow a severed finger [...] The explanations are evolutionary [...] Evolution's greatest contribution to medicine may be replacing the analogy of body as machine with feeling for the organism as a product of natural selection" (Nesse, 2001).

What Nesse is describing is at the core of taking an evolutionary approach to trauma. It isn't reductionist in thought. You may ask why, then, are humans so vulnerable to disease if this is all adaptation? Nesse outlines six reasons within the theoretical framework of evolution by natural selection, which is in line with Tinbergen's four questions, when applying evolution to questions of human vulnerability to "disease" traits.

2) Tinbergen's Four and Nesse's Six: Biological Questions and Human Vulnerability to Disease

For each of Tinbergen's four questions, there are two kinds of explanations (proximate and evolutionary) and two objects of explanation (developmental/historical and single form) (Nesse, 2013). Proximate questions utilize ontogeny and mechanism, while evolutionary questions explain "how a species came to its current form by describing a sequence of forms, and how they were influenced by selection and other evolutionary factors" (Nesse, 2013). Developmental/historical explanations describe "a sequence that results in the trait" and single form explains the trait "one slice at a time" (Nesse, 2013) (Bateson and Laland, 2013; Nesse, 2008; Nesse, 2013).

Proximate questions have been asked in medicine and clinical application for decades, and may look like this: 1) How does the trait work? (*mechanism*; proximate,

single form), or, 2) How does the trait develop in individuals? (*ontogeny*; proximate, developmental/historical). However, evolutionary questions are considerably rare in such applications (even rarer is evolution applied without misunderstandings or misapplications within the medical profession (Nesse, 2007)), and may look like this: 3) “How have variations in the trait interacted with environments to influence fitness in ways that help to explain the trait’s form?” (Nesse, 2013) (*adaptive significance*; evolutionary, single form), and 4) What is the phylogenetic history of this trait (*phylogeny*; evolutionary, developmental/historical).

Tinbergen’s four questions may cultivate further insight and a deeper understanding of any given trait, such as behavior, disease, dysfunction or abnormality (abnormality as defined in evolutionary medicine), which may influence medical and clinical decisions (Bateson and Laland, 2013; Nesse, 2008). To expand on Tinbergen in human health and evolutionary medicine, Nesse (2008) describes six reasons for “vulnerability to disease” in humans, which fall under three basic categories:

A) ***natural selection is slow***: 1. bodies are mismatched to the current environment as they are shaped for environments very different than modern ones; 2. co-evolution with fast-evolving pathogens is quicker because our generation times (as humans) are significantly longer, so there isn’t “perfect protection against infection”;

B) ***what selection shapes is limited***: 3. constraints are present, such as imperfect gene replication; 4. tradeoffs exist for every trait, which means every trait is suboptimal – for instance, “compared to eagles, our vision is less acute but our

color vision is superior” – each trait evolved within the context of the environment;

C) *in understanding what selection shapes, difficulties arise*: 5. reproduction is favored in the organism even if it negatively impacts health, wellbeing or lifespan; 6. defenses are useful responses shaped by natural selection, such as fever or pain.

With an understanding of Nesse and Tinbergen’s work, we may apply this knowledge in questions of trauma and respective healing and treatment modalities. In order to understand trauma from an evolutionary perspective, we need to understand an array of processes and networks as well as human life history traits. The next section will address each of Tinbergen’s four questions (mechanism, ontogeny, phylogeny, adaptive significance) in an integrative way as applied to trauma exposures and experiences (Nesse, 2007; Nesse, 2013).

4. EVOLUTION, THE SOCIAL BRAIN, AND TRAUMA

The human brain evolved steadily and quickly at a different trajectory than overall body growth (Flinn, 2006; Rosenberg, 2004). A human baby uses about 50% of its metabolic resources for the brain (Flinn, 2006); however, the brain boasts high metabolic costs across the lifespan (Rosenberg, 2004). For example, the energy required for human cognition involved significant trade-offs (Nesse, 2007), such as the obstetric complexities of birthing children with large brains (relative to body size) and resultant large heads (Rosenberg & Trevathan, 2002; Flinn et al., 2011). Why were such huge brains selected for by evolution? The adaptive significance must have been high for human intelligence (Flinn, 2006), and, indeed, as a species we boast unique characteristics: language; ability to travel forward or backward in our minds – and sometimes “see” different iterations of either (e.g. imagined future lives; how the past may have unfolded differently); consciousness; abstract thought; Theory of Mind (defined: “knowing what others know” as disconnected from empathy (de Waal, 2012); (de Waal, 2012; Flinn, 2006; Flinn et al., 2011). This characteristics are aligned with life history traits of humans, including “long interbirth intervals, extensive biparental care and prolonged attachment” (Flinn, 2006), reflecting a highly social and interdependent species where attachment and bonding are fundamental (Insel & Young, 2001; Young & Wang, 2004).

We literally live for these bonds: our children, our lovers, our parents, our closest friends (Flinn, 2006). These interdependent relationships are directly related to survival and reproduction. Our evolutionary history has influenced how we respond differentially to stimuli (social and otherwise) across certain contexts and situations; for example,

compared to our phylogenetic cousins, the chimpanzees or bonobos, we have similar responses to some stimuli but drastically different experiences and responses to other stimuli (Barrett, Henzi, & Rendall, 2007; Flinn, 2006). Chimpanzee, bonobo and human brains may reward (or punish) similarly, for example, when biting into ripe fruit (with a lot of glucose, for which there are evolutionary explanations) (Flinn, 2006), but as for other experiences, such as what we call “romantic love” or “happiness” in humans, evidence is lacking for the same in our chimp and bonobo cousins, which appears to make these experiences unique to humans (Flinn, 2006; Young & Wang, 2004).

Likewise, the evolutionary constructs that allow for the capacity of romantic love, or, how a mother responds to photos of their child (Young & Wang, 2004) in humans involved concurrently modifying neural receptors and resultant processes; attachment and bonding are “core features of the human social brain” (Donaldson & Young, 2008; Flinn, 2015). At the core of these features is the mother-offspring relationship; other affiliative relationships (i.e. mates, paternal care, family group, coalition-building and larger societal networks) appear to have “co-opted” or selected the same underlying neural mechanisms that regulate this trait (Flinn, 2015; Insel and Young, 2001). The neural regions involved with attachment in humans appear similarly across other species; however, neural regions associated with “interpreting and gauging others’ emotions and intentions” decrease in activity when humans engage in affiliative or bonding behaviors, suggesting this “may provide evidence for a links between psychological mechanisms for attachment and management of social relationships” (Flinn, 2015) (de Waal, 2012; Donaldson & Young, 2008; Flinn, 2015).

Close social relationships underscore some of our most intense feelings or sensations and are integral to how we learn to engage and participate in society and relationships (Donaldson & Young, 2008; Flinn, 2015). Certain neurohormones are associated with traits like bonding, such as mesolimbic dopamine, which happens to also be a key neurotransmitter in reward-inducing-related behaviors (behavior that make us feel good – or “rewards us” – in some way, so that we want to engage in the behavior again); for example, reward systems and processes underlie chemical dependency and substance abuse, eating sweet foods, orgasm and male ejaculation, as well as prosocial, attachment, bonding or altruistic behaviors (it is far beyond the scope to discuss the complexities of altruism or reciprocal altruism and related debates) (Flinn, 2006; Young & Wang; Zarrabian, 2018).

Neurohormones are involved in these social relationships as well, such as oxytocin (OT) and vasopressin (AVP/ADH) whereby distribution of OT and AVP is dense in brain structures associated with the “reward system” (endogenous opioid system), which correspond to maternal attachment, among much more (Donaldson & Young, 2008; Flinn, 2015; Fujita, Ide & Ideka, 2018; Gordon et al., 2011). OT and AVP/ADH appear to be the core neurohormones involved in social bonding, attachment and affiliative behaviors (prosocial behaviors; e.g. what we call “love” as humans). Additional neurohormones appear to have modulating or mediating effects during offspring development, such as cortisol and other glucocorticoids, dopamine, serotonin, corticotrophin-releasing hormone (CRH), adrenocorticotrophic hormone (ACTH) and many related others (Donaldson & Young, 2008; Flinn, 2015; Ross & Young, 2010).

Though there is variation, the neurohormones involved in pair-bonding in humans is similar to other species (e.g. monogamous prairie voles) (Insel & Young, 2001). However, it is important to remember that it's not just neurohormones affecting behavior, social behaviors and experience – the reverse is also true: these experiences affect our neurohormones as they affect many aspects of our physiology and psychology. One such integrally involved system is the hypothalamic-pituitary-adrenal axis (HPA axis) (Flinn, 2015).

1) HPA Axis

The Hypothalamic Pituitary Adrenal (HPA) axis is comprised of the 1) hypothalamus, 2) adrenal glands (“suprarenal”), and 3) pituitary gland and the interactions within and between these structures. The HPA axis is a large part of the neuroendocrine system and is associated with reactions to stressors, including social stressors (from a disagreement with a co-worker, to a child abused by their parent or caretaker), and the regulation of many interrelated body processes, such as digestion, immune system function, mood and emotions, and energy storage and expenditure (Heim, 2008). It upregulates glucocorticoids and adrenal androgens so the organism is able to respond and adjust to stressors. Inhibition of the system is equally important, as with any system with trade-offs (Nesse, 2007), to prevent or mediate overexposure of inflammatory and neuroendocrine stresses that lead to deleterious effects (Gupta, 2019).

The HPA axis is closely regulated by central mechanisms involving the hypothalamus and limbic system. Limbic structures send signals that reach the paraventricular nucleus (PVN) of the hypothalamus. PVN neurons secrete arginine

vasopressin and corticotrophin-releasing hormone (CRH; required for both basal and stress-induced ACTH release), triggering the release of adrenocorticotrophic hormone (ACTH) from the anterior pituitary (Boron & Boulpaep, 2002). The HPA axis is a classic example of an endocrine feedback system. ACTH increases production of cortisol, and cortisol decreases production of ACTH. Cortisol and other glucocorticoids apply feedback inhibition of both ACTH and CRH (and vasopressin), principally through the glucocorticoid receptor (Herman et al., 2011)

With prolonged exposure, glucocorticoids inhibit ACTH synthesis by directly inhibiting the transcription of AVP/ADH and the gene for POMC (pro-opiomelanocortin, which is the precursor for several bioactive peptides, such as ACTH; “POMC mRNA transcription in corticotrophs is negatively regulated by glucocorticoid” (Suda et al., 1988)), however, in the hypothalamus, glucocorticoids increase expression of POMC (Wardlaw et al., 1998). In addition to CRH, POMC, ACTH, cortisol, there are several other “messengers” involved in the HPA axis, such as vasopressin and oxytocin, which are crucial social neurohormones across mammalian species (Donaldson & Young, 2008; Flinn, 2015; Insel & Young, 2001; Ross & Young, 2009).

2) Cortisol, Oxytocin and Vasopressin

A. Cortisol and Social Support

Cortisol has been a go-to peripheral biomarker for stress and trauma for decades (Adam et al., 2014; Heim, 2008; Matousek, Dobkin & Pruessner, 2010; Weitzman, 1971). As relayed earlier, the adrenals secrete cortisol under several disparate conditions, but it’s important to note that cortisol is only one piece of the whole story when evaluating stress

and trauma. Herman and researchers (2011) warn it is not sufficient to use cortisol alone as a representation of HPA axis reactivity or stress response(s) – plasma samples are commonly used for this purpose in humans; however, plasma free cortisol (free cortisol index) is likely more relevant in inferring adrenal function (Del Rey, Chrousos & Besedovsky, 2008). Herman et al. (2011) suggest instead measuring ACTH and glucocorticoids over time, as best practice, in using peripheral measures to infer HPA axis responses, particularly to stress (of which trauma is a form). However, keeping in mind these facts, there has been extensive information garnered over the years using peripheral measures of cortisol (and other peripheral measures) in predicting stress or trauma-related responses as well as its role as one characteristic of mobilizing maintenance in the organism, such that it increases sympathetic activation, and, as part of circulating catecholamines (Flinn et al., 2011; Herman et al., 2011).

The cortisol response in humans is intimately related to social relationships, interactions and respective challenges, and the brain systems related to these biochemical and social responses are shaped throughout development and follow into adulthood; cortisol levels that are elevated are part of the human body's response to stress and often have consequences detrimental to health and health outcomes (Bruce & Donzella, 2000; Flinn, 2006; Flinn, 2015; Lovallo, 2015; Ross & Young, 2009; Wilson & Morley, 2003). For example, Ross and Young (2009) note that when cortisol release is stress-induced, it inhibits wound healing; however, “social housing buffers against stress-induced activation of the HPA” (Ross & Young, 2009), such that isolated individuals do not heal as well as those living with at least one other individual (pair housing or pair bonds).

Flinn and England (1997) analyzed the relationships between stress, health, socioeconomic condition and cortisol “profiles” of children in a Dominican village as a naturalistic and longitudinal study. They showed that cortisol levels in children fluctuated with psychosocial stressors from the social environment, particularly when involving familial relationships, and, further, found significant effects of these relationships on psychosocial stress in childhood and related illness as measured by cortisol proxy and additional methods (e.g. observational).

Measured cortisol response profiles of Dominican children reflected higher cortisol levels associated with negatively valenced experiences within relationships of parents or caretakers, with household composition playing a role in cortisol increases; for example, unstable mating relationships (e.g. among parents) were found to be one primary association with varying child stress-responses via cortisol proxy measures, whereby cortisol levels were higher in children of parents with unstable mating relationships. Children evidencing higher cortisol levels ultimately demonstrated an association with more frequent illness. Flinn and England concluded “family relationships and concomitant stress and immunosuppression are important intermediary links between socioeconomic conditions and child health” (Flinn and England, 1997).

Negative-affect social challenges (such as a child being punished, or, in more extreme cases – perpetrating abuse against a child or adolescent) have been shown to reliably reflect increases in cortisol levels and morbidity (Flinn & England, 1997; Flinn, 2006; Gunnar, Bruce, & Donzella, 2000). Children, across Dominican villages to the U.S. and beyond, seem to experience a relationship between stress and illness (Flinn & England, 1997; Flinn et al., 2011; Lovallo, 2015); more specifically, Dominican children

who experienced a stressful event (especially within the family system compared to other social relationships) had their chances of becoming ill double in the following week, compared to a week where no significant stressors were present in the previous week. Flinn (2006) found: “It is not lack of food or hygienic care, nor just the occurrence of traumatic events that affect child health, but the lack of social support, including parental warmth and other factors that influence emotional states” (emphasis added). This has enormous implications for how we both interpret and intervene for humans that have experienced significant trauma exposure or “toxic stress”, such as childhood abuse, sexual assault, socio-structural violence and more. Healthy social relationships and support, or feelings of connection and belonging, seem integral to healing trauma and associated health effects acutely and longitudinally.

Cortisol is extensively studied and overwhelmingly thought of as solely stress-related, though it is empirically shown to be involved in other processes. While cortisol is a common measure as a peripheral biomarker of stress or trauma, oxytocin and vasopressin also have expansive functions and are considered “social” neurohormones (though all three and many more are interrelated). ACTH, CRH, cortisol and others are associated with anterior pituitary secretion, while oxytocin (OT) and vasopressin (AVP) are the only two bioactive neuropeptides secreted by the posterior pituitary (Hall, 2015). The anterior and posterior pituitary comprise what is commonly referred to, singularly, as the pituitary gland. Considerations of AVP and OT from an evolutionary perspective is indicated.

Looking at phylogeny and evolutionary considerations of AVP and OT genomic loci, we must look at vasotocin and isotocin, which are the basic and neutral peptides

(respectively) in teleosts (the largest infraclass in the class Actinopterygii; a class of fish); “basic and neutral neurohypophyseal (NH) nonapeptides have evolved” from vasotocin (VT). NH nonapeptides are basically a very old evolutionary family:

“[...] believed to have originated much before the vertebrates, as one of the first neurotransmitters in the archetype metazoan nervous system (Grimmelikhuijzen et al., 2002). Starting from the most primitive metazoan- the cnidarians, the presence of nonapeptide homologs has been documented in several nonvertebrate phyla [...] In vertebrates, about 15 nonapeptides are known till date. They are classified into two families on the basis of the amino acid at the 8th position [...] Each vertebrate possesses at least two peptides, one each from the two families [...] This has led to a widely accepted theory that the VT precursor gene is the ancestor of all vertebrate nonapeptide precursor genes, and has given rise to the two lineages following an event of duplication early in the vertebrate evolution” (Banerjee, Chaube & Joy, 2015).

AVP and OT have conserved syntenic blocks (syntenic blocks are conserved regions within two sets of chromosomes that are being compared between individuals or species) and follow distinct lineages “with VT representing the common basic peptide in all nonmammalian vertebrates to be replaced by vasopressin (VP) in mammals, while isotocin (IT) is the neutral peptide in teleosts, mesotocin (MT) in lobe-finned fishes and noneutherian tetrapods, and oxytocin (OT) in eutherians” (humans are in the infraclass Eutheria, or, “placental mammals”; Eutherian mothers carry their unborn children within the uterus where they are nourished and protected until an advanced stage is reached”; subclasses and infraclasses are based on variations in reproductive systems) (Banerjee, Chaube, & Joy, 2015; Burnet, 2011).

In short, vasotocin (VT) and isotocin (IT) precursor proteins have the characteristics of NH precursors and “express in the both brain and ovary” and have “higher expression in the reproductive phases” in some species (Banerjee, Chaube, &

Joy, 2015; Burnet, 2011). There are similarities to how and where OT is expressed in humans and some associated behavior (Flinn et al., 2011; Ross & Young, 2010). In other words, AVP and OT are two neurohormones that have homologs conserved throughout the evolution of an extensive number of species; it seems they would confer strong adaptive significance given respective phylogenetic analyses within and across taxa (Banerjee, Chaube, & Joy, 2015; Flinn et al., 2011; Ross & Young, 2010).

B. Oxytocin (OT), Bonding and the Immune System

Comparisons of OT morphological, organizational and functional features of the brain that influence human behavior, and the genes that code and underlie these features across and within taxa, have been researched extensively across several fields (Banerjee, Chaube, & Joy, 2015; Insel & Young, 2001; Ross & Young, 2009), though prosociality has been the primary focus of human behavior studies on OT. A quick search of “oxytocin” in Google Scholar reflects several prosocial (and related) behaviors as associated with OT, as the first few links read: “oxytocin increases trust in humans” (Kosfeld et al., 2015), “oxytocin improves “mind-reading” in humans” (Domes et al., 2007), “oxytocin increases generosity in humans” (Zak et al., 2007), or “oxytocin selectively improves empathic accuracy” (Bartz et al., 2010). The prosociality component of OT seems to be the primary focus, though it is not OT’s entire story.

In the media and pop-science, however, OT has been dubbed the “love hormone” or “cuddle hormone”, largely disregarding other behavioral associations. Aside from sensationalist journalism, this perpetuation may also partly be due to researchers long-documented history of: 1) associating (virtually only) *peripheral* measures of OT concentration with complex human behavior traits, 2) across non-comparable analysis

methods, such as EIA and RIA with few exceptions, as well as 3) associations of variations in single nucleotide polymorphisms (SNPs) of the oxytocin receptor gene (OTR) with complex and specific behavioral outputs.

A side note on EIA and RIA analysis methods: *instruments that boast high selectivity and specificity, such as LC-MS-MS, show promise for future researchers in procuring more precise and accurate results of peripheral measures. To date, it seems there are no studies comparing individual peripheral OT samples across both EIA and RIA, let alone in tandem with LC-MS-MS; this seems to be low-hanging research “fruit” as studies that measure OT (or any other neurohormone via peripheral measures, such as saliva, plasma or urine) are unable to be variations in non-comparable analyses instruments (i.e. EIA and RIA). Previous studies that compare the concentration of certain neurohormones in peripheral samples (including OT) across both EIA and RIA reflect data outputs whereby measured peripheral concentration differs by orders of magnitude; this would seem to have a huge implications about the validity and reliability of such studies and associated applications of such findings, especially as applied to human behavior and respective interventions or treatments. As such, developing comparative algorithms (if possible) from processing the same peripheral samples (urine, plasma, saliva from each individual) across commonly used instruments (EIA, RIA) concomitantly with LC-MS-MS (with other modifications as indicated to increase selectivity and specificity) made provide novel insight into peripheral concentrations of OT, and may help to unify research across fields on OT and related neurohormones where peripheral measures are integral to the research yet presently not able to be compared quantitatively. Combining peripheral measures in instances where central*

measures are also able to be collected and analyzed may further contribute to the precision, accuracy, findings and implications of this type of research.

Complex and specific behavioral outputs associated with OT, as outlined by researchers, primarily only include prosocial behaviors, such as mother-child bonding, pair-bonding, sexual behavior, complex social cognition and social memory and respective behavior, and social support (Donaldson & Young, 2008; Heinrichs, von Dawans & Domes, 2009). However, OT is also involved in parturition, lactation, intimate partner bonding, alloparental behavior and so much more; it appears OT can also have “both activational and organizational effects on social behavior” (Ross & Young, 2010). For example, among mammals who pair-bond (think of monogamous behavior in humans), the HPA axis responds to separation with a stress response, which seems to reinforce bonding; upon reuniting, OT is released stopping the stress response initiated by separation. The same response may be observed for evolutionarily significant others, such as parent-child attachments or siblings, grandparents or other kin and non-kin (Flinn, 2006). OT is of particularly strong interest for researchers trying to understand the human social brain and human behavior.

Oxytocin is also associated with other behaviors, such as stress and fear responses, and even maternal aggression (De Dreu et al., 2011; Flinn, 2006). Behavior that may be perceived as prosocial or affiliative are those that increase within-group trust and cooperation (signaling e.g. loyalty and commitment) or bonding and related behavior; however, if we think of the associated consequences of increasing within-group connection or bonding, a consequence may also be a positive correlation with out-

group bias, up to prejudice, discrimination or between-group violence (De Dreu et al., 2011).

In fact, one study by De Dreu and researchers (2011), found that oxytocin increases ethnocentric behavior (defined: “the tendency to view one's group as centrally important and superior to other groups” (De Dreu et al., 2011)), whereby OT motivates in-group favoritism creating “inter-group bias” and “out-group derogation”, which may be accompanied by phenotypes of, for example, fear or distrust. This study suggests that OT may “have a role in intergroup conflict and violence” (De Dreu et al., 2011). Ultimately, empirical evidence supports oxytocin as a central component in sociality and social behavior, but evidence does not support the premise that OT’s role is *only* prosocial (De Dreu et al., 2011; Flinn et al., 2011).

Additionally, there are experiments that suggest OT affects wound healing (as does cortisol), which means that OT may directly interact with the immune system; in fact, the human oxytocin receptor gene (OTR) has a binding site for NF IL-6 (nucleofactor interleukin-6; an inflammatory cytokine) and for “acute-phase response elements, which are induced by infection or inflammation” (Ross & Young, 2010); binding to these sites may explain “how immune elements have the ability to induce labor” (Heinrichs et al., 2009; Ross & Young, 2010). In addition, the intranuclear release of OT by the supraoptic nucleus is directly stimulated by interleukin-1b (a biological response modifier that can boost the immune system, usually in cancer therapies) (Ross & Young, 2010). Administration of oxytocin also augments the “stress-alleviating effects of social support” (Donaldson & Young, 2008), suggesting therapeutic potential of either

increasing social support (thereby hypothetically increasing OT levels) or researching OT agonists as a therapeutic intervention; however, this must be balanced with the knowledge of how OT may concurrently increase out-group bias up to violent behavior. Beyond the immune system, many psychiatric health illnesses, such as depression, anxiety/panic, autism and schizophrenia, are associated with sometimes debilitating symptoms related to social behavior (Nesse, 2007). Some research on peripheral infusion of oxytocin yielded results of enhanced “emotional understanding of speech intonation and decreased repetitive behaviors”, reflecting associations with increased “retention of social cognition” (Donaldson & Young, 2008), which may have implications for mental health illness and wellness. Research within healthy populations also backs the role of social support in improving our abilities to manage stressful situations and in recovery among a variety of illnesses (Donaldson & Young, 2008), and OT may serve in a similar role among these interactions. However, OT is not the only neurohormone involved in human social behavior, and therefore, trauma exposures and resultant outputs (e.g. physiological, cognitive and more).

C. Vasopressin, Human Sociality and Immune Function

Vasopressin, or AVP/ADH (arginine vasopressin, “AVP”, also known as antidiuretic hormone, “ADH”; used synonymously), has two primary functions: 1) regulate renal handling of water (water homeostasis) and 2) vasoconstriction (Boone & Dean, 2008; Klabunde, 2011; Treschan & Peters, 2006). When ADH acts on renal collecting ducts (via V₂ receptors) to decrease urine output (antidiuretic) the downstream effects result in increases in blood volume, cardiac output and arterial pressure. AVP binds to vascular smooth muscle (via V₁ receptors) to cause

vasoconstriction via two pathways (IP₃ signal transduction pathway and Rho-kinase pathway), which increases arterial pressure. However, normal concentrations in humans are below the vasoactive range (Henderson & Byron, 2007). Many variables cause or modulate the release of AVP, of which four are integral: cardiopulmonary baroreceptors, arterial baroreceptor firing, extracellular osmolarity and Angiotensin II (Klabunde, 2011; Treschan & Peters, 2006).

Cardiopulmonary baroreceptors (specialized stretch receptors) synapse with the medulla's nucleus tractus solitarius (NTS; part of the medulla of the brainstem, which is involved in several autonomic processes). The NTS is a brain structure that takes part in autonomic reflexes and neuro-immune loops (Klabunde, 2011). This is just one part of several overlapping and convoluted pathways connecting processes related to both sociality and immune function; supporting this within naturalistic and longitudinal studies is Flinn and England (1997).

The NTS is also known as a fundamental processing hub for ascending visceral information throughout the body, and it receives information from other brain structures, such as the hypothalamus and higher centers, which modify medullary center (part of the brainstem) activity and are important during cardiovascular responses to emotion and stress (for example, during and after trauma exposure). This medullary autonomic outflow is divided into sympathetic and parasympathetic vagal branches (Klabunde, 2011); the efferent fibers of these nerves go to the heart and blood vessels to modulate target organ activity.

The NTS also has fibers that synapse with the hypothalamus, which controls AVP release from the pituitary (Klabunde, 2011). The NTS receives sensory input from

disparate central and systemic receptors, such as baroreceptors (pressure sensors to tightly control arterial blood pressure within negative feedback system; sensitive to both mean/steady pressure and rate of pressure change), chemoreceptors (regulates respiratory activity; impaired gas exchange in the lungs such as hypoventilation and respiratory arrest), and, neural connections *from* the NTS modulate the activity of sympathetic neurons (rostral ventrolateral medulla) as well as parasympathetic neurons (dorsal vagal nucleus and nucleus ambiguus), from which arise the vagus nerves (parasympathetic; tenth cranial nerves [CN X]) (Treschan & Peters, 2006). In the NTS, neuronal activity inhibits sympathetic neurons and reciprocally activates vagal neurons (Klabunde, 2011; Treschan & Peters, 2006).

As an example, with hypovolemia (decrease in blood circulating the body), the decreased central venous pressure, which is associated with e.g. dehydration or hemorrhage, and the decreased firing of low-pressure baroreceptors (atrial stretch receptors) leads to an increase in AVP release (Klabunde, 2011). This decreased firing and increase in AVP release leads to increased sympathetic activity. Other receptors in the hypothalamus, Angiotensin II receptors, also regulate release of AVP whereby an increase in Angiotensin II stimulates an increase in AVP release, again contributing to increased sympathetic activity. Last, changes in osmolarity of extracellular fluid are sensed by osmoreceptors, such as during dehydration (excess cortisol production [e.g. via stress or trauma exposure] contributes to dehydration; an invitation is extended to ponder the interconnections between all of these processes and social behavior); with increased osmolarity, AVP is stimulated for release. As previously noted, AVP is also integrally involved in human social behavior via multiple downstream effects, including

stimulation of the sympathetics, which is a crucial response system that autonomically mobilizes the body (Klabunde, 2011).

D. The Autonomic Nervous System (ANS) and Adaptive Significance

The autonomic nervous system (ANS), or visceral motor system, is part of the peripheral nervous system (PNS) and influences internal organs (Gordan, Gwathmey & Xie, 2015). It is divided into two parts: 1) the sympathetic nervous system (SNS), which is largely a mobilizing, energy expending system, and 2) the parasympathetic nervous system (PSNS), which is largely a resting, energy conserving system.

The enteric nervous system (ENS), which primarily governs function (sensing, regulating, controlling) over the gastrointestinal system (motility, secretions), *can* interact with the two divisions (PSNS and SNS), but works independently of them as well; the ENS, as considered an integral part of the ANS, seems a largely dissolved concept given the evidence, with few disagreeing. For instance, most researchers/investigators prefer to classify the ENS as separate from the ANS because the ENS has an extensive mesh-like system of nerve cells that don't fit neatly into the divisions (PSNS and SNS) of the ANS, and, the ENS is independently reflexive without necessitating either division's supervision (Browning & Travagli, 2011; Gordan, Gwathmey & Xie, 2015; Purves et al., 2001). Anatomically, "the preganglionic parasympathetic neurons that influence the gut are primarily in the dorsal motor nucleus of vagus nerve in the brainstem and the intermediate gray zone in the sacral spinal cord segments. The preganglionic sympathetic innervation that modulates the action of the gut plexuses derives from the thoraco-lumbar cord, primarily by way of the celiac, superior, and inferior mesenteric ganglia" (Purves et al., 2001). However, with some

resurgence of incorporating the ENS as part of the ANS (as in Porges polyvagal theory, discussed in detail later), it seems important to make this distinction before moving forward:

The PSNS and SNS may be thought of as complementary opposites; they work antagonistically or cooperatively to balance autonomic effector organ function to maintain homeostasis. The release of neurotransmitters mediates actions of autonomic nerves (Gordan, Gwathmey & Xie, 2015).

Activation of sympathetic efferent nerves to the heart: 1) increase heart rate (chronotropy, positive), 2) increase conduction velocity (dromotropy, positive), 3) increase contractility (inotropy, positive) and 4) increase rate of relaxation (increased lusitropy). Sympathetic activation has an overall effect in increasing cardiac output, arterial blood pressure and both artery and vein systemic vascular resistance; it is especially important during exercise and hemorrhagic shock, as well as during emotional stress (Gordon, Gwathmey & Xie, 2015; Hall, 2015).

Activation of the sympathetics constricts resistance vessels (arteries and arterioles), which increases vascular resistance and decreases distal blood flow; most blood vessels do not have parasympathetic innervation. Innervation of the parasympathetics includes salivary and gastrointestinal glands, as well as genital tissue (erectile) where the nerves cause vasodilation. As previously mentioned, the SNS and PSNS can be viewed as complementary opposites: when the sympathetic system is activated, parasympathetic activity is usually downregulated, and vice versa (though there are exceptions) (Gordan, Gwathmey & Xie, 2015; Hall, 2015).

Largely a resting system, the PSNS elicits “rest and digest” functions, such as salivation, lacrimation, sexual arousal, eating, defecation and more (Gordan, Gwathmey & Xie, 2015). Conversely, as the sympathetics are activated, it prepares the body for “flight, fight, freeze” and inhibits unnecessary functions for the immediate situation, such as inhibiting the gastrointestinal tract, which is metabolically expensive (Flinn, 2006; Gordan, Gwathmey & Xie, 2015). Making this more complex, however, your body doesn’t “know” the difference between *causes* for the sympathetic response (fight, flight, freeze) – it just responds to a threat stimulus (whether it’s a lion coming at you, a bully cornering a child, or a threatening human such as parent who is abusive toward their adolescent), or, uncertainty that is perceived as significant and for which behavioral response effects are unknown (Flinn et al., 2011; Nesse, 2001; Nesse, 2007). This response is instantaneous and powerful and is a full-body autonomic response.

Imagine how beneficial such an autonomic body-response could be in ancestral Sahara with lions (to be cliché), or, in response to a perceived violent or threatening human (as in child abuse). Then, consider how that response may have been shaped by certain selective forces in the environment over a long period of time, and how it may have conferred some advantage for the successful survival and reproduction of organisms that responded in this way (i.e. expressed this trait in this way). Again, the physiological response to a threat stimulus is the same (it’s also the same for feelings of excitement, anticipation, anxiety and others as well). This is known, classically, as the “fight or flight” response.

This response, and all the interwoven structures and interconnected processes and downstream effects previously described, is a fundamental piece toward understanding trauma exposure and how and why the body and brain, and respective reactivity (and respective trade-offs), literally change after such exposure(s); for example, how responses to *actual or perceived* threat stimuli change or intensify (e.g. hypervigilance), or, autonomic responses (e.g. more frequent sympathetic upregulation contributing to dysregulation of certain processes and systems), especially during which behavioral responses will have unknown effects. Much more may be garnered toward understanding trauma exposure and links to health outcomes by grounding related questions in an evolutionary framework, far beyond what is presented here. That given, there are implications in medicine and in clinical application for healing and treating trauma; understanding why and how symptom presentation (across all axes: cognitive, physiological, etc.) occurs post-trauma exposure (e.g. PTSD; panic disorder; chemical dependency), within an evolutionary framework, may give us some insight or methods working toward the possibility of mediating post-trauma-exposure changes that are linked to detrimental health outcomes both acutely and longitudinally – especially those linked to years of potential life lost (YPLL). YPLL associated with trauma may be, in part, associated with dysregulation of nervous system responses, which may be necessary for survival in the short-term (e.g. “chronic” upregulation of the sympathetics during chronic childhood abuse) but detrimental long-term (e.g. “chronic” upregulation after childhood abuse, once safe in adulthood). One such nervous system response that is autonomic and seems metabolically expensive is the freeze response. However, all of these responses,

even autonomic, appear to be capable of being modulated through neurophenotypic plasticity, which offers promise for trauma survivors and healing-based interventions.

5. FREEZE RESPONSE, NEURAL PHENOTYPIC PLASTICITY AND TRAUMA

1) The Freeze Response and Trauma Exposure

Thinking about the fight, flight, or freeze response (stimulation of the sympathetics) and neural phenotypic plasticity from a Tinbergen perspective, we may look at certain mental health diagnoses, highly correlated with traumatic exposures or experiences (especially those that are chronic), such as anxiety or panic attacks. Panic attacks are usually reported with overwhelming feelings of terror, with some individuals reporting concurrent experiences of (tonic) immobility. Panic attacks almost perfectly mimic body reactions to perceived imminent threats as the sympathetics upregulate for “fight or flight” (Cannon, 1916): heart rate and contractility increases, arterial blood pressure increases and blood is directed very quickly to the muscles, the body starts to sweat to cool itself, pupils dilate possibly to process stimuli more quickly to assess the threat and potential action(s), the body hyperventilates as the lungs try to pull in enough oxygen for needed energy expenditure, a surge of neurohormones and other neurochemicals are released, which make the body hyper-alert, aware, focused and energetic (Flinn et al., 2011; Gordan, Gwathmey & Xie, 2015; Möller, Söndergaard & Helström, 2017): preparing the body to fight or flee; however, freezing is also possible as in “fight, flight or freeze”.

The “freeze” part is the newer piece to this decades-old adage (first proposed by Cannon in 1916 as “fight or flight”) and is characterized by bradycardia and physical

immobility (Fragkaki et al., 2017). While we need to consider all alternative hypotheses possible in evolutionary medicine (Nesse, 2007) we can already think of *possible* evolutionary explanations: If there is a perceived threat (such as by a child for an abusive caretaker or other similar social challenges, especially within the family unit (Flinn, 2006)), perhaps freezing confers some sort of advantage in surviving predators or threats (i.e. an abusive caretaker) by mobilizing the systems necessary to divert body resources to address the stimuli and take action, such as extended time to assess the threat stimulus and analyzing possible actions – as in, before fleeing. Or, perhaps freezing confers an advantage whereby doing nothing is better than, for example, trying to fight or flee.

With any question about a trait, including behavioral outputs during or after traumatic experiences and respective healing or treatment modalities, if we are to think about it from an evolutionary perspective, we turn again to Tinbergen's four questions. As a reminder: they are divided into the two categories of proximate questions (mechanism, ontogeny) and evolutionary ("ultimate"; relating function to fitness) questions (phylogeny and adaptive significance). Ultimate cause is often used synonymously with function, but function is not a cause.

A side note about the term "fitness", as described above: *Contrary to widespread and popular belief, even among well-educated scientists, fitness, more commonly talked about as "survival of the fittest", has nothing to do with how strong or smart an organism is (including humans); instead, it refers to how well an*

organism adapts to its environment in order to survive through successful reproduction.

From an evolutionary perspective, the mechanism for trauma-related responses are the complex and interrelated neurophysiological, cognitive, emotional, autonomic, endocrine and other related processes and responses; viewed throughout developmental stages is asking questions about ontogeny. Much of these systems function autonomically, but work in concert with social stimuli and behavior, and may be partially modulated through some low- to non-invasive interventions (such as in yoga, or, in creating healthy social supports and communities, or, in offering consistency and choice to support gaining a sense of autonomy). Thinking about the adaptive significance of such autonomic responses may cultivate several hypotheses about its current utility.

Multiple lines of evidence support “freezing” (within the context of “fight, flight, or freeze”) as a protective response to threatening stimuli, which may be comparable to non-human animals that freeze or “feign death” in situations where “fight or flight” is more dangerous or has failed (Elbert & Schauer, 2010). In humans, the “freeze” response is proposed to present in multiple forms: 1) dissociation, 2) increase in pain threshold, 3) stupor “to the extent of catatonic-like nonresponding”, 4) characteristic of a trance (Loewenstein, 2018).

Studies from genetic, development, neurobiological and psychophysiological studies reflect preferential freezing – or a dissociative response – as significantly associated with individuals that have experienced chronic trauma, usually in some form of captivity (i.e. ongoing childhood abuse and domestic violence or sexual and human

trafficking) (Möller, Söndergaard & Helström, 2017). This freezing is known as tonic immobility. Tonic immobility is especially prevalent in survivors of rape, whereby 70% (n=298) reported tonic immobility and 48% “an extreme tonic immobility response” during the rape. Of the women who experienced rape, significant rates of detachment, numbness and lack of pain perception were reported; women with histories of childhood or adult sexual assault were two times as likely to report tonic immobility (Möller, Söndergaard & Helström, 2017). Sexual abuse may permanently alter the HPA axis response (Flinn, 2006). However, one hopeful characteristic of human brains that may mediate altered HPA axis responses is neural phenotypic plasticity.

2) Neural Phenotypic Plasticity and Trauma

Neural phenotypic plasticity, as “one function of neuroendocrine stress responses”, seems to have huge adaptive significance whereby there is adaptive neural reorganization as “prey benefit from adjusting to match the level of risk from predators in their environment. [...] PTSD appears analogous” to fear conditioning models and “involves similar effects of noradrenergic and glucocorticoid systems” (Flinn et al., 2011; McEwen & Gianaros, 2011). Such responses seem adaptive in situations where there is a threat or predator as they augment “specific mental functions”, regulate “energetic resources used by the brain” and help guide cortical remodeling (Flinn, 2006), which is pertinent to learning and memory.

Involved in this response are emotional memories and “other socially salient information” significant throughout child development in humans. Stress responses have neurological effects, and these responses may be reflective of short-term “contingencies

and guide long-term ontogenetic adjustments of emotional regulation and associated behavioral strategies” (Flinn, 2006). In the developing human child who is experiencing chronic abuse or trauma exposures, especially when perpetrated by caretakers, these short-term contingencies seem adaptive and likely useful in coping with a threatening and unpredictable social environment. However, if the short-term contingencies (e.g. SNS upregulation in response to a threatening caretaker) become long-term adjustments of emotion regulation (i.e. ANS and HPA-axis response changes), then it may be reasonable to consider how such responses are adaptive when there is a constant threat, but deleterious with no apparent benefit, or, described as pathological (e.g. PTSD, Borderline Personality Disorder, depression) if the near-constant autonomic stress response (chronic disruption of neural networks and upregulated fear and startle responses) continues once the threat is eliminated (e.g. the child becomes an adult and moves into safety, but the reactivity and responses are comparable to when threats were impending and chronic).

Physiological stress responses “promote adaptive modification of neural circuits in the limbic and higher associative centers that function to solve psychosocial problems” (Flinn, 2006), and the following are proposed as co-factors in individual differences: “perception, emotional control, rumination, reappraisal, self-esteem and social support networks” (Flinn, 2006). This seems to suggest that by intervening in such stress responses, such as in working toward regulating the nervous system (upregulating the PSNS), modifications may occur in neural circuits associated with solving psychosocial problems in healthier ways or in resetting belief set-points for body sensations associated

with certain stimuli and related stress responses, as through low-invasive therapeutic modalities over time.

Certain forms of therapeutic intervention, such as Healing Centered Yoga that combines bottom-up approaches, such as body- and somatic-based practices like interoceptive attention (Khalsa et al., 2018), with top-down processes such as processes of modifying perception, as through socioemotional learning strategies or choice-based practices, an effect may occur via neural phenotypic plasticity whereby the systems involved in the stress response may be mediated. For example, risk, or presentation, of autonomic or HPA-axis dysregulation and related diagnosed psychopathologies may be mediated or respective symptoms decrease (e.g. less reactive startle response; decreased panic symptoms) if the stress response can be mediated or “re-calibrated”. In addition, increases in healing and regulatory characteristics (e.g. perceived sense that the body is safe, especially consistently and long-term; increasing self-esteem; emotion regulation; connection; choice and autonomy) may be associated with decreases in long-term detrimental health outcomes in number, frequency, intensity or duration.

Psychosocially, altering the stress response toward regulation (assuming dysregulation is present) may include re-learning what is safe and what is not – both cognitively and as a *felt sense* in the body. Safety must come first – this isn’t just a materialistic barrier to healing trauma, as in safe housing (though safe housing is necessary as well); safety also refers to a felt sense of safety – the body and brain must *feel and sense* safe in order for the nervous system to calm or regulate, and healing is difficult to begin when the nervous system is aroused due to fear or threat stimuli. When safety is experienced, that seems to be when perceptions are changeable to support, for

example, from re-framing social-based problems, cultivating emotion regulation or self-love of -care, to feel calm enough to process new information as in top-down intervention process. This felt sense of safety, or lack thereof, is directly related to nervous system function.

6. PERIPHERAL NERVOUS SYSTEM AND TRAUMA – AN OVERVIEW

The peripheral nervous system (PNS, not to be confused with PSNS) works in concert with the central nervous system (CNS), which is comprised of the brain and spinal cord. The peripheral nervous is made up of a sensory division (“afferent division”) and an efferent division (“motor division”). The sensory division sends information to the CNS through sensory neurons (stimuli such as heat or pain or scent); the efferent division takes information from the CNS to target cells through efferent neurons. The efferent division is further divided into the somatic nervous system (controls voluntary movement) and the ANS (controls involuntary responses). As previously outlined, the ANS is then divided into the sympathetic nervous system (“flight/fight/freeze”) and parasympathetic nervous system (“rest/digest”). Several components of the sensory division are involved in trauma experiences and applicable healing modalities. In addition, the somatic nervous system along with the ANS as part of the efferent division of the peripheral nervous system are involved. While the ANS was described in detail earlier, it is incorporated, but not detailed, in this section. Many biological systems, alongside the HPA axis and neuroendocrine processes, work in concert to maintain homeostasis. However, the concepts of homeostasis and allostasis must be addressed within the context of evolution before proceeding.

1) Homeostasis, Allostasis and Allostatic Load

Cortisol, when excessive and long-term, can lead to deleterious effects, as previously outlined, resulting in repeated and chronic HPA activation (e.g. as associated

with long-term childhood abuse); the sum of this repeated activation is referred to as high “allostatic load”: the cumulative physiologic consequences on the body over time under chronic stress (McEwen & Gianaros, 2011) or trauma. “Allostasis” refers to the physiological or behavioral changes as consequences that support maintaining homeostasis, which are often viewed as pathological, reflecting, likely, differences in perspectives and approaches across fields (evolutionary biology, clinical psychology, neuroscience, and more); Flinn et al. (2011) explains:

“Such an interpretation can produce confusion about evolved functions of the HPA and its ontogeny. Caution is also warranted in assuming that the function of the HPA is to maintain “homeostasis.” The stress concepts of “allostasis,” “allostatic load” and “homeostasis” are proxy measures that usually, but not always, track the evolved functions of a set of physiological mechanisms [...] Physiological research on ontogenetic trajectories has targeted the homeostatic mechanisms of the HPA system [...] trauma is posited to result in permanent HPA dysregulation and hypercortisolemia, with consequent deleterious effects on the hippocampus, thymus, and other key neural, metabolic, and immune system components [...] If exposure to trauma had commonly occurred during a species’ evolutionary history, and caused maladaptive (fitness reducing) effects, then it seems likely that natural selection would favor protective mechanisms. If the occurrence of trauma provided useful information regarding the future environment (e.g., probability of food shortages—Gluckman et al., 2007), then it seems likely that natural selection would favor mechanisms that would modify the phenotype to better suit the predicted conditions [...]

In humans, early childhood social experiences can have profound and permanent effects on later adolescent and adult HPA regulation and stress responses [...] For example, difficult social environments – such as maternal depression, family death, orphanage, neglect and abuse – are temporally linked with unusual HPA responses [...] Although the evolutionary reasons for this are still equivocal (and may be species-specific, e.g., Wiedemayer, 2004), early social modulation of HPA responses may function to produce adaptive neural reorganization [...] The emerging picture of HPA responses in the naturalistic context from our Dominica study is a combination of physical exertion and metabolic demands on the one hand, and sensitivity to social challenges on the other. The results are consistent with clinical and experimental studies (e.g., Dunn, 2004; Hetherington, 2003a,b) in suggesting that family environments and their developmental sequelae of affiliation, attachment and security are important [...]” (Flinn, 2006) (HPA = hypothalamic pituitary adrenal axis, or, HPA axis).

It appears the dysregulated physiological responses (and downstream or interrelated effects) may in fact be a protective mechanism for a number of reasons integral to survival and eventual successful reproduction: a mechanism by which the organism remembers the trauma (i.e. brain structure networks involved in memory), its respective physiology and emotion states, as well as who, how and where the threat of trauma may exist in the future, which, for example, all may contribute to avoiding or preparing for a similar threat in the future.

A number of systems may function in very similar ways whereby the reactivity and responses are both adaptive and plastic and may be capable of changing, such that previously adaptive responses (e.g. chronic nervous system arousal in a child experiencing daily or frequent trauma) that are no longer adaptive (e.g. the child becomes of adult age and resides in safe housing, but reacts and responds [e.g. ANS or HPA arousal; hypervigilance] as though the environment still contains imminent threat) may be mediated (e.g. through intervention) such that acute or long-term profound deleterious effects are managed, reduced or (ideally) regulated. The following are described as integral processes or systems in evaluating trauma, resultant effects on brain and body, and healing modalities (though several other systems and processes are involved as well): sensory nervous system, interoception, visceroreception, exteroception and proprioception, ending with a note on polyvagal theory.

2) Sensory Division and Efferent Division

A. Sensory Division (Sensory Nervous System)

The sensory nervous system, as it sounds, is responsible for processing sensory information via afferent sensory neurons and sensory receptor cells. The receptive field is “the area of the body or environment to which a receptor organ and receptor cells respond” (Krantz, 2012). An example may be the rods and cones that respond to stimulus to represent our visual world – the part of the world the eye can see (we have a true blind-spot between our eyes) is known as the receptive field for the eyes. Receptive fields are empirically identified across visual, auditory and somatosensory systems. The sensory systems are ones that are more well-known: sight, sound/hearing, touch, smell, taste as well as balance. Sensations may be defined as involving “all those process that are necessary for the basic detection that something exists in the world” (Krantz, 2012).

Our sensory nervous system, which is comprised of multiple cortexes, codes for four characteristics of a stimulus via afferent neurons: 1) type (receptors are specific and sensitive to varying and disparate forms of stimuli), 2) intensity (e.g. sound getting softer or louder), 3) location (e.g. burning your hand on the stove sends signals to the brain about *where* you just burned your hand), 4) duration (e.g. how long the bad taste of food is in your mouth; transmitted via *patterns* of receptor firing) (Hall, 2015; Krantz, 2015).

All of this sensory information serves a variety of purposes, but the most important are 1) maintaining homeostasis (as a proxy), 2) responding to environmental challenges or changes (like seasonal changes in behavior; this can correspond with mating and reproductive behaviors), 3) navigating social relationships and challenges,

including transmitting information to conspecifics for a variety of reasons: cultivating affiliative ties such as fostering coalitions, cooperation, warning of danger, mating-related behavior and more.

Perception is an integral aspect of healing from trauma. Perception is how we identify and interpret this sensory information (Krantz, 2012). For example, waves that are produced by objects vibrating are processed through our auditory system and perceived as sound, such as a cat's purr. "Sensation is very basic, and perception involves certain aspects of our cognition" (Galotti, 2001, Solso, 2001 from Krantz, 2012) when stimuli is processed and integrated by the central nervous system. This is, in part, why singing bowls are included in the yoga program intervention, though there is literature supporting sound therapy and sound itself may be the object of focus during contemplative practices (Lutz, Gipson, & Robinson, 2018).

Our perception of the world and everything in it is modified based on how our brain interprets stimuli and information in the physical world and internal body, and how it is then processed in the brain for outputs and creates a rich schematic of our moment-to-moment experiences in our mind. It may be the soft fur of a cat, the smell of your mate's skin or the ineffable feeling of when certain stimuli (e.g. sunsets or music) evoke powerful emotional responses. However, all sensory information is not pleasant: we accidentally burn ourselves on stoves or ovens, watch movies that make our bodies startle and stimulate the sympathetics, misjudge our bodies and run into objects, or taste food we think is absolutely disgusting. Our somatic nervous system (as part of the efferent division) is in part what compels us to turn our head away from aversive stimuli

– such as food perceived as gross (it could be that the somatic nervous system plays a role in a sort of reflexive way to protect the body from an unknown and possibly threatening source).

B. Efferent Division: Somatic Nervous System and Autonomic Nervous System

The somatic nervous system controls voluntary movement via efferent neurons from the central nervous system (CNS) to target skeletal muscle cells for movement. We can consciously and voluntarily move our, for example, arms and legs. There are two types of nerves associated with the somatic nervous system: spinal nerves (peripheral; carry sensory information to and motor commands out of the spinal cord) and cranial nerves (nerve fibers that carry information to and out of the brain stem, including smell, vision, eyes, eye muscles, ears, neck, tongue, taste, shoulders) (Hall, 2015). The somatic nervous system controls the process of reflex arcs as well. This describes the musculoskeletal aspect of yoga (defined further in proprioception, below). The somatic nervous system, along with the two divisions of the autonomic nervous system, make up the efferent division of the peripheral nervous system.

3) Integral Pathways and Processes

A. Interoception

It seems useful to first define the suffix “ception”. “Ception” when combined with a noun refers to “indicate a layering, nesting, or recursion” (Merriam-Webster, 2017). This definition is apt as most of the processes involved are indeed layered, nested, and recursive, albeit in disparate ways.

Interoception refers to sensing internal body changes while interacting with cognition and emotion (Khalsa & Lapidus, 2016; Khalsa et al., 2018). There has been a slow convergence of evidence from an array of fields and modalities to elucidate the neural and biological systems involved in arousal states of the body and representation of interoceptive feedback from the body; however, integration of body systems has not gained much attention until recently, though interest in interoception and other sensory processes has been of interest to scientists for decades. The modern definition, defined by Khalsa et al., 2018: “Interoceptive processing occurs across all major biological systems involved in maintaining bodily homeostasis, including the cardiovascular (10, 11), pulmonary (12), gastrointestinal (13, 14), genitourinary (15), nociceptive (16), chemosensory (17), osmotic (18), thermoregulatory (19), visceral (20), immune (24, 25), and autonomic systems (26, 27)” (Khalsa et al., 2018). Researchers from various disciplines, historically separate in inquiries of interoception, are working together to understand previously siloed and discipline-specific research efforts (Khalsa et al., 2018), giving rise to a better framework and understanding of interoception moving forward. Interoception should not be confused with viscerosensation (the sensing of viscera – internal organs), which is but one piece of the contemporary definition of interoception. Interoceptive signals are transmitted to the brain through several pathways, which are convoluted, interconnected and hierarchical.

Interoceptive awareness is also dissociated into defined domains/features supported by empirical evidence: 1) attention, 2) detection, 3) magnitude, 4) discrimination, 5) accuracy (sensitivity), 6) insight, 7) sensibility, 8) self-report scales. Of these domains, this research utilizes interoceptive attention (observing internal body sensations

e.g. Week 3, connecting opposites), magnitude (perceived intensity; e.g. focus on internal sensation intensity and any changes in different yoga forms); sensibility (“self-perceived tendency to focus on interoceptive stimuli (trait measure)”, measured in part by the BPQ – adapted); and self-report scales (C&C, BPQ, some questions in the RSQ that are applicable) (Khalsa et al., 2018). Khalsa and researchers (2018) best describe these intricate interoceptive pathways:

“Several pathways have been implicated in the neural processing of interoceptive signals, beginning with a rich interface between autonomic afferents and the central nervous system. Relay pathways involve primarily spinal, vagal, and glossopharyngeal afferents, with multiple levels of processing and integration in autonomic ganglia and spinal cord (11, 20, 23, 26). Several brainstem (nucleus of the solitary tract, parabrachial nucleus, periaqueductal gray), subcortical (thalamus, hypothalamus, hippocampus, amygdala), and cortical regions (insula and somatosensory cortices) represent key afferent processing regions (26, 64, 65). A complementary set of regions involved in visceromotor actions represent key efferent processing regions including the anterior insula, anterior cingulate, subgenual cingulate, orbitofrontal, ventromedial prefrontal, supplementary motor and premotor areas (66-68). It is noteworthy that these neural regions coincide closely with other sensory processing systems, especially the nociceptive and affective systems. The degree to which these represent distinct or overlapping systems is presently unclear” (Khalsa et al., 2018).

The interoceptive systems are far-reaching and are integrally involved in cognition and emotion, and mental health, and therefore part of traumatic exposures and experiences and resultant outputs and health outcomes. Computational theories of interoception support empirical findings that expectations strongly shape interoceptive perception; this Bayesian approach is offered as a “unifying principle for interoception and exteroception” (Khalsa et al., 2018). Interosensations – afferent signals from body sensors – “are not only noisy but often ambiguous”; in fact, using hierarchical Bayesian

models (since interoception is hierarchical itself) may offer a different perspective for psychosomatic presentations or phenomena and placebo effects:

“Reconsidering classical homeostatic setpoints as beliefs (i.e., probabilistic representations of expected/desired bodily states) enables reactive regulation at the bottom of the hierarchy (39, 110): here, prediction errors elicit reflex-like actions that minimize momentary interoceptive surprise. Allostatic regulation at longer time-scales is achieved through modulation of homeostatic beliefs by inferred or forecast states signaled from higher hierarchical levels (39). Importantly, belief precision determines the force/pace of corrective actions – that is, the tighter the expected range of bodily state, the more vigorous the elicited regulatory action. This offers a novel explanation for psychosomatic phenomena and placebo effects” (Khalsa et al., 2018).

This has importance in diagnosis and intervention. If belief precision influences corrective actions after interoceptive surprise, then we may think in what ways we can influence belief set-points to elicit changes in corrective action or other interoceptive processes; this is of particular importance in trauma-related disorders such as PTSD or panic disorder, where cognitive distortions (e.g. dread, extreme fear) cause biological changes (e.g. hyperventilation) influencing interoceptive processes (e.g. sensory stimuli are interpreted as extreme [interoceptive magnitude], up to believing one is dying).

One way we may be able to modulate these extreme body responses is to focus on belief set-points in clinical application. A modality used in some somatic- and body-based therapies is practicing eliciting a feeling and “witnessing” the body sensations associated with them; usually, the opposite (subjectively and individually labelled) is then guided to be evoked, followed by evoking both opposite feelings and noticing the sensations in the body when “combining” feelings. This may alter belief set-points through experiencing body sensations when the body is calm, which may, over time, help to “re-calibrate” belief set-points, thereby hopefully decreasing perceived e.g. intensity of

body sensations believed to pose harm (perceived as a threat) (or, pathologically, diagnoses-related symptoms). This review is specific when differentiating between feelings and emotions.

A side note on emotion: *Adolphs and Andler (2018) offer an explanation of emotion from a functionalist perspective. Through “bracketing”, or setting side, the concept of consciousness and normally observable physiological or behavioral outputs we use to infer emotion states of others (an analogy of aliens observable with no preconceptions is presented), they posit it is, “plausible that emotions would emerge as a class of internal states that provide causal explanations of behaviors at a particular level of control and complexity: a level intermediate to that of reflexes and deliberated behavior. This level of control, in turn, is distinguished by a set of operating features that we can begin to list (and that the aliens would similarly list), which is distinctly separate from feelings”; emotions integrate information over time and are states of the whole organism (including non-human organisms) and are not confined to certain brain structures, since brain structures themselves are defined as results of inputs and outputs that “are not sensory or behavioral” (Adolphs & Andler, 2018; emphasis added). The list of proposed emotion features include scalability, valence, persistence, generalization, global coordination, automaticity and social communication. This is important when referring to modalities or measures using the words “feeling” or “emotion” as interchangeably; several emotion theories already exist proposing the dissolution of the two as they are understood as two different things (Adolphs & Andler, 2018).*

The process of evoking opposites (often starting with an individual's subjective, negatively valenced feeling of low intensity [e.g. irritation], and over time, choosing feelings that gradually increase in perceived intensity [e.g. rage]) and associated body sensations, then complemented by the individual's subjectively assigned opposite. Last, feeling and sensing both opposites. This practice is part of contemplative-practice-based treatment modalities, such as certain forms of yoga, for trauma and may support re-setting belief set-points as well as cultivating (hopefully) feelings of agency and empowerment through managing feelings of one's own volition (and perhaps sensations as well, or, over time). However, there are other processes at work in trauma intervention, such as exteroception as previously mentioned within the context of Bayesian models (Khalsa et al., 2018).

Yoga and other meditative or movement-based treatments may be aimed at “improving metacognitive awareness of mind–body connections by systematically attending to sensations of breathing, cognitions, and/or other modulated body states (e.g., muscle stretching)” (Khalsa et al., 2018), and is considered a current treatment relevant to interoception and mental health.

B. Exteroception

Exteroception refers to the stimuli perceived from environmental surroundings originating outside of the body (this distinction is necessary because of how this word is used across disciplines; among evolutionary anthropologists, the “environment” is described as including internal body processes), which is, among its numerous roles, crucial to an organism's ability to adapt to its environment. These are the classically

thought-of senses: sight, sound, taste, smell or touch. Exteroception also plays a critical role in conditioned response and addiction.

In one study testing an exteroceptive framework for addiction, DeWitt et al. (2015) conducted a meta-analysis on existing empirical work with exteroception and found that heightened exteroceptive processes may underlie craving responses to drug- or substance-related cues in the environment, which may reinforce or worsen substance abuse disorders. Conclusions point toward contemplative practices (e.g. yoga, mindfulness training) incorporating exteroceptive processes as targets for intervention in humans experiencing substance abuse or chemical dependency (DeWitt et al., 2015). The Healing Centered Yoga program intervention incorporates exteroceptive processes during each weekly session, along with interoceptive and proprioceptive processes.

C. Proprioception

Proprioception is considered part of the somatosensory nervous system, which is spread all throughout the body, and is one part of the sensory nervous system (described above); other aspects of the somatosensory nervous system include the sense of touch, and how it is perceived and processed for e.g. a loved one versus touch by an unwelcome or threatening person, as well as balance and haptic perception.

Proprioception refers to the perception and awareness of body position and movement in space (physical proprioception) allowing for sensory-motor integration, which necessitates mechanosensory neuron populations throughout the body known as proprioceptors. “Mechanotransduction channels found in proprioceptive sensory neurons” have evolved for millions of years, even if separately in animals and insects for about a half-billion years; however, this likely reflects evolutionary significance given

proprioceptive homologs are highly conserved as evidenced. While proprioception is evident across a large number of taxa, the functional diversity of proprioception varies within and across taxa over its millions of years of differential selective pressures (Tuthill & Azim, 2018).

Guiding individuals through proprioceptive awareness or sensibility is one part of HCY yoga facilitation (e.g. balance forms). It is difficult to find literature on proprioception in mental health; however, a study by Scholz, Ott and Sarnoch (2001) found that in a sample of patients with somatoform disorder (n=20) there was more precise perception of muscle control but the intensity was not greater compared to healthy controls as hypothesized. Researchers conducted studies on proprioception in individuals diagnosed with schizophrenia about 50 years ago, but empirical evidence for proprioception and mental health appears scant at the present time.

Two articles on Somatic Experiencing® (SE) were found for treating trauma, based on the work of Peter Levine. SE is “a form of trauma therapy that emphasizes guiding the client's attention to interoceptive, kinesthetic, and proprioceptive experience”. While SE seems beneficial in clinical applications for trauma, the theoretical foundation rests on Porges’ polyvagal theory, which has been rejected or falsified throughout an array of studies across multiple academic fields (Campbell, Taylor, & Egginton, 2005; Campbell et al., 2006; Farmer et al., 2016; Grossman, 2017; Taylor, Leite, & Skovgaard, 2010; Taylor et al., 2014). This is not advocating for anyone to stop using modalities that are therapeutically efficacious or perceived as beneficial or healing; modalities can be effective even when the explanations aren’t accurate.

4) Polyvagal Theory: Therapeutic Efficacy and Underlying Explanations as Mutually Exclusive

Polyvagal theory is gaining attention and popularity, across clinical applications and body- or somatic-based interventions and among the public alike. To be clear: this description is *not* refuting the therapeutic efficacy, feasibility, or acceptability of interventions, based in polyvagal theory, to priority populations experiencing past or present trauma. As polyvagal theory continues to gain traction as a framework for treatment modalities for trauma, especially within the contemplative practices, it is important to note there is research rejecting the theory. It also appears there is no empirical evidence to support the polyvagal theory, though it has been rejected across several studies (Grossman, 2017). The three basic premises of the Polyvagal theory are as follows (Porges, 2013):

Premise 1: Neurogenic bradycardia and RSA are mediated by different branches of the vagus and need not respond in concert.

Premise 2: Neurogenic bradycardia associated with orienting is a phylogenetic vestigial relic of the reptilian brain and is mediated by the dorsal motor nucleus (DMNX).

Premise 3: Withdrawal of cardiac vagal tone through Nucleus Ambiguus (NA) mechanisms is a mammalian adaptation to select novelty in the environment while coping with the need to maintain metabolic output and continuous social communication.

Grossman (2017) notes there is “literally no direct evidence available but there is a great deal of evidence against all three primary first premises of the polyvagal suppositions” and continues to outline several studies containing data that show clear evidence against polyvagal underpinnings (for example: Campbell et al., 2006; Taylor et al., 2006). With so much evidence to reject, rather than support, the theoretical foundation of polyvagal theory, polyvagal suppositions are not included as a theoretical foundation for either the implemented HCY yoga program, *Healing Centered Yoga (HCY): An Adjunct Clinical Intervention Program and Practice for Healing Trauma*© (referred to also as “HCY”, “HCY yoga”, “yoga program”, “yoga therapy program” herein) or facilitated practice outside of the program or associated research.

Therapeutic efficacy of Porges’ clinical applications respective to the polyvagal theory show promise; however, it’s important to reiterate that clinical applications may confer therapeutic efficacy even when the underlying explanations for such efficacy are inaccurate. This appears to be the case with the polyvagal theory and respective clinical applications. Since there appears to be therapeutic efficacy associated with clinical applications of the theory, three “container” forms proposed by Peter Levine (2017) are implemented as one piece of the second half of the HCY program’s Session 1. Peter Levine is the founder of Somatic Experiencing©, which is grounded in Porges’ polyvagal theory. Again, this simply shows that an intervention can be therapeutically efficacious even if the explanations are incorrect (Grossman, 2017).

7. YOGA AS AN ADJUNCT CLINICAL INTERVENTION IN TRAUMA AND CHEMICAL DEPENDENCY

1) Yoga, Health Research and Intervention

Yoga has been studied across numerous fields evaluating its effects on healthy and non-healthy populations alike. A Google Scholar search using keywords “yoga physiology” reflects articles ranging from mental health illness to motor disorders, with yoga as an intervention with health benefits. Evidence continues to compound quickly on yoga as a complementary practice within integrative healthcare and as an adjunct clinical intervention (Sullivan et al., 2018), with limitations previously described.

Turning to yoga and its role in trauma exposure and resultant brain and body effects (whether DSM-defined or not; there is significant debate about types of trauma and lack of specificity in DSM trauma-related diagnoses (van der Kolk, 2015)), yoga is recommended for individuals across a variety of exposures as treatment intervention: sexual trauma exposure (placed in light of the #MeToo movement) (Rousseau, Weiss-Lewit, & Lilly, 2019); chronic, treatment-resistant PTSD (Rhodes, Spinazzola, & van der Kolk, 2016); management of stress, anxiety and depression as part of mental health care (Butterfield, Schultz, Rasmussen, & Proeve, 2017); improving wellbeing and quality of life in trauma survivors, though with cautious optimism in yoga’s role as an intervention for various forms of trauma exposure. In one study, for example, findings indicate significant decreases in symptom severity and “negative tension reduction techniques (e.g., self-injury)” and reductions in depressive and dissociative symptoms among

women with chronic, treatment-resistant PTSD after participating in yoga intervention (Rhodes, Spinazzola, & van der Kolk, 2016). In addition, community-partnered and community-based research seems to be severely lacking on yoga implementation at large, with few exceptions (Ragavan et al., 2017). This research aims to fill some of these gaps through facilitating a community-partnered study for yoga as a therapeutic intervention and detailed reporting of intervention, often lacking in the literature.

2) HCY Combining Bottom-Up and Top-Down Approaches

Yoga and the contemplative practices have been studied for decades in context to intervening for medical conditions and trauma, such as the work of Jon Kabat-Zinn, Bessel van der Kolk, Peter Levine, Richard Miller, David Emerson and more. Each administers some form of trauma-sensitive yoga with varying priority populations and facilitation is not homogeneous. And, while many trauma-sensitive yoga practices are also presented via disparate theories, most present yoga or related contemplative practices as a somatic- and body-based intervention alone, as effective for survivors of trauma exposure, from PTSD experienced by war veterans to chronic childhood trauma exposure.

Much research has yet to be done toward homogeneous facilitation, or, heterogeneous facilitation empirically supported and organized as trauma effects the body differently based on the type, intensity, duration and timing (i.e. developmental timeframe) of trauma exposure(s) and the person or community experiencing the trauma exposure. For example, it seems likely that certain yoga forms or facilitation techniques would vary as pertinent to the priority population. There may be varying

needs and differential aspects of yoga that are effective based on variables of trauma exposure(s); for example, war veterans (adult trauma exposure), versus single-time rape victims/survivors with no prior chronic trauma exposure histories (acute, single incident trauma), versus chronic and/or developmental trauma, such as chronic abuse exposure, may yield differences in modes of treatment and intervention; fields of clinical psychology are slowly working toward differentiating trauma as necessary for appropriate intervention and treatment (Spiehs & Waters, 2016). Making this perhaps more necessary is the knowledge that individuals who experience trauma, such as childhood abuse, are more likely to experience re-traumatization or future trauma exposures such as sexual assault. However, research building is promising for yoga as an intervention for trauma exposure and experiences and contributing to treating the resultant effects on the brain and body and perceived healing.

Many of the aforementioned researchers in yoga or contemplative practices, and many not mentioned, largely administer yoga as a purely bottom-up process, separating it from top-down processes, such as CBT or DBT. However, HCY yoga – both the practice and program described herein – purposefully combines bottom-up and top-down approaches and processes. In this way, it is facilitated as a somatic- and body-based practice (bottom-up), while integrating cognition, feelings and emotions (top-down) (for an overview of conceptualizing emotion, it is encouraged to read Adolphs and Andler, 2018).

3) Yoga and Chemical Dependency

Yoga has been applied as intervention for substance abuse or chemical dependency, though results are mixed. In one study, yoga was more effective with comorbid conditions, such as for chronic pain management for individuals experiencing opiate or alcohol abuse, though there were smaller effect sizes for depression and anxiety (Lutz, Gipson, & Robinson, 2018). However, this may be due to small sample size, heterogeneous facilitation or both, and/or other variables. Research on yoga as an intervention within chemical dependency sample populations is scant at best. Search terms for “yoga and chemical dependency” turn up significantly fewer results than “yoga and substance abuse” where the former has very few search results and the latter reflects a surge of research beginning in what appears to be 2018 (Google Scholar).

Preliminary research on substance abuse and yoga’s role in treatment is also promising. In one study (Wimberly, Engstrom, Layde, & McKay, 2018), researchers found decreased stress and substance use among individuals experiencing chemical dependency and living with HIV; in a controlled pilot study (n=13), participants in a buprenorphine/naloxone medication-assisted treatment who participated in yoga showed strong evidence for yoga as an adjunctive treatment compared to controls, whereby the yoga treatment group reflected decreased stress levels (Lander et al., 2018); in a study evaluating hatha yoga for chronic pain in individuals experiencing opioid use, decreases in pain and anxiety were observed pre- to post-yoga facilitation (Uebelacker et al., 2019); in another study taking a different perspective, yoga’s effect on motor function was researched among individuals experiencing substance abuse – results demonstrated

that yoga as an adjunctive treatment enhanced motor function compared to a physical-exercise group (with no yoga experience) as control (Gaihre & Rajesh, 2018).

Continued research into the effects of yoga as an adjunctive treatment for chemical dependency are greatly needed. It is encouraging that controlled and/or randomized studies are building for substance use or abuse but much more research is required to elucidate yoga's effects, as well as feasibility, acceptability and therapeutic efficacy in varying priority populations. It may also be that there is not a true distinction between substance use, substance abuse and chemical dependency; it seems these terms may be used interchangeably or synonymously in the literature, at least in context to yoga, when they should not be used as such. Substance abuse *precedes* chemical dependency and refers to abuse of legal or illegal substances that cause problems or distress such as legal problems or interference with interpersonal relationships; conversely, chemical dependency is a normal body and brain response to any addictive chemical substance whereby when the substance is stopped, symptoms such as withdrawal may occur, which can lead up to death as sometimes seen in opioid withdrawal (Darke, 2019; John Hopkins University, 2019). This HCY yoga program is very specific in wording whereby the priority population is experiencing treatment for chemical dependency as defined above.

8. YOGA CULTIVATING CHOICE AND AUTONOMY IN TANDEM WITH SOCIAL SUPPORT FOR TRAUMA EXPOSURE

Choice and autonomy are commonly stolen from humans experiencing past or present trauma. In individuals where trauma exposure is chronic and in captivity (e.g. childhood abuse, human and sex trafficking), findings indicate tonic immobility and symptoms such as dissociation are more common (Möller, Söndergaard & Helström, 2017). Dissociation, in extreme form reflecting DSM diagnoses such as Dissociative Identity Disorder (DID), and tonic immobility are largely separate from cognitive processes involving choice and autonomy as previously outlined; this behavioral response is largely reactive and autonomic.

Therefore, while choice, agency and autonomy are stolen from the individual during captive or chronic trauma exposure, they appear to remain “stolen” during post-trauma exposure effects; it may be that these experiences and feelings of choice, agency or autonomy can be learned or cultivated post-trauma exposure via therapeutic intervention, of which yoga is one possibility. These experiences and feelings appear to be associated with top-down processes of *actual and perceived* choice, safety and predictability (choices, for example, aren’t really choices if coerced into them or chosen out of fear); cultivating a safe, predictable, choice-based environment may correlate to or result, in part, in supporting individuals’ perceptions of agency and autonomy and perhaps perceived empowerment post-trauma exposure (perhaps during traumatic exposure as well, such as IPV/DV, though it is unclear how this may happen given

safety seems a prerequisite for healing; it may be that long-term intervention supports higher functions and cognition via emotion regulation over time, but this is a stretch). However, the interrelation of these items aren't known and may not be linear, but more convoluted, layered or webbed.

In addition, body and brain reactivity and responses associated with trauma exposure likely play a significant role in perceptions of choice, agency and autonomy, since these are difficult to experience, if not impossible, when the body and/or brain feels unsafe. However, with neural phenotypic plasticity, as previously outlined, these automatic responses, that can become deleterious over time, may be able to be mediated through certain interventions that focus on choice and autonomy in an environment that is perceived as safe (by both brain and body) and likely for an extended duration of time, in concert with consistent, predictable and healthy social supports. However, perceptions of safety can take a very long time to develop depending on the variables of trauma exposure; these perceptions may not be linear either, and may oscillate between feeling safe then unsafe and back again, or, even both at the same time – there may be almost infinite iterations of how and when spaces are perceived as safe (or unsafe), varying within or between individuals. Acknowledging and radically accepting and honoring this reality sits at the core of this HCY program and practice.

These three components – perceptions of agency, autonomy and choice – are just as integral to healing trauma as social support and neurophysiologic regulation. How social support is vital to healing and wellbeing has been discussed in-depth above. Pairing aspects of autonomy (e.g. making choices about one's body that are unconditionally accepted; practices that contribute to agency) with reliable and safe

social supports (e.g. a community with shared past and present experiences), in tandem with practices that support upregulation of the parasympathetics over time (e.g. contemplative practices), form the pinnacles of the HCY program in how these concepts or practices interweave and apply to healing trauma via yoga as an adjunctive intervention. The hope is that what is learned or experienced on the yoga mat, from a sense of agency through choice to practicing self-love, starts to be noticed, witnessed, or practiced “off the mat”, or, in everyday life. However, there are privileges associated with these pinnacles: a reality that must be addressed and respective action taken.

9. YOGA AS A PRIVILEGED RESOURCE, SOCIAL HEALTH DISPARITIES IN YOGA AND PERSONAL RESPONSIBILITY

There is privilege in entering a yoga studio or practicing yoga, and not having to face, consider, or think about gender, sexuality, ethnicity, physical abilities and more. Often, if something does not affect us, we don't notice it exists – sometimes we may not even believe it exists. But, with privilege comes responsibility (Johnson, 2017). The responsibility to bring awareness to that which may not affect us and to cultivate collective wellbeing one individual at a time; this is one key foundational piece on which Healing Centered Yoga (HCY) is based.

Importantly, the “yoga industrial complex”, which chronically favors a white supremacy framework, has left a large disparity between those who have access to this resource and those who don't (Johnson, 2017); there is likely a larger disparity in access to yoga as specifically facilitated for healing trauma (e.g. trauma-sensitive yoga facilitation), since it is largely only offered clinically – and access to psychologically based or mental health and wellness services are largely only accessible to those with monetary privilege (which often intersects with other privileges, such as those relating to gender or ethnicity or ability).

In online forums, social media and the yoga community, you may find a lot of current debate about whether or not social justice, oppression and equity have a place in yoga. Many of those who opine these have no place in yoga, which appears to be the

majority of thread contributors, appear to be gifted the privilege of not having to think about how it feels to walk into a yoga studio dominated by colonized yoga, which perpetuates trauma associated with sociostructural violence and more. Colonized yoga is exactly what it sounds like: appropriated and re-formed to serve predominantly cishet (cis-gender heterosexual), White, middle-to-upper SES females, with a “yoga body” and “yoga clothes”, or, you may not feel you belong. These disparities reflect a disconnect from the roots, philosophy, and ethics (Yamas and Niyamas) of yoga (Adele, 2009; Johnson, 2017; Sullivan et al., 2018).

If yoga is a resource for intervention and healing trauma that shows evidence-based promise, yet is predominantly only accessible by, or welcoming to, a specific set of privileged individuals in or from a relatively specific cultural background (here, that cultural background is dominant white culture), social determinants of health (SDOH) have a role in accessing yoga as a resource alongside yoga ethics. Yoga as a resource (though more research is indicated) shows promise as an adjunct clinical intervention for treatment or mediation of a wide array of diseases, illnesses or dysregulations as well as a resource for general wellbeing and is even preventive in several ways. Given this reality, SDOH domains lend to understanding who has access to yoga as a resource and who doesn't; for example, children and adolescents of adult caregivers who experience economic stability disparities likely have less access to yoga, since it is an expensive resource both in the public sphere (averaging \$100-200 per month for a yoga studio membership, which is equivalent to the cost of a week's worth of food for the average U.S. citizen (Rosenfeld, 2016)), and, in rarer cases where yoga is implemented as therapy

(ranging from \$75-\$200 per hour for yoga therapy (Brandt, 2019)). It seems the most common domains of SDOH and related disparities in access to yoga are 1) economic (in)stability, 2) health and healthcare, and 3) social and community context, which intersects with varying identities and associated social health disparities, such as sociostructural violence.

To contribute to narrowing such social health disparities in yoga and working toward de-colonizing yoga, this program is implemented in a priority population where the vast majority of individuals report they never practiced yoga or never had the opportunity based on variables such as clothing, money, or perceptions of non-belonging. Others reported “I can’t do yoga and be like a pretzel” or “I’m not skinny enough to do yoga” elucidating mainstream perceptions of yoga and respective colonization. As a white woman, I have privileges that allow me to facilitate yoga in the first place, given the colonization of yoga predominantly by white women. This means I also have the privilege and responsibility to draw awareness to this fact and do my part in trying to dismantle it. And while I try to honor the practice as something that wasn’t mine to begin with, by incorporating e.g. a session theme of Social Justice during the HCY program or not using gendered terms during facilitation, it is not enough. Michelle Cassandra Johnson (2017) explains the intersection of colonized yoga, dominant white culture, and perpetuating trauma:

“In the West [...] traditional practices were taken and given a Western flare focusing on Western ideals such as the physical body and building a stronger body [...] While I think all of these things are important, they are void of [...] anything other than one’s individual experience. White supremacy culture breeds individualism. It is based on competitiveness, the idea that there is one right way, and receiving benefits based on merit. The exportation, exploitation and

colonization of yoga coupled with the ideals expressed in dominant white culture have turned the practice of yoga into an obsession with the purification of the physical body, strength, selfishness and power hoarding all to benefit the individual. As a teacher, I'm mixed up in this mess. I'm trying to figure out how the hell I can teach this practice in a way that honors the tradition and pushes people to move past their own individual experience and into a larger consciousness about the collective culture [...] It is difficult to disentangle the practice of yoga and the business of yoga in this country and it's nearly impossible to teach in a way that honors the practice. But still, I teach because I believe in the power of the practice. When I show up to teach, I think about my authentic self and how to show up as her. I am aware of the fact that I am practicing something that wasn't mine to begin with but that I benefit from greatly and that I can share with other people. I call people to something bigger through the practice of yoga [...] All of the travesties that people experience off the mat are in the space and every one of us is complicit in the perpetuation of trauma through our actions. We can also choose to be active in our quest towards creating liberation through our actions”.

Keeping this in mind, facilitation itself can be exclusive; for example, using words such as “Okay, *ladies*” reinforces yoga is not for individuals identifying as gender-fluid (non-binary), trans- or cis- male and other identities. Johnson (2017), specializing in dismantling racism and decolonizing yoga as a social activist and clinical social worker, outlines several ways to take action for inclusiveness. These include, but are not limited to, stopping language-gender assumptions (example above), building trust through consent, cueing in a way that is sensitive and aware of the needs in the room, being aware of biases and taking action, and more. Johnson (2017) describes what yoga can be like when entering a yoga studio as a woman of color:

“As a woman of color, it is important for me to feel like the practice of yoga is intended for me and that I can be included in the practice. All of me. I have had the disjointed experience of entering spaces to practice yoga and have immediately lost my breath because of an often unspoken vibe that tells me I am not normal and that I am not what is expected in the space. I have had teachers and studio owners assume that I haven't practiced yoga before. They didn't ask me. They actually told me where to set up so that I can be behind someone so that I can keep up with the

sequence. I have been the only person of color in classes and that has made me wonder is this a welcoming place for people of color”.

Similar experiences have been outlined by trans-identifying individuals or those identifying as LGBTQIA+. These experiences should be sounding alarms that we must include social justice, oppression and equity in the conversation about yoga and take action, while returning to this over and over again to work together toward dismantling it. By dismantling this framework and associated assumptions, we hopefully contribute to creating a more just world, even if it is through starting on our yoga mats. If humans walk in and don't feel they belong, then the space is not safe and healing can't begin – whether it's yoga or another space.

“Yoga is personal and political. Many studios shy away from becoming involved with political or social justice issues. Remaining neutral in the name of equanimity is yet another example of spiritual bypassing. Studios feel they need to remain unbiased in the spirit of accessibility without any analysis or understanding of how yoga as an institution perpetuates bias and oppression. When people avoid social justice and political conversations, they are having a different conversation. A conversation that further marginalizes people who have been historically invisibilized, invalidated and discounted. Studios who focus on being non-biased perpetuate the homogenization of yoga. The westernized practice of yoga has avoided the conversation about oppression and privilege because it sees itself as a practice that transcends dominant cultures toxic narratives and norms. It sees itself as an all-inclusive practice doing good for the mind and body without a need to reflect and study the ways in which it is perpetuating cultural and institutional oppression”. (Johnson, 2017).

As a yoga teacher, it is my responsibility to cultivate spaces of belonging, acceptance, and where multiple identities and personal truths can exist, and to facilitate yoga the same. It's not enough to have intentions. We must take action toward impact, and this is an important distinction (Johnson, 2017). It is my responsibility to acknowledge my privileges and biases and take action relevant to them; to be and remain

comfortable with uncomfortable or difficult conversations, such as oppression and white supremacy, and not shy away from them; to notice differences in identities of each person, so I can fully see each person; to bring attention to spiritual bypassing and stop perpetuating it through silence or indifference or neutrality; to own my responsibilities and show up as my authentic self so that, hopefully, others show up as their authentic selves (Johnson, 2017). It seems to me these are some of the seeds required to be planted in order to practice and facilitate yoga in a way that contributes to healing, or slows the perpetuation of trauma as we commonly see in colonized yoga, as well as individual trauma, and contribute to narrowing social disparities relevant to the practice of yoga and health. Part of this is evaluating heterogeneic vs. homogeneic facilitation of yoga.

The homogenization of yoga, as referenced above, is perpetuated by colonized yoga; however, this is in contrast with researchers calling for homogeneic practices as a means to analyze validity and reliability of yoga interventions – a valid request in science. However, as previously described, homogeneic practices in yoga may not be empirically supported (based on various aspects of trauma: type, frequency, duration, intensity, multiple exposures, acute vs. chronic, and so forth), just as psychological and psychiatric treatment interventions are not identical across diagnoses (e.g. treating an individual experiencing schizophrenia is quite different from an individual experiencing anorexia nervosa). Further, homogeneic yoga interventions and facilitation preclude differential interventions based on varying identities, which itself can affect the efficacy of intervention. Acknowledging differences in trauma exposure(s) as well as differences in identities seem equally important in yoga facilitation and intervention. For research purposes, yoga need not be homogeneic; instead, 1) detailed reporting of yoga

interventions ought to come first, which this research aims to contribute to. This is likely 2) followed by analyses of the various *aspects* of facilitated yoga interventions (e.g. bottom-up approaches; top-down approaches), then, 3) identifying overlapping and disparate variables of yoga facilitation and classifying or categorizing them as evidence compounds. These classifications may inform which sample populations may benefit from certain aspects of yoga. From there, 4) continuing research in yoga as differentially and appropriately applied to various sample populations may be compared for feasibility, acceptability and therapeutic efficacy. In the yoga community, you may hear something akin to “it is all the same yoga”, and, in this light, certain consistent aspects of yoga facilitation may, for example, reflect therapeutic efficacy across disparate sample populations (or they may not). However, yoga as an intervention requires substantially more research, and community partnerships with shared power, to work toward facilitation that both welcomes and honors all identities and offers healing in a way that is well-received by differing priority populations.

I don't claim to have the answers, to so much of this conversation, but a start seems to be recognizing the vital importance of acknowledging our own privileges and biases, and returning to these topics again and again to continue working toward a more just society – by taking action both on and off the yoga mat. “Skill in action is a practice of recognizing my own and others identities, wholeness and humanity and owning my responsibility to the collective good. Skill in action is truth telling and engaging in conversation about oppression and yoga. Skill in action is a way of life and being” (Johnson, 2017). This research begins with establishing a community partnership with shared power in a sample population experiencing chemical dependency, with histories

of high trauma exposure, and with the majority of individuals never practicing or having access to yoga, either as a wellness resource or therapeutic intervention.

10. METHODS

1) Community Partnership and Assessment

This research was designed as a community-partnered pilot study. It employs a mixed-methods approach using qualitative and quantitative techniques through psychological, physiological and anthropological instruments and approaches.

Established, modified and created *psychological and physiological surveys* provide proxy data on extent of trauma, body perception and awareness, responses to stress, coping strategies (voluntary and involuntary), and a created Choice and Community (C&C) survey, which evaluates perceptions of choice and community for each participant. *Field notes* supplement surveys, from which the following types of data are derived: perceived trigger words or forms, likes and dislikes of each respective yoga program Session, notes from conversations and otherwise emic perspectives, as well as etic perspectives on how to modify the program to best meet the needs of the priority population given unforeseen or ever-changing variables. *Quantitative and qualitative data* expand on each other, allowing for a rich, balanced, and more detailed analysis of the priority population before and after intervention. The primary types of data collected are outlined; please view Figure 2 for the program and pre/post research design overview.

A. Securing the Community Partnership

To initially contact the community partner, snowball sampling was implemented, starting at the Family Impact Center. As the HCY *practice* (not the program researched here) is offered for both patients at a local clinic and to the public

on a weekly or twice-weekly basis, a relationship was already formed with the Director. It was simply asked whether or not the Director was aware of any facilities in the community who may have a population experiencing, or that has experienced, trauma, *and* where the HCY program may be welcomed. The Director immediately thought of the facility for which this research was conducted: a chemical dependency recovery treatment-center, for adult women and their children, currently residing in transitional living; this facility will be called “Bambu Treatment Center” (BTC).

Given time constraints, the researcher immediately drove to the facility as a “drop-in” to speak with the Director about the HCY yoga program and possible implementation through a community-partnered approach to research. The Director was not present; however, about a week later an email outlined significant interest in the program, as front-staff informed the Director of the drop-in, and an in-person meeting was scheduled. At the in-person meeting, before the PI finished explaining the background and logistics of the yoga program, the Director was enthusiastic to get started. Israel et al. (2005) outlines the process for securing a community partnership and an 8-step process for community assessment, which were attempted throughout this process.

Step 1 of the process is to define the scope of the problem and listen for need, not intentions (and other steps follow as described). The scope of the problem is multi-faceted among this sample population. While a list of created questions was supposed to guide this process, the expectations versus reality of this step are in stark contrast. Expectations were to go through by step, asking each question to the community-partnered Director, but no steps were actually followed as planned, and were definitely

not chronologically assessed. Instead, a more organic conversation was held, and only pieces of the steps were addressed; however, Israel et al. (2005) note this process is almost never ideally implemented. In addition, during this first in-person conversation, relevant information was garnered to create a well-informed, healthy, supportive, shared-power, committed and truly collaborative partnership whereby priority needs are integrating care to augment the recovery and wellness of the priority population in recovery for chemical dependency.

Defining the need for a partnership (Israel et al., 2005) occurred through listening for community-partner needs, and by the end of the first in-person meeting with the Director of BTC, there was explicit commitment by the facility Director to form an academic-community partnership for research. After the meeting, the Director of BTC took the research proposal and respective intervention outline to the community's Board of Directors, where it was equally well received. About a week or two later, an email by the Director of BTC confirmed the academic-community partnership relaying approval from the facility's Board. A stakeholder/advisory board was created with the Director of BTC, the Director's immediate supervisor, the principal investigator (PI) and their advisor. The limiting factor was then Institutional Review Board (IRB) approval, which was not secured until about two months after the initial meeting with the BTC facility Director.

During this two-month timeframe, the researcher kept in contact with the community partner at least once every week or two, in order to keep communication alive in the partnership and to update the Director of BTC on progress with the IRB approval process. (The final steps outlined by Israel et al. (2005) that have not been

reviewed (data collection plan; findings, interpretation, dissemination, and translation; priority setting and Participatory Action Plan; preparing for the next phase) are included throughout the rest of this work in a manner congruent with logical flow for increased comprehension).

B. Funding

Funding was not procured for this research for a variety of reasons. The process moved very quickly given time constraints, which prevented securing internal or external funding opportunities. In addition, the PI determined paying the out-of-pocket expenses would be feasible; while feasible, costs were higher than expected.

C. Study Venue and Ancillary Facility Requirements

BTC was the sole venue for the study. The community assessment, all meetings, all intervention sessions, and all research-related requirements or tasks were completed within the venue. The venue itself boosts privacy and confidentiality; approval is needed to enter the facility itself, which only gives access to front-desk staff. Once entering, the front-desk staff then determine whether to grant permission to enter a second locked door where the community resides. Since volunteer inclusion criteria requires residency at the facility, some barriers to volunteer attendance were removed, such as eliminating the need for transportation by volunteers.

In a facility focused on chemical dependency recovery, such as BTC, additional requirements were necessary for the PI to engage in partnership with this community. Unforeseen was about 12 hours of facility/organization-related training, which was an additional requirement for implementing the therapeutic yoga intervention program at BTC. Researchers should keep in mind that additional training beyond IRB training may

be required, especially in facilities serving vulnerable or sensitive populations, as well as processes verifying identity and associated history across several axes. For example, a background screening, confidentiality agreements, and other related forms or processes were required to be completed by the researcher in order to facilitate on the premises. Agreements within these processes also included, for example, consent given by the researcher to have a facility-hired private investigator conduct an investigation that may or may not include talking to the researcher's family and friends, following and observing behavior or daily routines, and other related items or tasks; whether or not an investigation was completed on the PI for this study is unknown.

11. DATA COLLECTION

1) Study Recruitment and Consent

Participants were recruited through distribution of a recruitment flyer and snowball sampling after obtaining IRB approval. The Director of BTC received an electronic copy of the flyer, and was asked to print and post the flyer around the BTC facility and spread the word about the upcoming research. Several emails outlined that distribution needed to be completely free of coercion, and, in that light, the PI was not present for distributing flyers in order to decrease the possibility of perceived coercion.

After two weeks of recruitment-flyer distribution, the PI held an “Introduction Session” to outline and describe the research, verbatim from a printed form, then a Q&A was held; this occurred in a community room at the facility. Interested volunteers then had the opportunity to ask questions one-on-one with the PI and voluntary consent was affirmed for each participant during this time. This occurred in an adjacent, but more private, room and setting; this is where voluntary consent was affirmed for each individual participant. Consent for this research was administered and affirmed orally; to best protect confidentiality, one master sheet connects real names to alphanumeric codes assigned to participants, while pre- and post-tests only have the alphanumeric code listed. However, to be clear: participants were addressed by their first name throughout the research – not by their assigned code.

Inclusion criteria for the study are as follows: 1) Residing at the BTC facility for treatment and recovery for chemical dependency, 2) Identify as trans- or cis-female, 3) Age 18 or older, 4) Legally able to affirm informed consent, 5) Able to attend and

fully participate in at least one full session of the program. The reason for #2 of inclusion criteria is BTC only allows women and their children to reside in their facility; males are not at the facility and do not appear to be part of direct-care staff, either. Exclusion criteria for the study, and criteria for being removed from the study, are as follows: 1) Inverse of inclusion criteria listed, 2) At any time during the program, behaving or acting in aggressive, violent, or otherwise harmful ways towards others or Self, 3) Touching another person's body without the person's explicit and non-coerced consent, 4) Serious Adverse Event occurs that precludes a volunteer from continuing to participate.

Compensation for participation in the study included: 1) Choosing a personal journal/notebook and pen for socioemotional learning strategies and notes during Mindful Reflection (Figure 2), and anything else at the participants' discretion, during the program, 2) DIY projects to take home, 3) A certificate of completion for those who participate for the full 6 weeks.

2) Study Coding

As previously mentioned, volunteer participants were all assigned an alphanumeric code, which was written on each pre- and post-test. Pre-tests and post-tests were administered in paper form; no data was collected electronically. All codes started with two letters that remained consistent across participants, and two numbers were assigned to each volunteer starting at "01" and moving up. For example, the assigned code for the first consented volunteer is akin to "HS01", then the second consented volunteer would be "HS02", then "HS03", and so on. All data from paper surveys was

then entered in Excel, listing values (e.g. survey scores; feedback) by participant's assigned code.

3) Sample Size

The goal participation for this pilot study was n=10-20 individuals within the defined community. The community itself can support about 20 individuals for residential care at any given time. Preference is given to individuals experiencing recovery from intravenous (IV) drug use and are pregnant. To give an idea of how sample size occurred over time: For the first week of the program, seven individuals voluntarily consented to the study; however, with inclusion criteria stating participation is allowed at any time during the program, as long as one entire session is attended, the turnover rate in participation became quite high. This caused the sample to increase by about 5-7 volunteers per week, while losing a variable number of volunteers from the previous weeks (e.g. individuals discharging from the residential BTC program). Total sample size grew over the 6-week intervention, but attrition was high as described in results. Given these realities, this study (n=25) lacks the necessary power to analyze inter-individual scores (quantitative data) with comparative statistics. Instead, trends in feasibility, acceptability and therapeutic efficacy will be the focus of analysis, given the sample size and related variables.

12. INTERVENTION/PROGRAM: DESIGN

1) Program History and Development

Healing Centered Yoga (HCY): An Adjunct Clinical Intervention Program and Practice for Healing Trauma© is outlined herein. It is developed and written by Heather Saxon, M.A., M.P.H., GC-PHR, E-RYT-200, YACEP, C-SEL*F; she specializes in evidence-based healing modalities and clinical interventions for trauma (including past and present; acute and chronic; developmental/childhood; treatment-resistant) and associated mental health diagnoses such as PTSD or panic/anxiety, working from a multidisciplinary approach grounded in evolutionary medicine.

A. Short Biography Specific to this Research

Heather has practiced yoga for 9 years and is certified by Yoga Alliance as an E-RYT-200 (Experienced Registered Yoga Teacher) and YACEP (Yoga Alliance Continuing Education Provider). She is certified in Social Emotional Learning and Facilitation (C-SEL*F), Youth Mental Health First Aid, and “trauma-informed” yoga outreach. Heather’s M.A. in evolutionary and cultural anthropology focused on mindfulness for homeless adolescents with experiences of trauma, across psychosocial, socioemotional and neurobiological axes. She has about 3 years of combined research experience in clinical, cognitive and translational neuroscience and neurophysiology, and, about 2 years research experience in mindfulness and yoga. She has also worked in the mental health clinical field, mostly non-profits, for about 7 years as a Case Manager, Client Advocate, and Mental Health Worker, with primary populations including people who have experienced homelessness, trauma, and mental health illness (aka “mental

illness”/“mental disease”). This program and corresponding research are part of Heather’s thesis through the School of Public Health as well as her practicum for the Sinclair School of Nursing where her advisor, Maithe Enriquez, PhD, APRN, FAAN, is an experienced researcher. Heather is also a co-author published on topics specifically related to this research, such as interoception and mental health (provisional mentor: Ralph Adolphs, PhD): [https://www.biologicalpsychiatrycnri.org/article/S2451-9022\(17\)30234-3/fulltext](https://www.biologicalpsychiatrycnri.org/article/S2451-9022(17)30234-3/fulltext). She incorporates all of her knowledge, education and experience into developing programs and interventions for healing trauma in adolescents and adults, and in building awareness through education and storytelling; these endeavors include, for example, researching, facilitating, and volunteering body-based approaches and programs for intervention (i.e. yoga), creating clinic toolkits for trauma teams (implemented at a community clinic in association with the MU School of Medicine), or guest speaking about informed consent in clinical practice and the role of trauma in medicine as well as low- and non-invasive interventions, such as yoga.

B. History and Development

Healing Centered Yoga (HCY) is an adjunct clinical intervention incorporating empirical evidence and literature from clinical psychology, anthropology, the neurosciences, social work, public health, nursing, as well as experiential learning and feedback from individuals and patients, and the literature on trauma and modalities of clinical intervention.

HCY started as a practice (not a program) in September, 2018 where referrals were received for patients from a local community clinic, through the MU School of Medicine, facilitating HCY as yoga therapy and an adjunct clinical intervention.

Referrals for HCY yoga spanned facilitating one-on-one HCY with patients, as well as HCY for partners, children/family, and open group/community yoga as options. Of these options, open/group community yoga has been offered 1-2 times per week, always cost-free, and in partnership with either the local community clinic or the local Family Impact Center for approximately 1.5 years. The *Healing Centered Yoga (HCY): An Adjunct Clinical Intervention Program and Practice for Healing Trauma*© has been implemented in chemical dependency treatment centers for both adolescents and adults. It is developed for any priority population where trauma exposure has a high correlation (e.g. clinics, treatment or rehabilitation centers, prisons, juvenile detention, health centers, and more).

The reason for the name *Healing Centered Yoga* is at the core of both the practice and the program. It is a semantic principle: By saying “trauma-sensitive/informed/centered” __X__ (enter yoga, or any other intervention, process or treatment), it implies there is something “wrong” with the person; for example, “You have trauma and you need to be fixed”. This is problematic because it blames the individual (or community/group) for what they’ve experienced or what has been perpetrated *against* them and, at its core, is victim-blaming. The perspective is shifted by saying “Healing Centered”: we are purposefully not focusing on the person and their trauma whereby trauma defines the whole person. Instead, we acknowledge the psychosocial, sociostructural, interpersonal, and other environmental and evolutionarily significant factors that are involved in trauma exposure, resultant effects on the brain and body, and healing from trauma. The HCY focus turns to combining healing modalities for the body and brain – from autonomic to cognitive, often integrating multiple axes and amalgamating bottom-up and top-down approaches; such as noticing internal body

sensations while simultaneously witnessing or modulating thought processes (interoceptive attention and meta-cognitive processes, respectively). In this way, we incorporate empirical evidence for a holistic and non-judgmental approach to healing trauma, which are aligned with yoga ethics.

The development of the administered program intervention was founded and built on the principles or concepts described above. The program is listed in detail below, but examples of how empirical evidence (such as associated with socioemotional learning strategies, coping mechanisms, or other practices associated with mental health or wellbeing) is connected with yoga ethics may be useful. The yoga ethics followed are outlined by the Yamas and Niyamas and the first principle, from which all the others branch from, is Non-Violence (“Ahimsa”). Honored in this program are the roots and history of yoga, to the best of my ability, which are included secularly in each session of the program.

Connecting the HCY principles and concepts to the Yamas and Niyamas (yoga ethics) is essential to this program (and the HCY practice itself as yoga therapy). Ethics are presented secularly and interweaved throughout both yoga forms and Mindful Reflection portions of each program Session. An example of each is as follows, ordered as the Yamas and Niyamas are presented:

YAMAS (universal morality)

1. Ahimsa (non-violence); example: non-violent communication (socioemotional learning strategy) in Session 4.
2. Satya (truthfulness); example: harmony of thoughts, words and actions in Session 6; in certain forms of chemical dependency recovery, honesty is integral to sobriety.
3. Asteya (non-stealing); example: non-stealing of others' voices and acknowledging biases that contribute to stealing from others in Session 5. Stealing is not restricted to material items.
4. Brahmacharya (non-excess); example: practicing opposites of feelings and noticing sensations, alternating opposites, and combining them; a practice in non-excess of particular feelings (or perhaps emotions); Session 3.
5. Aparigraha (non-possessiveness); example: concept of fitting in versus belonging (non-possessiveness of others) in Session 5.

NIYAMAS (personal observances)

6. Saucha (purity/cleanliness/wholesomeness); example: cultivating self-care in Session 1, such as bathing, or, as it intersects with other ethics, such as Satya (#2).
7. Santosha (contentment with what is); example: giving gratitude in words and actions during Session 4.
8. Tapas (self-discipline); example: noticing biases and returning to associated concepts consistently and over time with love and care, as in Session 5 – this example overlaps with #9.

9. Svadhyaya (self-study); example: practice of witnessing thoughts, feelings, sensations during yoga forms during each session, or, noticing whether thoughts, speech and actions are aligned as in Session 6.

10. Ishvara Pranidhana (surrender); example: engaging, instead of avoiding or ruminating, with and/or accepting certain feelings and sensations that are oppositely valenced in Session 3.

Since this program is focused on yoga as an adjunct clinical intervention in a community where English is the primary language and individuals are vulnerable, and to cultivate belonging in this particular community, the use of Sanskrit is limited to words that cannot be translated (≤ 5 words total) to English. This HCY program is currently only offered in English, with future plans for facilitation in Spanish.

2) HCY Foundational Concepts and Principles in Program and Practice

Each person has full control over their own body at all times and is in full control over the decisions that pertain to their bodies at all times. The following principles and concepts form the foundation of this practice and program. They include, but are not limited to:

1. Increasing predictability in the immediate environment, hopefully contributing to a sense of safety among individuals that translates more perpetually and builds over time:

- *Facilitator stays on their mat at all times. At the beginning of practice, invitations are offered to close the eyes or keep them open, practice a soft gaze, or whatever each individual chooses. It might literally be said, "I am going to be here on my*

mat the entire time; if you choose to close your eyes, whenever you open them I will be right here on this mat”. Expressing verbally why the facilitator is making the choices they are making may further increase predictability, and in turn hopefully cultivate safety, in the immediate environment.

- *No touching, no assists. Each person’s body is their own. Along these lines, community forms, as are all forms, are completely voluntary and no one has to participate in any form they don’t want to or choose not to. This principle may contribute to a sense of ownership over one’s body – something often lost during trauma, especially certain types such as childhood abuse or sexual assault.*

2. Every decision a person makes about their own body is invited and supported:

- *Switching forms as needed for the body or brain is encouraged. Somatic-based and body-based aspects are included in this practice, with which this principle aligns; it may contribute to a sense of ownership over one’s body, which may, in turn, increase perceived feelings of safety allowing for tuning “in” (e.g. interoceptive attention) to one’s body (difficult to do when the body feels unsafe).*
- *Choosing any yoga form at any time. Every person may be in a different form during HCY, and that is fully supported. This principle may contribute to agency, autonomy and empowerment. Following this principle are the following three bullet points:*
 - *Decline any form at any time.*
 - *Any individual is free to leave the HCY practice at any time, for any reason.*

- *No one has to talk to anyone during HCY.*
- *Invitations are constant: to stay in whichever form for however long the body feels is supportive or useful or however long is simply chosen, whether 1-second or the full HCY practice, or, somewhere in between. This practice champions choice, and choices can be difficult with high trauma exposure, so this practice focuses on first creating an environment that prioritizes real and perceived safety as much as possible; this is integral throughout healing processes, in cultivating perceived choice and autonomy, and in regulating the nervous system over time when such an environment is consistent.*

3. Cultivating an environment where social support and community connection are essential:

- *Social support is integral to healing. Social support, and perceived consistent safety within those supports, may contribute to individual resiliency and healing (from healing trauma to physical wound-healing). Facilitation in communities with shared experiences may further social cohesion and a sense of healthy social support and connection or belonging.*
- *The understanding and application that this is not a demand-based program, but an invitation-based program to facilitate choice, empowerment, equity, authenticity and community connection (social support) as integral aspects of healing. This experience is not only authentic between individuals participating, but authentic between individuals and HCY facilitator.*

3) Personal Notebooks: A Material Step in Autonomy

Each individual is given a notebook journal (used synonymously as “notebook”, “journal”, “healing journal” or “journal notebook” throughout) to use however, or in whatever ways, each person finds individually useful or supportive. Having a sense of ownership over one’s self may start with ownership over some meaningful material, like a notebook. Non-possessiveness may be a yoga ethic, but it can be practiced in different ways and doesn’t necessitate precluding ownership of an item that may encourage autonomy and agency; I propose is that this is practicing non-violence, which is the first yoga ethic from which all others branch.

Each session will introduce different forms, have themes that include socioemotional learning strategies, choice-building practices, body awareness practices, breathing techniques and other coping strategies, community-building practices, body-based practices and more; during Mindful Reflection of each session, individuals may include these topics as relevant to their healing journal (for example, maybe two out of six breathing techniques are found useful by a given individual in Session 2, so they can record those in their notebook). However, nothing is required to be written in the notebook by individuals.

Individuals have sole discretion over their notebook journals, and the notebook is solely for the individual. Individuals will never be asked to share anything from their notebook with the researcher, the community partner or facility, or any affiliates, unless the individual chooses to of their own volition and without any sense of coercion. The notebook is supposed to serve as something that is theirs alone to support in healing and

it belongs to no one else; the owner alone chooses who can see or hear, what and when, and shall not be asked by any researcher nor employees or affiliates of any facility, associated university, or any other entity or being to disclose anything in the owner's notebook indefinitely. The notebook becomes the ownership and property of the individual with any alteration to the notebook.

4) Offered Forms

The reason each session is not set in specific sequences is because of HCY's foundational principles. The practice is supposed to be authentic as well as iteratively adapted for the priority population. For example, if volunteers have already set up their yoga mats and are lying on the floor, I may begin with a mindful resting form lying on the mat (e.g. child's form or reclined resting [Savasana]) instead of a seated form. The beginning of the practice is facilitated to align with the choices individuals are already making about their bodies, without input from outside members (i.e. the research or facility staff).

*Figure 1
Offered Forms*

| FORM GROUPS | OFFERED FORMS |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| <i>MINDFUL BEGINNING</i> | Easy seated; thunderbolt; staff; mountain; head/neck rolls; shoulder shrugs/rotations |
| <i>SPINAL</i> | Cat/cow; rotating cat/cow; cobra; forward fold; halfway lift; reclined spinal twist; Marichi's form |
| <i>STRENGTH</i> | Warrior I/II; plank form; table-top arm and leg extensions; |
| <i>INVERSION</i> | Legs on the wall; downward dog |
| <i>STRETCH</i> | Peaceful Warrior; extended triangle form; pigeon/reclined pigeon; butterfly/reclined butterfly; seated forward fold |
| <i>BALANCE</i> | Tree; Warrior III; extended hand-to-foot form |
| <i>COMMUNITY</i> | Tree – community; Warrior III – community; extended hand-to-foot form – community; heart side stretch (Peaceful Warrior) – community circle |
| <i>REST</i> | Reclined butterfly; reclined resting; easy seated; thunderbolt; child's form |

Each session, except Session 0, included a series of forms, including at least one from each of the following categories during each session, but not necessarily in order.

5) Weekly Session Supplies

The following supplies are needed for every session: copies of consent forms to distribute to individuals after affirming oral consent; facilitator handbook; facilitator notebook and pen (same as volunteers') to share in authentic experience; master sheet to record new individuals, individuals who have discharged or will be discharging (to know when to administer post-tests), and individuals who actually physically attend the session at the start of the session or those who leave; new notebooks and pens for new consenting volunteers; yoga mats (unless provided by the community partner or facility); yoga mat disinfectant and cleaning towels (to wash and reuse). Individuals are invited to bring their journals and pens to each session for Mindful Reflection. Additional supplies are listed in each respective session below.

6) Duration and Timeline

- ***Whole study***: One hour-long HCY session per week, for six weeks, preceded by the Introduction Session, and with a subsequent Post Session (Figure 2).
- ***Length of weekly HCY session***: Includes HCY Yoga (forms) (~30 mins), transition time (~5 minutes) and Mindful Reflection (~25 minutes). Every week of the HCY program has a topic/theme corresponding to the material covered during Mindful Reflection.

- **General trend of six-week program:** The first three weeks are focused more on the Self, while the last three are focused on Community and integrating both the Self and Community.

7) Pre-Test and Post-Test Surveys

PRE-TESTS ONLY

A. Adverse Childhood Experiences (ACEs) Questionnaire – adapted (Appendix 1)

One common measure of past trauma is the Adverse Childhood Experiences (ACEs) questionnaire. Adverse childhood experiences, and chronic or past toxic stress or trauma, have been associated with chronic health conditions (e.g. obesity, depression, suicide attempts, heart disease, cancer, stroke, and more), behavior with possible severe health consequences (smoking, drug use, alcohol abuse, chemical dependency), and “life potential” loss (e.g. decreased graduation rates, lost time from work, decreased academic performance and achievement) (CDC, 2016). In fact, the original study evaluating ACEs found a strong, graded relationship “between the *breadth* of exposure to abuse or household dysfunction during childhood and multiple risk factors for several of the leading causes of death in adults” (n= 13,494) (Felitti et al., 1998; emphasis added).

ACE is a 10-item survey assessing various trauma experiences during childhood. It is scored such that a higher number (10 = highest possible number) is correlated with higher risk for previously outlined adverse health outcomes (CDC, 2016). It then logically follows that calculating an ACE score is a beneficial clinical tool to gauge the health risk of an individual with past trauma(s), regardless of (and not necessitating) the type(s) of trauma associated with a given ACE score. Such a adapted method allows

identifying the *number* of different types of trauma to gain a more holistic perspective of each community member, without asking to disclose the specific *type* of trauma and cause undue harm or distress.

PRE AND POST TESTS

B. Body Perception Questionnaire (BPQ) – adapted (Appendix 2)

“The Body Perception Questionnaire (BPQ) is a self-report measure of body awareness and autonomic reactivity” (Kolacz, Holmes & Porges, 2018). Its items are based on Porges’ polyvagal theory, which has been largely rejected by compounding evidence, yet, is commonly used. However, when modified and adapted, useful information may be garnered from the questions listed by re-categorizing them into, for example, proprioception, interoceptive awareness domains/features and other empirically validated and associated systems and processes.

C. Responses to Stress Questionnaire (RSQ) – adapted (Appendix 3)

Measures involuntary stress responses and coping to stressful situations, which includes rumination, intrusive thoughts, physiological arousal, emotional arousal and involuntary action. The RSQ has been shown to correlate well with a biological measure of heart-rate activity in a laboratory task (Connor-Smith, 2000). Participants rate their agreement with various statements on a 4-point Likert-type scale.

D. Choice and Community Survey (C&C) (Appendix 4)

Measures subjective perception of choice and perception of community. Choice is an important aspect of healing as it relates to agency, a sense of control over one's body, and empowerment. Community, and perceptions of belonging to a community, is integral to measures of individual resilience in the literature. Other aspects of the surveys ask

questions about exteroception, varying features of interoceptive awareness and proprioception.

13. INTERVENTION/PROGRAM: IMPLEMENTATION

1) HCY Program – An Overview

An overview of the *Healing Centered Yoga (HCY): An Adjunct Clinical Intervention Program and Practice for Healing Trauma*© is shown in Figure 2. This compressed view is meant to give a feel for the pre-post design of the study and time and type of surveys (pre-and post-tests) administered, as well as corresponding and respective topics/themes and activities.

Figure 2
Healing Centered Yoga (HCY): An Adjunct Clinical Intervention Program and Practice for Healing Trauma©:
Program Overview and Research Design

| Week | Name | Topic/Theme | Activity | Surveys Administered |
|-------------|----------------------|-------------------------|-------------------------------------------------------------------|-----------------------------|
| 0 | Introduction Session | N/A | Recruitment, explanation of study, Q&A, consent; Pre Tests | ACEs, BPQ, RSQ, C&C |
| 1 | Week 1 | Self-Love | Sparkly Soothing Container | N/A |
| 2 | Week 2 | Breathing | Breathing Techniques | N/A |
| 3 | Week 3 | Your Body Your Choice | Opposite Sensations, Feelings & Connecting | N/A |
| 4 | Week 4 | Community Connection | Sticky Notes of Gratitude; Singing Bowl Experience | N/A |
| 5 | Week 5 | Social Justice | Notebook – Justice & Non-Violent Communication | N/A |
| 6 | Week 6 | Harmony | My Healing Reminder Rock; Daily Practice | N/A |
| 7 | Post Week | N/A | Post Tests ; Continuity of Care - Partner Discussion | BPQ, RSQ, C&C - Extended |

2) HCY Program – Detailed

This section aligns with the Facilitator Handbook, which was created to guide facilitation throughout the study; it was very well followed with any iterative modifications explained throughout this thesis. An even more detailed description of the program can be found in Appendix 5.

WEEK 0:

INTRODUCTION SESSION

This week starts with all introductory items. The recruitment flyer should have already been disseminated. The recruitment script is read verbatim. Possible volunteers then meet with the researcher in an adjacent room where questions are answered, and voluntary consent via oral affirmation is given, if voluntary chosen. Once consent is affirmed, participants are given a copy of the study in waiver of written consent. Study coding is performed and recorded in the master sheet with the participant's name and alphanumeric code, as each participant affirms consent (the master sheet is also used to record week of discharge, who attended what session and for how long, and other details over the course of the yoga therapy intervention program). Each participant then receives pre-tests (ACEs – adapted, BPQ - adapted, RSQ - adapted, C&C) to complete. After completion, each participant may choose a personal notebook journal and pen for when Mindful Reflection Week 1 begins.

WEEK 1:

SELF-LOVE FOR HEALING

- 30 minutes HCY (forms and breathing) + Squeezing Muscles (sense container)***
- 5-minute transition***
- 25 minutes Mindful Reflection***
- Reflection Topic(s): Self Love and Self Care Choices***
- Activity: Sparkly Soothing Container***
 1. Likes/dislikes/trigger words
 2. Self Care
 3. Comfort Forms
 4. Our Glitter Brain and Body Container
 5. Self Love
 6. Mindful Ending

WEEK 2:

BREATHING FOR HEALING

- 30 minutes HCY (forms and breathing)***
- 5-minute transition***
- 25 minutes Mindful Reflection***
- Reflection Topic(s): Breathing Choices; Nervous System and Breathing***
- Activity: Breathing Techniques Practice***
 1. Likes/dislikes/trigger words
 2. Soothing Sigh Breathing

3. Heart-Focused Breathing
4. Hummingbird Breathing
5. Cooling Moment Breathing
6. Alternate Nostril breathing
7. Mindful Ending

WEEK 3:

YOUR BODY | YOUR CHOICE FOR HEALING

- 30 minutes HCY (forms and breathing) + Body Awareness Practice**
- 5-minute transition**
- 25 minutes Mindful Reflection**
- Reflection Topic(s): Choice, Agency, Empowerment**
- Activity: From Our Mat To Our World: Opposite Sensations, Opposite Feelings and Connecting**
 1. Likes/dislikes/trigger words
 2. Opposite Feelings – Mindful Choices
 3. Opposite Sensations – Mindful Choices
 4. Connecting Opposites – Feelings and Sensation
 5. Reflection on Choice, Agency and Empowerment
 6. Mindful Ending

WEEK 4:

COMMUNITY CONNECTION FOR HEALING

- 30 minutes HCY (forms and breathing)**

- *5-minute transition*
- *25 minutes Mindful Reflection*
- *Reflection Topic(s): Gratitude for Self and Others - Connection*
- *Activity: Sticky notes of Gratitude; Singing Bowl Experience (“sound bath”)*
 1. Likes/dislikes/trigger words
 2. Giving Gratitude
 3. Community Connection Breathing
 4. Mindful Ending

WEEK 5:

SOCIAL JUSTICE FOR HEALING

- *30 minutes HCY (forms and breathing)*
- *5-minute transition*
- *25 minutes Mindful Reflection*
- *Reflection Topic(s): Wellness as a vehicle for change; diversity and belonging*
- *Activity: Notebook – Justice and Non-Violent Communication*
 1. Likes/dislikes/trigger words
 2. Our Living World
 3. Fitting In v. Belonging
 4. Non-Violent Communication
 5. Singing Bowl Sound Experience
 6. Mindful Ending

WEEK 6:

HARMONY FOR HEALING

- 30 minutes HCY (forms and breathing) + BODY AWARENESS PRACTICE*
- 5-minute transition*
- 25 minutes Mindful Reflection*
- Reflection Topic(s): Union; Harmony*
- Activity: My Healing Reminder Rock; Daily Practice; Certificates of Completion*
 1. Likes/dislikes/trigger words
 2. Yoga = “Yoke” = Union = Harmony
 3. Remember the still water and body container from Week 1?
 4. My __(Healing)__ Rock
 5. 3-Minute Personalized Daily Practice
 6. Certificates of Completion + Mindful Ending

WEEK 7:

POST WEEK

1. Remaining post-tests administered
2. Advisory Board/Community Partner Questionnaire administered
3. Set up continuity of care
4. Additional loose ends
5. Mindful ending; goodbyes

14. INTERVENTION/PROGRAM: EVALUATION

1) Objectives and Research Questions

PRIMARY OBJECTIVES

1. Iteratively modify *Healing Centered Yoga (HCY): An Adjunct Clinical Intervention Program and Practice for Healing Trauma*© facilitation (output), a form of evidence-based yoga developed for healing trauma, during a community-partnered study as a 6-week adjunct clinical intervention program (process evaluation).
2. Analyze health measures and well-being before and after the study, across individual self-report scales (some as proxy for physiological reactivity), with a focus on trends, especially as relative to number of reported trauma exposures by individuals in the community and in aggregate (outcome evaluation).
3. Evaluate feasibility, acceptability and therapeutic efficacy of the intervention in the priority population (impact evaluation).

SECONDARY OBJECTIVES

4. Move toward health equity in yoga through offering an accessible and sustainable health modality (yoga) to a sample population with low access or perceptions of non-belonging in yoga (outcome evaluation).
5. Contribute to the literature on yoga as an adjunct clinical intervention, through offering
 - a) detailed teaching methods of yoga facilitation in communities, and
 - individuals within those communities, experiencing trauma (past or present), b) data on physiologic measures and individual health and wellbeing trends before

and after yoga intervention through survey proxy, c) a community-partnered yoga program developed to work toward narrowing social health disparities associated with yoga, and d) contribute to the scarce literature on yoga as an adjunct clinical intervention in a sample population experiencing chemical dependency recovery (outcome evaluations).

RESEARCH QUESTIONS

1. Are there trends, from pre-to-post HCY program intervention, on: a) autonomic nervous system reactivity and body awareness as measured by the BPQ questionnaire – modified; b) perception of choice, autonomy and community connection or belonging as measured by the Choice and Community Survey; c) involuntary and voluntary cognitive and neurophysiologic processes, during individual responses to stressful situations, that may associate with trends in involuntary and voluntary coping strategies as measured by the RSQ questionnaire – modified; d) trends from a, b, or c, that correspond with number of traumas exposures experienced by an individual, as measured by the ACEs questionnaire, both intra-individually and in aggregate among the sample population.
2. Is the *Healing Centered Yoga (HCY): An Adjunct Clinical Intervention Program and Practice for Healing Trauma*© intervention feasible, acceptable, and therapeutically efficacious to the priority population, as measured by: a) percent of participants who attend each session; b) number of total sessions each volunteer attends; c) field notes; d) participant verbal feedback; e)

trends across physiological and psychosocial axes derived from proxy surveys.

2) Interpretation of Findings

Evaluation and interpretation of findings (Israel et al., 2005; Guttmacher et al., 2010) include:

1. Close-ended (Likert-scale) questions evaluating outcomes and outputs of the study by participants.

- Iterative feedback requested and recorded during each week of the program (impact evaluation).
- Completed questionnaires pre- and post- intervention (outcome evaluation).
 - Adverse Childhood Experiences Questionnaire (ACEs)
 - Body Perception Questionnaire (BPQ)
 - Responses to Stress Questionnaire (RSQ)
 - Choice and Community Survey

2. Open-ended questions evaluating Advisory Board and Community Partner's perception of outcomes and outputs of the study (Appendix 6).

- Iterative feedback during each week of the program (impact evaluation).
- Advisory Board/Community Partner Questionnaire (outcome evaluation).
 - A questionnaire (Appendix 6) developed to receive feedback from the community partner to evaluate both the program and the partnership throughout the duration of program research.

3) Data Analysis and Interpretation

A. Participant Verbal Feedback and Field Notes

Research Questions: Is the HCY program intervention feasible, acceptable and therapeutically efficacious to the priority population, as measured by: a) percent of participants who attend each session; b) number of total sessions each volunteer attends, c) field notes, d) participant verbal feedback, e) trends across physiological and psychosocial axes of proxy surveys. Questions c) and d) are detailed here, while a), b) and e) are detailed in subsequent sections.

For the sake of comprehension, results are analyzed by weeks respective to which part of the research question is being addressed. Each week contains the following categories from field notes: 1) Beginning (notes from pre-session or start of session); 2) Yoga Forms Observation (data from the first 30-minutes of each weekly session or associated comments or data about this portion, during which yoga forms/movements are facilitated); 3) Mindful Reflection Observation (data from the last 25-minutes of each weekly session or associated comments or data about this portion); 4) Community Partnership Meeting (details about meetings or conversations with the community partner outlined by week); 5) Feedback (participant feedback, or, community partner feedback as applicable and noted); 6) Additional Notes (any data relevant to the weekly session not included in the previous five categories).

WEEK 1

Beginning

Week 1 session started late. Out of n=7 who consented and completed pre-tests, only three participated in the entire session – a fourth participant left after about 10-15 minutes. Participation was lower than anticipated for Week 1; about half of consenting volunteers left (n=4) after receiving journal notebooks and pens.

Yoga Forms Observation

During yoga facilitation, my eyes as facilitator are usually in a soft gaze or even closed as it feels supportive for my body. I never leave my mat during yoga form facilitation and no one ever touches anyone else, this includes no assists by the facilitator.

Facilitating in a circle is ideal to offer and cultivate community and safety (e.g. you can see where everyone is at all times; no one is behind you or out of sight). The mats were prearranged as a “messy” oval; the room appears large enough to comfortably fit seven to nine people; however, a support beam is in the center of the room. This arrangement did not seem comfortable for the priority population as most moved their yoga mats in different angles or to a different place altogether. This made facilitating difficult, creating both blocks in line of sight and in the apparent comfort of participants. In future weeks, yoga mats will be available but not prearranged and evaluated from there.

Attention and focus in the room seemed low until about the second form, or in forms that are more active, such as rotating cat/cow (a more obviously active form) versus staff form (a less obviously active form). The following forms were completed in

order: easy seat, neck and shoulder rolls, table top, cat/cow, rotating cat/cow, staff form, child's form, resting form, easy seat.

Mindful Reflection Observation

The activity (soothing sparkly containers) had high acceptability. There seemed to be excitement and a lot of engagement with this hands-on socioemotional learning activity. This was a valuable insight, in retrospect, moving forward with this program (i.e. hands-on activities have higher acceptability than journals based on participant feedback and number of participants leaving after yoga but before Mindful Reflection).

However, with the hands-on activity, it appeared difficult for participants to cognitively attend to additional concepts during Mindful Reflection; this reinforces only focusing on one task at a time, even if the tasks are related. That said, one participant was observed writing almost constantly in their personal journal throughout the Mindful Reflection period; the other two participants were observed engaging with their journals some, especially more toward the end of Mindful Reflection. To make mandatory staff feel welcome as part of the community and program (a facility technician has to accompany the PI at all times during the program), they were offered pens and journals, which culminated in direct-care staff technicians participating, and appeared to cultivate bonding behavior between technicians and participants. This was a welcome surprise.

Community Partnership Meeting

Two people filled out post-tests today after the session as both were set to discharge from the facility before Week 2. As part of iteratively modifying the program, a post-test was left with the community partner Director for the third participant to

complete who thought they may be discharged; the Director would give it back to me the following week.

During this discussion with the Director, I became aware that the maximum amount of time for any person to stay at the facility is four weeks, which means the study began in such a way that no one would be able to finish the full six weeks of the yoga program. This was disheartening; however, the inclusion criteria was attending only *one* full session (in order to make the practice as available and accessible as possible to the community – it was a trade-off), and valuable information can be garnered from varying weeks of participation in the program.

Feedback

There were no reported triggers cited, either words or forms, when asking participants for feedback. Feedback reflects high acceptability for the first week (n=3) based on participant comments: “This yoga made me feel better than other yoga I’ve been to that felt like exercise” was expressed by the one participant who reported practicing yoga one time before this study; “My body feels looser. I felt liquidized and more free flowing” and “I felt more graceful and relaxed” were comments by volunteers who reported never practicing yoga.

Additional Notes

Participants expressed gratitude and excitement about journals, pens, and sparkly soothing container bottles. One volunteer who completed pre-tests but did not attend the actual first session for any duration of time requested the compensatory items associated with the study (i.e. journal and pen); this is something that may need to be considered for future compensation.

WEEK 2

Beginning

Three participants attended, with almost all new volunteers. One participant who completed pre-tests chose to not participate in Week 1 or Week 2. The program got started late again this week by about 5-10 minutes.

Yoga Forms Observation

There should probably be more time allotted for program sessions for two reasons: 1) It takes longer than anticipated to get into the room designated for yoga, set up, and begin, 2) It can feel rushed.

Forms offered (in order): easy seat, neck and shoulder rolls, staff, table top, cat/cow, rotating cat/cow, table top, plank, down dog, walk feet to hands for forward fold, followed by resting form. A short (approximately 3-minute) body awareness practice (also known as a “body scan” or “body awareness scan”; however, ‘scan’ may be a trigger word, so the HCY program uses the words “body awareness practice”) (Figure 1).

After two weeks, it is apparent that the number of forms expected to be completed within a 30-minute session is not usually feasible; one form from each category listed (Figure 1) is difficult given: 1) number of forms possible given time constraints, and 2) adapting the forms to meet participants where they are at. In other words, it seemed more therapeutically efficacious to facilitate authentically and in a way that feels supportive as a facilitator, rather than to “force” trying to include one form from each category. In following weeks, authenticity and meeting participants where they are at will continue to

take precedence over attempting to fit a certain number of forms, from certain categories, into a certain timeframe.

Mindful Reflection Observation

A series of different breathing forms were presented for Week 2 Mindful Reflection. There seemed to be some engagement with breathing forms, but the excitement from Week 1 hands-on activity perhaps set up expectations for weekly hands-on activities. This is valuable feedback to modify future implementation by including more hands-on activities. Mindful Reflection was ended about 5 minutes early (for a total of 20 minutes, instead of 25) as all members of the facility had a mandatory facility-related event to attend promptly at 9:00 am. Even though the program session ended early, all breathing techniques were completed in a largely non-rushed manner.

Community Partnership Meeting

No meeting was held for Week 2 due to the mandatory event.

Feedback

There were no reported triggers cited, either word or forms, when asking participants for feedback. The following comments reflect acceptability of Week 2: “I like the breathing for my anxiety”; “I think I can use this in this morning”.

Additional Notes

Since the program is during scheduled wellness hour at the facility, another activity is underway in the adjacent room each week. This increases the amount of auditory stimuli and the adjacent room can become loud and interruptive; while unpredictable or noisy sounds may be incorporated into the practice as something to witness, it likely takes away from the therapeutic efficacy of the intervention. In

addition, there's appears to be a lot of restlessness for some participants when the forms are more still or resting than active; many participants have left after yoga but before Mindful Reflection, and those that leave during yoga seem to do so during more low-intensity forms (gentle head and shoulder rolls, for example, compared to rotating cat-cow). Whether this has something to do with individuals in the priority population experiencing withdrawal or associated chemical dependency symptoms is unknown.

WEEK 3

Beginning

Eight participants were present for Week 3, including five new volunteers. One participant volunteering since Week 1 expressed not wanting to stay after yoga forms because they wrote in their journal the previous week and relayed, "I don't want to do the same thing". I replied that their decision was completely valid, but that I wanted to offer the information that what we focus on is different, and that whatever they choose is supported. The participant chose free time over Mindful Reflection (free time discussed further in Community Partnership Meeting). This choice seemed to reinforce the idea that the program should consider including weekly hands-on activities during Mindful Reflection; topics and journaling can still be part of this timeframe, but allotting time for even short-duration hands-on activities may make the program more acceptable to the priority population. The same participant noted the "glitter bottle" from Week 1 and that they thought each week would have new "arts or crafts".

Yoga Forms Observation

Yoga forms appeared well accepted; in order: easy seat, neck and shoulder rolls, table top, cat cow, rotating cat/cow, legs up the wall with choice of free form (prompts: self-massaging the legs or knees; stillness; any other choice), then “feet to floor” (whereby the person allows the legs to free-fall to the floor), resting form, easy seat. During resting form, a short (approximately 3-minute) body awareness practice was facilitated before finishing in easy seat.

Lion’s breath (usually as a series of 3 breaths) was offered after easy seat but before Mindful Reflection, which appears to follow a pattern, regardless of the facilitation site (including experiences of the researcher with public classes, adjunct clinical intervention with patients, or otherwise): 1) There seems to be a bit of shock, giggling, and reluctance after the first lions breath. By the second, some of the community joined in. By the third, almost everyone was engaged. In this particular situation, the last lion’s breath was quite the roar (very loud) with virtually full engagement. Participants were observed starting to laugh or smile and look at each other. It appears the breath and the respective perceived “silliness” of it is enjoyed and appears to foster connection among participants. Two or three participants were observed taking deep, long breaths or “sighing” breaths (exhaling with a sigh) after the third lion’s breath, which seems an important observation; this kind of deep, apparently not-conscientious, breathing hasn’t been observed in previous weeks, with few exceptions during yoga forms. Lion’s breath will continue to be offered in future weeks as this particular form of breath seems to reflect high acceptability.

Yoga was only about 20 minutes and Mindful Reflection was also only about 20 minutes long. However, in final resting form (back body in contact with the mat

[Shavasana] or “fetal form”), participants didn’t appear ready to conclude the yoga form part of the intervention session. Typically, during the last resting form during each session, it is relayed during facilitation that you can stay as long as you choose, with no rush, and, in your own time, start slowly moving to a seated form or some other more ‘aware’ form. This week, in particular and noticeably, many volunteers chose to stay in a fetal form for about 5 minutes, which was much longer, by about 3 minutes, than in prior weeks. At end of yoga forms (8:35am), three participants left (see Week 3 Community Partner Meeting).

Mindful Reflection Observation

The attention or awareness at the beginning of Mindful Reflection seemed low. For the participants who chose to leave before Mindful Reflection, the following reasons were provided verbally (though no one asked why they were leaving): One relayed, “I have to be somewhere else” and expressed not wanting to participate without hands-on activities; another participant left and then returned about 10 minutes later and loudly expressed personal details to the direct-care staff technician. The environment can be interrupted through many avenues in the priority population, so future implementation may include agreements to stay the whole time, or, if choosing to come and go then agree to do so in a quiet manner that is courteous to the whole community.

Week 3 Mindful Reflection involves alternating feelings and respective sensations through the following process garnered from experiential learning: 1) Evoking a feeling that is difficult but low in intensity (e.g. irritation) and noticing the respective sensation in the body, 2) Thinking of the feeling’s subjective opposite (e.g. patience) and evoking that opposite feeling and noticing the respective sensation, 3) Evoking both opposite feelings

at once and noticing the sensations in the body. This practice appeared well-received based on volunteer feedback, discussed further below.

Community Partnership Meeting

Daily routine is an integral part of chemical dependency recovery at the facility. Sessions the past two weeks were expedited and Mindful Reflection was shorter than expected, ending early by about five minutes. This adjustment is to respect the schedule and represents shared power of the intervention in the priority population. In addition, the Director and researcher worked together to find solutions for completed post-tests: the Director administered them plus or minus 2 days from each volunteer's last day participating in the yoga program.

A discovery was made during this meeting that there are "levels" at the facility, from Level 1 to Level 4. If a resident is at a Level 2 or higher, a privilege is leaving wellness hour early, at 8:30am promptly, for free time until 9:00am. With a tight routine as an integral part of recovery, this free time seems highly prized and sought after. This seems to largely explain why many volunteers choose to leave at 8:30 am, which corresponds to the end of yoga, before transitioning into Mindful Reflection.

The Director noted that some of the participants would be experiencing withdrawal (as this is a chemical dependency treatment center), and associated cognitive and behavioral outputs; it was noted this may explain some behavior, such as any vomiting, as well as any "erratic" behavior characteristic of chemical dependency recovery, such as anger, tiredness or lethargy. The range of chemical dependency treatment varies from alcohol abuse to methamphetamines and IV-drug use.

Feedback

There were no reported triggers cited, either word or forms, when asking participants for feedback. The following comments reflect acceptability of Week 3: One participant noted they really liked practicing opposite feelings and sensations and that they had “never done that before”. Another participant chose to share, without any prompting, that they were engaging in this same type of practice during therapy with their psychologist and reported “it really helps”. A third participant said they found the opposites useful and they “really like that part of it”, referring to Mindful Reflection. The majority of Week 3 participants are mostly new volunteers.

Additional Notes

1. Program modification

The program, while seemingly high in acceptability based on participant feedback, seems low in feasibility as currently implemented. Given the reality of the short duration of residency in a transitional living facility for chemical dependency recovery, parts of the program that may “build” may need to be minimized while more “stand-alone” practices expand in duration each weekly session.

Some possible changes to future implementation may be: 1) increasing the amount of time per weekly session while simultaneously decreasing number of total weeks. Given multiple late starts or a fluctuating rushed-feelings, allot 1.5 hours for the program sessions as it seems more feasible; 2) Compounding the six weeks into three sessions with longer session times, such as 2-2.25 hours and incorporating yoga

and the activities of two weekly sessions; 3) modifying to a daily-session program for a duration of six days, 4) modifying all material in an equal way where number of weekly sessions corresponds to facility's average length-of-stay for residents.

Pre- and, particularly post-tests, are difficult to procure. Often, a resident is discharged in-between weeks. During the first two-weeks, this resulted in several post-tests not being completed; this is addressed in Week 3 Community Partner Meeting.

While choosing to stay or leave is a participant's choice during any given program session, today occurred the realization that community agreements (such as leaving quietly or keeping shared information confidential) were only proposed and agreed upon during the first week. Given the high turnover of residents, and therefore volunteers, community agreements may need to be reiterated on a weekly basis. This realization occurred when several volunteers chose to leave at 8:30 am for free time, and engaged in loud conversation during their departure.

2. Mindful Reflection Activity Modification

Word spreads quickly throughout the facility pertaining to ongoings inside the residential community. Word about Week 1 activity was spread, which prompted more comments about hands-on activities. Mindful Reflection modifications may be helpful as follows: 1) Journals are still used for theme and respective content of the weekly session (by choice, always), but offering hands-on activities every week for the duration of the last half of Mindful Reflection; 2) Any engagement or hands-on activity may be acceptable, even if the duration is short.

WEEK 4

Beginning

Week 4 began with 12 participants. The room was very crowded and mats were arranged without any distinguishable pattern by participants. When the facilitator walked into the room, at least 5 participants had laid their mats in a row and were all lying down next to each other on their mats. They eventually moved into a seated form and all participants moved their mats to create space for other participants, unprompted.

Yoga Form Observation

Forms were completed in this order: resting form, seated, neck and shoulder rolls, table top, opposite arm and leg, down dog, cobra/sphinx, resting form and body awareness practice. All volunteers participated throughout the yoga practice and there was more space than initially thought. Seemingly a trend, the room starts to quiet and become more engaged after about two yoga forms or during more active forms.

Mindful Reflection Observation

This week, the entire room exited at 8:30 am, except for one Level-1 resident volunteer. Reasons came back to no hands-on activity post-session; the researcher thought the sticky note practice was hands-on, but it turned out that 1) participants didn't know the activity for the day, and 2) free time seems to be valued above all other activities as all who left during observation were Level-2 resident volunteers or higher. Mindful Reflection consisted of one participant and one participating technician. Gratitude sticky notes, imagined to be among a group of participants, ultimately was completed between the participant, the technician and the facilitator. Feedback was good, though the participant expressed wishing others were there with her.

Community Partnership Meeting

Post-tests were discussed with the community partner as collecting them has been more difficult than expected. A community-partner solution was to administer post-tests plus or minus two days from the last day a volunteer participates in the program, which corresponds to participants' discharge days. This has been implemented. However, in this community, post-test logistics need to be deeply considered and planned as residential turnover is high.

Feedback

There were no reported triggers cited, either word or forms, when asking participants for feedback. Aside from feedback noted above, the participant (n=1) during Mindful Reflection noted that they really enjoyed the Week 4 activity. No other feedback was procured for Week 4.

Additional Notes

1. Cost/Materials

Journals and pens get expensive (n=20 participants who have attended at least one session), so including more activities may be cost prohibitive depending on funds available.

2. A Participant Handbook

It may be very useful or supportive to create a sort of Participant Handbook. There are two reasons for this: 1) predictability of the session and orienting to the theme and activity for the week – while this is covered during the recruitment script during consent, a handbook would be useful as likely no participants are memorizing the program session material during that time, and 2) it includes the material and skills

learned, during week(s) of participation and for other weeks, which may support continuity of care and increasing access to resources (e.g. descriptions of how to engage with different breathing techniques).

3. Compensatory items

Some residents participating in the program request compensatory items for other residents who are not participants. This is difficult because of cost and ethics; no residents have been given compensatory items without participating, however, it is difficult to say no and there are requests every week so far. Other participants requested another pen because their ink ran out due to “using it all the time for everything”; while this was only two participants and additional pens were given, this is something that needs to be considered during implementation if costs are a barrier.

WEEK 5

Beginning

Two volunteers from previous weeks participated along with two new participants. Two other participants from previous weeks chose to participate in standard care instead (the other activity during wellness hour).

Yoga Forms Observation

The yoga forms seemed to elicit more engagement than in previous weeks. A medium-sized group (n=4-8) seems to make the sessions more accessible and community-cultivating compared to n=1-3 where too low participation makes take away from some Mindful Reflection activities or n=9+ where high participation is difficult, especially in a smaller room. It is recommended that the total number of people in the study be limited to how many yoga mats can comfortably fit in a circle in the room; while

this may seem obvious, previous weeks with unexpected high attendance caused little space in the room. Sequence was as follows: easy seated, shoulder rolls, neck and head movement, table top, opposite arms and legs, cat/cow, rotating cat/cow, staff form, Marichi's form, butterfly, reclined resting, easy seat.

Mindful Reflection Observation

The singing sound bowl experience was administered this week as there wasn't time in the previous week; this item was iteratively modified to meet the community's needs. Participants appeared to be very engaged in the Mindful Reflection with all observed writing in their notebooks and seemingly processing the material. The time was too short, as commonly seen throughout this intervention, so non-violent communication was talked about but not practiced, as was planned.

Community Partnership Meeting

None held this week.

Feedback

The feedback for the singing bowls was overwhelmingly positive with the following comments recorded, "It felt like so calm and putting me to sleep", "I like the different sounds and how loud and quiet it gets". Another participant relayed after the practice, "I love the way you do yoga. It's so relaxing". These comments seem to reflect high acceptability and possibly therapeutic efficacy.

Additional Notes

No reasons were given for why two participants from previous weeks chose not to participate; one of these participants discharged before Week 6.

WEEK 6

Beginning

One new volunteer participated along with four volunteers from previous weeks. One of these four volunteers participated during all four weeks of their residential stay and appeared extremely engaged throughout each weekly session.

Yoga Forms Observation

The session began in easy seat, followed by shoulder rolls, head and neck rolls, table top, cat/cow, rotating cat/cow, downward dog, plank, cobra, legs up the wall/in the air, resting form, easy seat. A smaller group seems to allow for increased engagement; even individuals at higher levels who were allowed to leave at the 30-minute mark of the session chose to stay; this happened in the week before as well. It is unknown what variables contribute to choosing to stay versus choosing free time, but it was relayed that the activities were engaging.

Mindful Reflection Observation

Harmony, connection, healing, and reminders of learning items in previous weeks were focused on. Each participant appeared very engaged with the Mindful Reflection material, except for one volunteer who chose to stay on their mat (Level 1) and appeared to be dozing in and out; this is supported. Withdrawals or exhaustion may be present in early recovery, and, if their body and brain felt safe or calm enough to fall asleep during practice, then that's a compliment of sorts from my perspective as a facilitator. The healing reminder rocks evoked excitement and volunteers appeared to enjoy picking a

rock (smooth, more like gemstones) to keep as a reminder of connection and choice, and everything they may have learned throughout the program.

Community Partnership Meeting

Demographic information was going to be procured. However, it was at this time that we realized HIPAA for the facility was separate from IRB, so demographic information could not be procured. However, the sample population's primary first language was English, and volunteers were of all different ages. This is unfortunate and future researchers should consider this when implementing at facilities who have high protections for good reason. The reason demographic information was not procured during pre-tests is that administration took an average of 15-20 minutes to complete and volunteers expressed that it felt very long, so we didn't want to add to it; the knowledge of restricted access didn't surface until this week. This must be accounted for in future research.

Feedback

Feedback was overwhelmingly positive by volunteers. Regarding Mindful Reflection, one volunteer said, "I really enjoyed the activities for today". Another commented, "I was so angry and your yoga helped so much. Thank you and please keep doing it", and another said, "Your yoga really helped with my recovery. I'm sad it's over". However, we had a mindful ending with a community breath and talked about how continuity of care would be discussed in more detail the following week.

Additional Notes

None to note.

WEEK 7

“Are you starting yoga again?” was the first comment directed to me when I arrived for Week 7, or, Post Week. I explained that I was there for remaining post-tests and to say goodbye and establish continuity of care. Continuity of care will be via open-access, cost-free, YouTube videos, which was thought to be the best option given the PI facilitator is graduating and moving out of state. Remaining post-tests were gathered as well as the community-partner Director’s completed Advisory Board/Community Partner Questionnaire (Appendix 6).

B. Advisory Board/Community Partner Questionnaire Feedback

The responses of this questionnaire are verbatim (unless bracketed for privacy, confidentiality or other reasons) and organized as presented within the questionnaire (Appendix 6):

a. *“I feel that HCY formed an equitable partnership with [BTC]. The program was well run, and met the needs of the [individuals] in the home. Program instructor was able to accommodate the fast moving attendance in the home and was able to help [individuals] understand the program and purpose of the program”.*

This feedback may best reflect the ability of the program to be iteratively modified in order to meet the needs of the community partner and priority population.

b. *“HCY was very informative about expectations and how the program would fit into our facility. The first and last impressions have been good and enjoyed our partnership”.*

This feedback may best reflect effective methods of communication and creating equitable partnerships.

c. *“I don’t believe the [individuals] were able to participate enough to form an opinion about the effectiveness of the program. I believe more time would have been beneficial. Unfortunately our program is only 30 days long and if the client is detoxing it could have been only 2 maybe 3 times they were able to participate”.*

This feedback is in line with feasibility trends described, regarding modifying the program whereby the frequency is increased or there is less time between sessions and/or longer time periods for each weekly session.

d. *“I believe more advertising of YouTube may have been beneficial for continued follow thru [sic]. I believe the [individuals] have so much going on that many times it is hard to have them follow thru [sic] with the extra curriculum activities. When the bottom of Maslow’s Hierarchy of needs are not met, it is hard to move up the ladder effectively in a short period of time”.*

This is a valid point; however, it seems the type of activities in Mindful Reflection play a role in how effective or well-received a given activity is. As previously described, interactive or novel activities (such as sparkly soothing calm containers or singing sound bowls), rather than sessions that *only* focus on writing and concepts, need to increase while journaling decreases to improve acceptability insofar as the Mindful

Reflection portion. In addition, bottom-up practices involved in the intervention work toward fulfilling the bottom tier of Maslow's hierarchy as previously detailed in the literature review; though it may not be as effective precluding top-down processes, it seems ongoing bottom-up practice may confer some felt sense of either safety or calmness in the body...but maybe not.

e. *“I think the program is wonderful and would be beneficial to have in the public. I feel the group of [individuals] we have here are again, just not quite ready for that level of thinking. Thinking about the benefits of Yoga [sic] comes over time – we have to get them out of crisis first I believe. 30 days is really not enough time to reach that level of processing”.*

This makes sense that crisis isn't conducive to healing, and this is another valid point. However, understanding the practice doesn't comprise the entire practice, and benefits may be experienced aside from meta-cognitive awareness of the intricacies of the practice or program. This seems to solidify less journal/notebook/writing activities, which may take a lot of effort or thought and is not perceived as beneficial during chemical dependency treatment or crisis; again, more interactive activities, especially on the artistic or creative side, rather than writing or journaling, seem indicated.

Overall, the feedback seems very positive. It seems with some changes, such as higher frequency of intervention (more than once per week), more hands-on activities in lieu of, or in conjunction with, writing activities and better dissemination about continuity of care, feasibility, acceptability and therapeutic efficacy may increase to some degree.

C. Quantitative Trends

Research Questions: Is the HCY program intervention feasible, acceptable and therapeutically efficacious to the priority population, as measured by: a) percent of participants who attend each session; b) number of total sessions each volunteer attends; c) field notes; d) participant verbal feedback; e) trends in physiological and psychosocial axes of surveys. Questions c) and d) are detailed above in qualitative trends; questions a) and b) are detailed below.

Acceptability trends are detailed above in qualitative trends, organized by weekly session, via field notes and participant verbal feedback. Percent of volunteers who attend each session is unable to be analyzed as written due to confounding variables, such as length of residential stay, or, number of weeks varying by individual. The number of total session each volunteer attends is divided into a few different categories, in addition to the following measurements, outlined below: total number of completed pre-tests and post-tests; average number of sessions attended, based on program duration (six weeks); average percent of sessions attended, based on program duration (six weeks); average number of yoga sessions attended (not including Mindful Reflection; average percent of sessions attended, based on individuals' duration of residency. The words "sessions" and "weeks" are used interchangeably.

D. Feasibility Trends

Total number of completed pre-tests and post-tests:

All participants completed pre-tests (n=25; 100%). Conversely, post-tests were completed by only 56% of participants. The low number of post-tests were due to a few reasons: n=3 left against staff advice in-between weekly sessions, so did not complete

them; some participants were unsure of their discharge date, so post-tests were not completed before discharge; others declined to complete the post-tests. Post-test administration had to be modified to fit the community partner's needs. As such, some post-tests (n=3) were completed the same day with others completed plus or minus two days from residential discharge.

Average number of sessions attended, based on program duration (six weeks):

Each individual's number of sessions were analyzed out of total number of program sessions. The average number of sessions attended out of the six-week program was 1.35; if individuals who completed pre-tests but never attended the program are excluded from the data, the average number of sessions attended increases to 1.77 (difference of 0.42 sessions). This is in line with community partner feedback, whose Director notes that each individual was only able to attend 2, maybe 3, sessions.

Average percent of sessions attended, based on program duration (six weeks):

The percent of sessions attended for each individual out of a total of six weeks were analyzed, even though the maximum possible number of sessions (due to residency limits of 4 weeks at the facility) attended by any given individual was four sessions. Average percent of sessions attended out of six sessions was 23%. When excluding individuals who participated in zero sessions but completed pre-tests, the average percent rises to 31%.

Average number of yoga sessions attended:

As previously noted, part of this low attendance is due to individuals participating in only the first-half of each weekly session; the average number of sessions attended, when only evaluating yoga attendance (first 30-minutes of each weekly session) is 1.68 (higher than average of total number of sessions attended). When excluding those who completed pre-tests but participated in zero weekly sessions, the average number of those attending yoga only increases to 2.21 (difference of 0.53 sessions), which is about a 10% increase compared to total number of sessions.

Average percent of sessions attended, based on individuals'

duration of residency:

The total number of possible weeks that any individual could attend was four weeks, which meant no one was able to finish the full six weeks; as such, total number of sessions each individual attended was analyzed out of *possible* weeks each individual could attend (based on first session and discharge data; individuals who left against staff advice and did not participate in any weekly session are not included); for example, if a volunteer consented and participated in Week 1, but was discharged before Week 2, then their attendance is 100%. As another example, if an individual attended one full session, two half-sessions, then were discharged between weeks (i.e. total of 3 possible weeks), then their attendance is 2/3, or 66%. The average percent of sessions attended was 59% of possible sessions; when removing individuals who attended zero sessions (i.e. completed pre-tests, but did not participate, and were discharged before the next week), average percent rises to 77%.

E. ACEs Trends in a Chemical Dependency Sample Population

Trends of number of traumas experienced by an individual, as measured by the Adverse Childhood Experiences (ACEs) questionnaire – modified, were evaluated. The average number of traumas experienced by participants was 6.7; median = 7; mode = 10 (n=23 as two respondents chose to not answer). When excluding n=3 individuals who reported zero ACEs, along with n=2 individuals who chose not to answer, the average number of traumas across participants increases to 7.7; median = 9; mode = 10 (n=20). This suggests a strong trend between trauma and chemical dependency behavior, given the limitations of the study.

F. Acceptability Trends

Acceptability trends are largely detailed under qualitative analyses, organized by weekly session. Further trends will be discussed in planned future manuscript(s).

G. Research Questions and Outcome Evaluation in Processing for Manuscript

The outcome evaluation associated with pre- and post-test trends will be outlined in future manuscripts. Preliminary analysis appears to reflect mixed results across measures (pre-and post-tests). Trends in pre- and post-tests were associated with the following research questions:

Are there trends, from pre-to-post HCY program intervention, on: a) autonomic nervous system reactivity and body awareness as measured by the BPQ questionnaire – modified; b) perception of choice, autonomy and community connection or belonging as measured by the Choice and Community Survey; c) involuntary and voluntary cognitive and neurophysiologic processes, during individual responses to stressful situations, that may associate with trends in involuntary and voluntary coping strategies as measured by

the RSQ questionnaire – modified; d) trends from a, b, or c, that correspond with number of traumas exposures experienced by an individual, as measured by the ACEs questionnaire, both intra-individually and in aggregate among the sample population.

These research questions are in process of analysis and will be included in planned manuscript(s), along with question e) from the following research question:

Is the *Healing Centered Yoga (HCY): An Adjunct Clinical Intervention Program and Practice for Healing Trauma*© intervention feasible, acceptable, and therapeutically efficacious to the priority population, as measured by: a) percent of participants who attend each session; b) number of total sessions each volunteer attends; c) field notes; d) participant verbal feedback; e) trends across physiological and psychosocial axes derived from proxy surveys.

15. DISCUSSION

The overall trends of this study reflect 1) high acceptability; 2) low feasibility affecting therapeutic efficacy, but with opportunities to increase feasibility with changes to the program; 3) successful community-partnered study with co-learning and shared power; 4) significant trends in trauma and chemical dependency as comorbid.

Changes to the program to increase acceptability, feasibility or therapeutic efficacy include:

- 1) Increases in hands-on activities, especially those that are creative or novel experiences (e.g. sparkly soothing containers; singing sound bowl experience);
- 2) Higher frequency of sessions – along these lines, perhaps daily 30-minutes practices, with one Mindful Reflection each week, for 4 weeks and up to 6 weeks (in line with how the program is already administered);
- 3) Longer session periods if combining yoga forms and Mindful Reflection in each session;
- 4) Less pre- and post- tests; in addition, substituting out more selective, specific, and empirically based pre/post tests, such as the Multidimensional Assessment of Interoceptive Awareness, Version 2 (MAIA-2) (Mehling, 2018) for the BPQ – modified. This hopefully allows for:
- 5) Collecting demographic data as a trade-off for less time-intensive pre-and post-tests.

It seems that either constant engagement, through body movements or practices involving cognitive tasks, has higher acceptability and feasibility than practices that require a lot of stillness within body or mind. Chemical dependency treatment is when

an individual is in or was in recent crisis, and stillness practices just don't appear to be best practice based on feedback from this sample population. These changes will be made in future implementation. As described in qualitative trends, not all yoga forms were practiced and it turned out to not be feasible to practice one form from each category each week; this was because of time limits and/or because it didn't feel appropriate given the needs of the room respective to each week.

Other iterative modifications included a body awareness practice ("body scan", but HCY doesn't refer to it this way because "scan" may be a trigger word) every week, for about 5 minutes at the end of yoga forms, since feedback was consistently positive regarding the practice. A few people fall asleep during this practice, but that also means the nervous system is calm enough to be able to do so, to some degree, which may also indicate feelings of safety.

Data analyses are still being conducted and remaining results will be written up in planned manuscripts for dissemination.

16. CONCLUSION

Darwin's evolution by natural selection, as expanded on by Tinbergen and clarified by Randolph Nesse with applications through Evolutionary Medicine, offers a solid theoretical foundation on which to evaluate human health traits and vulnerabilities, including those associated with trauma exposure and modes of healing. It provides us with frameworks to better understand why a trait that appears deleterious may develop in the organism as a protective mechanism, such as panic attacks post-childhood abuse. It also may guide us to ask novel questions about how to intervene, treat and heal when evolution is applied appropriately to human health and vulnerability, and when viewed concurrently across multiple fields of science and medicine, which this thesis and applicable research aim to achieve, in part.

The *Healing Centered Yoga (HCY): An Adjunct Clinical Intervention Program and Practice for Healing Trauma*© program has potential to be a therapeutically efficacious intervention with some modifications, such as increased frequency of sessions, longer weekly sessions, or program modification whereby number of sessions match duration of residential stay for chemical dependency treatment or recovery. Alternatively, perhaps a facility where treatment is more ongoing and is available for a longer period of time, rather than for individuals experiencing current recovery and associated symptoms such as withdrawals, may be a better fit for the program as currently written.

In this sample population experiencing chemical dependency treatment with significant reported past trauma exposure, acceptability for the program and

practice seems extremely high according to participant feedback; the exception to this is to decrease time or number of activities involving journaling and cognitive tasks and increase activities that are hands-on, creative or novel.

Results of study show a strong positive trend between chemical dependency treatment and amount, or number of, trauma exposures. This should be validated in more controlled studies, since this may indicate a need for a trauma-informed and -sensitive approaches across chemical dependency treatment and recovery among residential, inpatient and outpatient settings. If actual or perceived safety is lacking in treatment due to a lack of trauma-sensitive care knowledge and application, it seems recovery would be compromised.

Continuity of care should be more carefully planned in future studies. Barriers include the program as new to the priority population whereby options for continuity of care are limited based on the nature of the facility and short-duration of residential stay; in addition, the PI is moving out of the local area soon. Additionally, with a “rolling” sample, contingencies need to be in place to ensure continuity of care on a week-by-week, or, session-by-session basis, rather than only planning for the last week.

1) Limitations

Several limitations are in this research. First, a trade-off was made between a controlled or blinded study and a community partnership. Given the scant number of studies for yoga implementation as community-partnered study as well as in chemical dependency and recovery, it seems valuable information was garnered from this

approach. Second, the program design did not align well with the residential facility's maximum length of stay. Third, pre- and post-tests could be improved through substituting out more rigorous and empirically supported surveys, and, should be reduced in length to better accommodate the priority population. Other limitations include a non-steady, fluctuating and small sample size; no control group – a trade-off for this community partnership; inclusion criteria was minimized as a trade-off for increased accessibility to the priority population. There are other limitations to the study, which will be discussed in future manuscript.

2) Implications for Future Research

Several implications have been discussed for future research throughout this thesis. However, this program is currently being implemented at a second site with modifications from this study incorporated along with iterative modifications for the second site's community partner and respective facilitation. The second site's sample population is adolescents experiencing chemical dependency treatment, but in outpatient (not residential) treatment and volunteers may be in the program for up to one year. It is being implemented as a yoga therapy intervention at this second site. Preliminary results reflect much higher feasibility; a detailed account of this research is planned for future dissemination in manuscript.

Future research may include a control group in standard care whose only voluntary role would be filling out pre- and post-tests congruent with the treatment group receiving HCY yoga facilitation; shortened pre- and post-tests overall, which are more focused and selective; community partner studies in similar sample populations regarding

feasibility and how yoga program interventions are best facilitated for therapeutic efficacy within a residential chemical dependency treatment paradigm with a short duration.

Overall, the results of this intervention are promising. There was a lot to learn from both sides of the academic-community partnership, but it was a productive relationship with obvious co-learning and an equitable partnership and shared power throughout the duration of implementation. The primary limiting factor to acceptability of intervention in a residential chemical dependency treatment facility appears to be design of the program whereby sessions are too infrequent and hands-on activities need to be increased while notebook activities are decreased. The primary limiting factor to feasibility of intervention appears incongruency between length of residential stay for recovery and length of the yoga intervention program (too long overall, not frequent enough throughout). These are fairly simple modifications because the HCY program intervention design was specifically created to be iteratively modifiable to meet the community partner and/or priority population's needs; the goal is that such future modifications will reflect significant increases in feasibility, hopefully increasing the probability of therapeutic efficacy in future priority populations.

APPENDIX

1. Adverse Childhood Experiences Questionnaire

PRE TEST ONLY

ADVERSE CHILDHOOD EXPERIENCES (ACE) QUESTIONNAIRE - adapted

Adapted by: Heather Saxon, M.A. & Elizabeth Modde, MSIII, 2019

Many of us experience stressful life events that can affect our health and wellbeing. Acknowledging that traumatic events impact our long-term health can help us realize what is complicating our health situations.

The results from this questionnaire will be kept confidential and responses will contribute to understanding how to best support the health and wellness of you and your community.

Please read the statements below. Count the number of statements that apply and write the total number on the line provided. Please DO NOT mark or indicate which specific statements apply to you.

Section 1. ACEs

Think about your life as a **child** (before age 18).

1) Of the following, HOW MANY applied to you before age 18?

Write the total number ____

Which of these happened to you before age 18...

- My parents or guardians were separated or divorced
- I lived with a household member who served time in jail or prison
- I lived with a household member who was depressed, mentally ill or attempted suicide
- I saw or heard household members hurt or threaten to hurt each other
- A household member swore at, insulted, humiliated, or put you down in a way that scared you OR a household member acted in a way that made you afraid that you might be physically hurt
- Someone touched your private parts or asked you to touch their private parts in a sexual way
- You went without food, clothing, a place to live, or had no one to protect you
- Someone pushed, grabbed, slapped or threw something at you OR you were hit so hard that you were injured or had marks
- You lived with someone who had a problem with drinking or using drugs
- You often felt unsupported, unloved and/or unprotected

2) Of the following, HOW MANY applied to you before age 18?
Write the total number ___

Which of these happened to you before age 18...

- You were in foster care
- You experienced harassment or bullying at school
- You lived with a parent or guardian who died
- You were separated from your primary caregiver through deportation or immigration
- You had a serious medical procedure or life threatening illness
- You often saw or heard violence in the neighborhood or in your school neighborhood
- You were often treated badly because of race, sexual orientation, place of birth, disability or religion

2. Body Perception Questionnaire

BODY PERCEPTION QUESTIONNAIRE - adapted **(Kolacz, Holmes & Porges, 2018).**

Please read the following questions and answer them based on how you've felt the past few weeks. Please use the numbers below for your answer.

| |
|------------------|
| 1 = Never |
| 2 = Occasionally |
| 3 = Sometimes |
| 4 = Usually |
| 5 = Always |

Body Awareness – VSF (very short)

| | <i>Number</i> |
|-----------------------------------------------------------|---------------|
| 1. I feel my mouth being dry. | _____ |
| 2. I feel how fast I am breathing. | _____ |
| 3. I feel swelling of my body or parts of my body. | _____ |
| 4. I feel muscle tension in my arms and legs. | _____ |
| 5. I have a bloated feeling because of water retention. | _____ |
| 6. I get goose bumps. | _____ |
| 7. I have stomach and gut pains. | _____ |
| 8. I feel stomach distension or bloatedness. | _____ |
| 9. I get a tremor in my lips. | _____ |
| 10. I feel the hair on the back of my neck "standing up". | _____ |
| 11. I feel an urge to swallow. | _____ |
| 12. I feel how hard my heart is beating. | _____ |

Subdiaphragmatic Reactivity - adapted

| | |
|--------------------------------------------|-------|
| 1. I have "sour" stomach. | _____ |
| 2. I feel like vomiting. | _____ |
| 3. I am constipated. | _____ |
| 4. I have indigestion ('heart burn'). | _____ |
| 5. After eating I have digestive problems. | _____ |
| 6. I have diarrhea. | _____ |

Supradiaphragmatic Reactivity – adapted (numbered by questions procured in the original BPQ)

| | |
|---------------------------------------------------------------------------------|-------|
| 1. I have difficulty coordinating breathing and eating. | _____ |
| 3. My heart often beats irregularly. | _____ |
| 4. When I eat, food feels dry and sticks to my mouth and throat. | _____ |
| 6. I feel shortness of breath. | _____ |
| 7. I have difficulty coordinating breathing with talking. | _____ |
| 10. I gag from the saliva in my mouth. | _____ |
| 11. I have chest pains. | _____ |
| 13. When I talk, I often feel I should cough or swallow the saliva in my mouth. | _____ |
| 14. When I breathe, I feel like I cannot get enough oxygen. | _____ |
| 15. I have difficulty controlling my eyes. | _____ |

3. Responses to Stress Questionnaire

RESPONSES TO STRESS QUESTIONNAIRE (RSQ) – ADAPTED
(Connor-Smith et al., 2000).

a. Think about which of these things have happened with other people in the past year (Check all that apply):

- Being around people who are rude Fighting with other people
- Not having as many friends as you want Having problems with a friend
- Having someone stop being your friend Being left out or rejected
- Being teased or hassled by other people Asking someone out and being turned down
- Feeling pressured to do something Other, not listed: ___ _____

b. Circle the number that shows how stressful, or how much of a hassle these problems were for you (please just circle one number).

- | | | | |
|------------|----------|----------|------|
| 1 | 2 | 3 | 4 |
| Not at all | A little | Somewhat | Very |

c. Below is a list of things that people sometimes do, think, or feel when something stressful happens. Everybody deals with problems in their own way—some people do a lot of the things on this list or have a bunch of feelings, other people just do or think a few things. **Think of the situations you just checked off. For each item on the list below, circle one number from 1 (not at all) to 4 (a lot) (like the number scale below) that shows how much you do or feel these things when you have problems with other people,** like the ones you just checked off.

NUMBERS

- 1 = Never
2 = A little
3 = Some
4 = A lot

Involuntary Engagement

a. Physiological Arousal

Number

1. When I have problems with other people I feel sick to my stomach or get headaches. _____

2. I get really jumpy when I'm having problems getting along with other people. _____

3. When I have problems with other people, I feel it in my body. _____

(Remember to **fill in a number**, then **Check all that happen**):

My heart races

My breathing speeds up

I feel hot or sweaty

My muscles get tight

None of these

b. Emotional Arousal

4. When I have problems with other people right away I feel really: _____

(Remember to **fill in a number**, then **Check all you feel**):

Angry

Sad

Scared

Worried/anxious

None of these

c. Involuntary Action

5. When problems with other people happen, I can't always control what I do. _____

(Remember to **fill in a number**, then **Check all that happen**):

I can't stop eating

I do dangerous things

I can't stop talking

I have to keep fixing/checking things

None of these

Involuntary Disengagement

a. Emotional Numbing

6. When problems with other people happen: _____

(**Check all that happen. If you check an item** remember to **fill in a number** next to it):

I don't feel anything at all. _____

I really don't know what I feel. _____

I don't feel like myself – it's like I'm far away from everything. _____

b. Cognitive Interference

7. When I have problems with other people: _____

(**Check all that happen. If you check an item** remember to **fill in a number** next to it):

My mind just goes blank and I can't think at all. _____

- It's really hard for me to concentrate or pay attention. _____
- When a rough situation happens with other people,
I get so upset that I can't remember what happened or what I did. _____

c. Inaction

8. When I'm having problems with other people:
(**Check all that happen. If you check an item** remember to **fill in a number** next to it):

- I just end up lying around or sleeping a lot. _____
- I just freeze, and I can't do anything. _____
- I can't seem to get around to doing things I'm supposed to do. _____

d. Escape

9. When I have problems with other people:
Check all that happen (then remember to **fill in a number** next to it):

- I just have to get away – I can't stop myself. _____
- I can't be near anything that reminds me of the situation. _____
- I just can't get myself to face the person I'm having problems
with or the situation. _____

Primary Control Engagement Coping

a. Problem Solving

10. When I have problems with other people:
Check all that you do (then remember to **fill in a number** next to it):

- I try to think of different ways to change the problem or fix the situation.
Write **one plan** you thought of: _____
- I ask other people for help or for ideas about how to make the problem better. _____

Check all you talked to:

- | | |
|----------------------------------------|---------------------------------------------------|
| <input type="checkbox"/> Parent | <input type="checkbox"/> Sibling (sister/brother) |
| <input type="checkbox"/> Friend | <input type="checkbox"/> Therapist/psychologist |
| <input type="checkbox"/> None of these | |

- I do something to try to fix the problem or take action to change things.
Write one thing you did: _____

b. Emotional Regulation

11. I do something to calm myself down when I'm having problems with other people.

Check all that you do (then remember to **fill in a number** next to it): _____

- | | |
|--------------------------------------------|-------------------------------------------------------|
| <input type="checkbox"/> Take deep breaths | <input type="checkbox"/> Listen to music |
| <input type="checkbox"/> Take a break | <input type="checkbox"/> Practice yoga or Mindfulness |
| <input type="checkbox"/> Walk | <input type="checkbox"/> Meditate |
| <input type="checkbox"/> None of these | <input type="checkbox"/> Other, not listed: _____ |

12. I keep my feelings under control when I have to and then let them out when they won't make things worse. _____

Secondary Control Engagement Coping

a. Cognitive Restructuring

13. When I'm having problems with other people:

Check all that apply to you (then remember to **fill in a number** next to it):

- | | |
|------------------------------------------------------------------------------------------------------------------------------|-------|
| <input type="checkbox"/> I tell myself that things could be worse. | _____ |
| <input type="checkbox"/> I tell myself that it doesn't matter, that it isn't a big deal. | _____ |
| <input type="checkbox"/> I think about the things I'm learning from the situation, or something good that will come from it. | _____ |

Primary Control Disengagement Coping

a. Denial

14. When I have problems with other people:

Check all that you do (then remember to **fill in a number** next to it):

- | | |
|---------------------------------------------------------------------------------------------------------|-------|
| <input type="checkbox"/> When I'm around other people I act like the problems never happened. | _____ |
| <input type="checkbox"/> When something goes wrong with other kids, I say to myself, "This isn't real." | _____ |
| <input type="checkbox"/> I try to believe it never happened. | _____ |

Secondary Control Disengagement Coping

a. Distraction

15. When I have problems with other people:

Check all that you do (then remember to **fill in a number** next to it):

- | | |
|---------------------------------------------------------------------------------------------------------|-------|
| <input type="checkbox"/> I think about happy things to take my mind off the problem or how I'm feeling. | _____ |
| <input type="checkbox"/> I imagine something really fun or exciting happening in my life. | _____ |
| <input type="checkbox"/> I keep my mind off problems with other people by: | _____ |

Check all that you do:

- | | |
|-----------------------------------------|------------------------------------------------|
| <input type="checkbox"/> Exercising | <input type="checkbox"/> Playing video games D |
| <input type="checkbox"/> Seeing friends | <input type="checkbox"/> Doing a hobby |
| <input type="checkbox"/> Watching TV | <input type="checkbox"/> None of these |

4. Choice and Community Survey

- 1 None of the time
- 2 Some of the time
- 3 Most of the time
- 4 All of the time

Pre and Post Test:

- 1. I feel like I have a lot of choices in my life. _____
- 2. I feel like I have 100% control over my body. _____
- 3. I feel connected to (defined) community. _____
- 4. I feel a sense of belonging in my community. _____
- 5. I feel that I have the resources I need to stay clean. _____
- 6. I can feel the sensations on the outside of my body
(e.g. the air on my skin; sounds around me). _____
- 7. I can feel the sensations on the inside of my body
(e.g. my stomach growling when I'm hungry
or my heart beat during certain emotions). _____
- 8. I am a competitive person. _____
- 9. I am a generous person. _____
- 10. I bump into things or people. _____

POST-TEST ONLY

Post Test Only:

- 1. Healing Centered Yoga program is a part of my wellness. _____
- 2. I plan to continue practicing HCY once the program is over. _____
- 3. I have the resources to continue practicing HCY once the program is over. _____
- 4. I feel I have full control over my body in HCY. _____
- 5. I feel I have a lot of choices during HCY. _____
- 6. I feel HCY has contributed to my healing process. _____

5. Healing Centered Yoga (HCY): An Adjunct Clinical

Intervention Program and Practice for Healing Trauma©

SESSION 1 **SELF-LOVE FOR HEALING**

- **30 minutes HCY (forms and breathing) + Progressive Muscle Relaxation**
- **5-minute transition**
- **25 minutes Mindful Reflection**
- **Reflection Topic(s): Self-Love and Self-care Choices**
- **Activity: Sparkly Soothing Container (water bottles + water + glitter + glue)**
 - Get empty water bottle, fill ¾ water, add a few tablespoons of extra-fine glitter; then, fill to 2-inches from top of bottle with liquid glue; glue top back on; swirl it around.
 - Use as analogy for the brain as a socioemotional learning practice; may also serve as an anxiety-reduction support.
- **Supplies:** Empty water bottles, liquid clear glue, fine or extra-fine glitter, plastic bags/small towels/paper towels (for individual “work stations” and easy clean-up), journal notebooks and pens.
- **Session Quote:**

“Self-care is never a selfish act...Anytime we can listen to [our] self and give it the care it requires, we do it not only for ourselves, but for the many others whose lives we touch” – Parker Palmer

1. Likes/dislikes/trigger words or forms – 5 minutes

2. Self-care – 10 minutes

- Sparkly Soothing Container →**Begin activity while continuing with Mindful Reflection:**
- Things we may find comforting, which are self-care: a favorite item, reading, self-massage, bath, listening to music, dancing, art (Notebook).
- Things we may not find comforting but are still self-care: getting out of bed when we feel tired, showering when we don’t feel like it, opening our bills even though we may feel scared, giving our bodies water and food (Notebook).
- **Comfort Forms** (Levine, 2017)
 - a. Comforting Container:
 - If you like, as you’re ready, take your right hand and place it underneath your left arm, on your side body. Then, place the left hand on the right shoulder.
 - Do you feel more aware of your body? Maybe like it’s a container?

“This helps us become aware of our container...The body is the container of all our sensations and all of our feelings. It’s all in the body... When we can feel our body as the container, then the emotions and the sensations [may] not feel as overwhelming – they’re being contained. (Levine, 2017).

- **b. Heart and Brain:**
 - Place one hand on your forehead. Then, place the other hand over the upper front body, in the middle (by your heart). Choose eyes open or closed, or somewhere in between like a soft gaze.
 - What do you sense is going on between the hands? Anything? Do you sense some sort of a shift? Stay as long as you like in this form.
- **c. Heart and Belly:**
 - Place one hand on your belly. Then, place the other hand over the upper front body, in the middle (by your heart).
 - Do you sense a connection with your body, or, the feeling that your body is your container?

3. Our Glitter Brain and Body Container – 5 minutes

- Our container, or body, is like the water bottle. The glitter is all the thoughts, feelings and emotions that our bodies – our containers – hold. We can think of the water as a still place that we always have in our brains.
 - The glitter is always in the bottle, just like our thoughts, feelings, and sensations are always in our body container...
 - Which Comfort Form(s) or self-care actions feel supportive or useful for you – or that you’re just curious about?
 - Do you think any of these may support you when you feel distressed, upset, overwhelmed, anxious, or some other feeling?
 - Something to help the thoughts, feelings, emotions (glitter) gently start to settle in the body (like the container)?
 - Do any support you in feeling more aware of your body (your container)?

4. Self-Love – 5 minutes

- “My Whole Heart Desire”
 - Your ultimate “why” for getting up, moving, living, etc. (Notebook)
- Showing up for self
 - *“We don’t have to show up perfect, we just have to show up”.*

- What does it mean to show up for our Self? How can we practice Self-Love in showing up for ourselves?
 - Some other practices that may support us in showing up in ways that are healing for our Self and others:
 - Intentions and Affirmations
 - Daily Practice (Notebook)
 - Gratitude
 - Daily/Nightly Practice (Notebook)
- 5. Mindful Ending – 2 minutes: From Our Mat To Our World**

SESSION 2

BREATHING FOR HEALING

- **30 minutes HCY (forms and breathing) + Body Awareness Practice**
- **5-minute transition**
- **25 minutes Mindful Reflection**
- **Reflection Topic(s): Breathing Choices; Nervous System Overview and Breathing**
- **Activity: Breathing Techniques Practice**
- **Supplies: No additional supplies.**
- **Session Quote:**

“Does your breath work? I know it is air entering. And leaving you. But are you breathing. Are you alive. Is it working”?

– Nayyirah Waheed

1. Likes/dislikes/trigger words or forms – 5 minutes

2. Soothing Sigh Breathing – 3 minutes

- Take a deep inhale in for 4 seconds, exhale for 5 seconds with an audible (or silent) sigh.
- Do you notice any sensation in your body as you inhale in and sigh the breath out?
 - Prompt: e.g. the belly stretch; the body easing a bit; something else? Maybe it’s nothing, and that’s perfect too.
- Repeat as many times as you choose.

3. Heart-Focused Breathing – 3 minutes

- Place both hands over the heart, breathe in through the nose for 3 seconds, breathe out through the mouth for 5 seconds. May exhale with a sigh.
- Think of the breath filling your heart and releasing what no longer feels supportive or useful, if you choose; or, maybe breathe while thinking of your Wholehearted Desire. Or choose whatever feels supportive for your body and brain.
- Repeat as many times as you choose.

4. Hummingbird Breathing – 3 minutes

- Breathe in through the nose. Place tip of tongue on roof of mouth. Making a hummingbird sound when you breathe out (through mouth or lips).
- Repeat as many times as you choose.

5. Cooling Moment Breathing – 3 minutes

- As you inhale, make a circle with the tongue by curling up both sides making tunnel. Breathe in through the tunnel through your mouth.
- Notice whether the breath feels cool when you breathe in.
- Exhale through the nose just a bit longer than you inhaled – you can release the tongue from its tunnel-shape if you choose, for the exhale.
- Repeat as many times as you choose.

6. Alternate Nostril breathing – 3 minutes

7. Notebook: What’s your favorite breathing choice, if any? When do you think you would choose to practice certain kinds of breathing? During certain emotions or body sensations? (Notebook) – **3 minutes**

8. Mindful Ending – 2 minutes: From Our Mat To Our World

SESSION 3

YOUR BODY | YOUR CHOICE FOR HEALING

- **30 minutes HCY (forms and breathing) + Body Awareness Practice**
- **5-minute transition**
- **25 minutes Mindful Reflection**
- **Reflection Topic(s): Choice, Agency, Empowerment**
- **Activity: Opposite Sensations, Opposite Feelings and Connection**
- **Supplies:** Blank paper (three sheets per person + 1 for community), glue sticks or liquid glue, glitter (leftover from previous weeks), paper bags/plastic bags/towels (for individual “work stations” and easy clean up), journals and pens.
- **Session Quote:**

“Yoga must not be practiced to control the body. It is the opposite:

It must bring freedom to the body –

All the freedom it needs”.

-Vanda Scaravelli

1. Likes/dislikes/trigger words or forms – 5 minutes

2. Opposite Feelings – Mindful Choices - 4 minutes

- Sad/Content, Sad/Happy, Angry/Restful, Angry/Calm, Anxious/At Ease, Anxious/Content, Irritated/Patient, Restless/Restful.
- Subjective to each individual.

3. Opposite Sensations – Mindful Choices - 4 minutes

- Hot/Cold, Warm/Cool, Sharp/Dull, Burning/Cold, Tingling/Neutral.
- Subjective to each individual ’s body.

- Body map* with glitter (one color for each opposite feeling, for two colors total).
 - Write associated feeling out in words next to the glitter denoting body sensations.

4. Connecting Opposites – Feelings and Sensation – 8 minutes

- Pick one feeling. One that isn't too intense for your body (e.g. prompt: irritation, not rage). What is it's sensation in the body, if any?
- What is the opposite of that feeling *for you*? What and where is the opposite sensation in the body, if any?
- If you like, try to notice the body sensations for both feelings at the same in the body. What is it like?
- As you're ready, if you like, can you switch back and forth between the sensations and feelings? If so, how does that make you feel or what do you sense?
- Whatever you feel or sense is perfect.
- Repeat this process however many times you choose, by choosing a different feeling or the same one and noticing body sensations that happen with those feelings.
- Body map with glitter (one color for each opposite feeling, for two colors total).
 - Write associated feeling out in words next to the glitter denoting body sensations for BOTH opposites when experienced at the same time.

5. Community Body Map

- Combine all feelings and sensations of the whole community onto one map with associated feelings written out as associated with body sensations denoted in glue/glitter.

6. Reflection – 5 minutes

- Sometimes thoughts are just thoughts, but it doesn't mean we always have to act on them.
- Sometimes, feelings are intense, but can we practice a balance of letting ourselves feel while understanding we can choose to perceive them differently, or, maybe evoke different sensations in our bodies.
- Does it feel supportive or healing to use your breath as an "anchor" if the feelings or thoughts or emotions (glitter in the container) becomes overwhelming? If not, what does feel supportive or useful?

7. Mindful Ending – 2 minutes: From Our Mat To Our World

***Body Map(s):** Three sheets of blank white paper or construction paper. Draw out an outline of a body – it doesn't need to be pretty, just resembling head, torso, arms and hands, legs and feet. Label "front body" on one side and "back body" on other side; repeat for all 3 sheets of paper. Then, by paper: 1) Write "First feeling/sensation", 2) Write "Opposite feeling/sensation, 3) Write "Both opposite feelings/sensations at the same time". Use glue sticks or liquid glue while each individual "draws" the sensation in their body on their body map – then sprinkle glitter over the glue (remembering each

feeling/sensation and its opposite are denoted by two different colors). Each individual can see what everything looks by side-by-side. Allow enough time for glue to dry (glue sticks dry faster).

SESSION 4

COMMUNITY CONNECTION FOR HEALING

- *30 minutes HCY (forms and breathing) + BODY AWARENESS PRACTICE*
- *5-minute transition*
- *25 minutes Mindful Reflection*
- *Reflection Topic(s): Gratitude for Self and Others - Connection*
- *Activity: Sticky Notes of Gratitude*
- *Supplies: 1-2 packs of sticky notes; colorful pens*
- *Session Quote:*

*“Connection and connectedness
are just other words for
community and communion”
-Parker Palmer*

1. Likes/dislikes/trigger words or forms – 5 minutes

2. Giving Gratitude – 20 minutes

- Take a pack of sticky notes and a pen or pencil. Please don't write your name or anyone else's name as we're going to stay anonymous – unless you choose differently.
 - On the first sticky note, write one thing you're grateful for, **about someone in this room**. On a different sticky note, write one thing you're grateful for in your life, **about someone or something not in this room**. On a third sticky note, write one thing you're grateful for **about yourself**. Write as many sticky notes for each category as you wish; invite individuals to write at least three, with one from each category, but any choice is perfect. When you've written all the sticky notes you like, place them all over the poster board wherever you like! Be mindful not to cover the words on others' sticky notes! (Note: free space on a wall is perfect to place sticky notes, if a poster board isn't accessible).
 - Now, however many sticky notes you posted, choose that same number from any of the sticky notes on the poster board/wall (not necessarily the ones you wrote).
 - Why did you pick the ones you picked?
 - Go around and let each human read their sticky notes and how they chose them. Did it just “speak” to them? Is it something they identify with? Something they want to

be? Something different? There's no right or wrong answers.

3. Community Connection Breathing – 8 minutes

- Choose any comfortable form, and if you like, form a circle as a group.
- If it feels supportive or useful, gently place one hand on your stomach and one hand over your heart. Or, place your hands wherever feels supportive.
- As guided, inhale all together, and exhale all together (repeat x3-5).
- If you like, share any feelings or sensations from breathing as a community, if any. Sharing is not required. Whatever you choose is perfect.

4. Non-Violent Communication – 10 minutes

- 5-Step Process: Reflect on current challenge; state facts; express feelings; state needs; make request (Kashtan & Kashtan, n.d.).
- Might this assist in matching the outside and inside experiences?

5. Mindful Ending – 2 minutes: From Our Mat To Our World

SESSION 5

SOCIAL JUSTICE FOR HEALING

- **30 minutes HCY (forms and breathing) + BODY AWARENESS PRACTICE**
- **5-minute transition**
- **25 minutes Mindful Reflection**
- **Reflection Topic(s): Wellness as a vehicle for change; diversity and belonging**
- **Activity: Notebook – Justice and Non-Violent Communication; Singing Bowl Sound Experience (“sound bath”/“sound healing”)**
 - **Supplies:** Singing bowl set (crystal used by founder, but any set of different material is just as perfect); examples of non-violent communication.

NOTE: 1. Singing Bowl Sound Experience – 10 minutes

This immediately follows Body Awareness Practice while individuals are still in resting form from yoga practice. Continue guiding the room through breathing and awareness while setting up sound bowls – make any sound part of the practice of witnessing.

- **Session Quote:**

“I want to say thank you to the rare few individuals in my life, who have listened without judgment, spoken without prejudice, helped me without entitlement, understood without pretension, and loved me without conditions”.
-Yakub Shaikh

2. Likes/dislikes/trigger words or forms – 5 minutes

3. Our Living World – 15 minutes

- **If you like, write down one bias you may have identified about yourself in your notebook. Are there any body sensations or feelings that go with that bias? Feel free to write it in your notebook.**
 - What can you do to redirect your bias toward understanding it?
 - Are there any ways you can take action in your community or daily life?
 - **Now, write down what feelings or body sensations you experience when you feel or think about the word “justice”, if any.**
 - “Justice in my body feels like the capacity to breathe and move freely in my body and space. Justice in my body looks like me having full control over when and how I give consent. It feels like me being unapologetic for being me and having space to fully express myself. Justice in my body feels like complete alignment physically, emotionally, mentally...”.
– Michelle Cassandra Johnson (Johnson, 2017).
- 4. Fitting In versus Belonging – 5 minutes**
- Holding space versus making space.
 - What does it mean for you to “fit in” versus “belong”?
- 5. Mindful Ending – 2 minutes: From Our Mat To Our World**

SESSION 6

HARMONY FOR HEALING

- **30 minutes HCY (forms and breathing) + BODY AWARENESS PRACTICE**
- **5-minute transition**
- **25 minutes Mindful Reflection**
- **Reflection Topic(s): Union; Harmony**
- **Activity: My Healing Reminder Rock; Daily Practice; Certificates of Completion**
- **Session Quote:**

*“Happiness is when
what you think, what you say, and what you do
are in harmony”.*
— Mohandas Gandhi

- 1. Likes/dislikes/trigger words or forms – 5 minutes**
- 2. Yoga = “Yoke” = Unity/Union = Harmony – 8 minutes**
 - Self with Self – Internal thoughts and external actions match
 - Self with Community
 - Self with Nature
- 3. Remember the still water and body container from Session 1?– 7 minutes**
 - Contributing to *healing*
 - *Growth and resilience* are important, but *healing* is just as important

- Healing v. Growth v. Resilience
- The importance of all three, and cultivating all three.

4. My (Healing) Rock – 7 minutes

- **Pick your own Healing *Reminder Rock!***
- Connection to self
- Connection to community
- Connection to that still water and body container
- Connection between external and internal
- Connection to _____ (Notebook)

5. 3-Minute Personalized Daily Practice – 8 minutes

- Short, so you can do it at any time; 1-5 minute practice.
- Consider including:
 - One breathing choice (from Session 2)
 - Intention
 - Affirmation
 - Gratitude
 - Other options

○ **6. Certificates of Completion + Mindful Ending – 8 minutes**

6. Advisory Board/Community Partner Questionnaire

ADVISORY BOARD/COMMUNITY PARTNER QUESTIONNAIRE

a. Do you feel that HCY formed an equitable partnership with McCambridge Women and Children's Center, from the beginning to the end of the intervention program?

If yes:

- Please elaborate and give examples of how the partnership was equitable:

If no:

- Please elaborate and give constructive feedback on how the HCY program and founder/facilitator can cultivate a more equitable partnership:

If both:

- Please elaborate and give examples of both.

b. Do you feel that HCY is/was an effective collaborative partnership, from the first meeting/communication to the end of the intervention program?

If yes:

- Please elaborate and give examples of how the partnership with HCY program and founder/facilitator was effective and collaborative.

If no:

- Please elaborate and give constructive feedback on how the HCY program and founder/facilitator can cultivate a more effective and collaborative partnership.

If both:

- Please elaborate and give examples of both.

c. Do you think McCambridge Women and Children's Center community members who voluntary chose to participate in the HCY-week intervention benefitted from the program?

If yes:

- How so, or, in what ways?
- What have you observed or heard to support your opinion?

If no:

- How so, or, in what ways?
- What have you observed or heard to support your opinion?

d. Do you think the HCY practice is sustainable for current members or alumni of McCambridge Women and Children's Center, after the program intervention, and after community-partnered solutions?

If yes:

- What method of delivery do you think is best for HCY sustainability (e.g. YouTube channel; live audiovisual streaming or conference calling [Zoom/Skype]; other).

- How do you think HCY can become more sustainable for members of McCambridge Women and Children’s Center and individuals who are part of communities similar to McCambridge Women and Children’s Center?

If no:

- What method of delivery do you think would contribute to HCY sustainability?
- How do you think HCY can become more sustainable for members of McCambridge Women and Children’s Center and individuals who are part of communities similar to McCambridge Women and Children’s Center?

e. Would you recommend the **Healing Centered Yoga (HCY): An Adjunct Clinical Intervention Program and Practice for Healing Trauma**© program?

If yes:

- To which communities or populations? Why or why not?
- To the general public? Why or why not?
- What was the best part of the program? Why?
- What part of the program could benefit from modifications or adjustments?
 - Why?
 - Which modifications or adjustments do you recommend?

If no:

- Why don’t you recommend the program?
- What changes for the program would you recommend, so you’re more likely to recommend in the future?
 - What solution or solutions would you recommend for stated changes?
 - Are the solutions different based on the population/s you would recommend HCY to, if recommended changes/modifications/adjustments are made?
- What was your least favorite part of the program? Why?
- What was the best part of the program?
 - Why?
 - Would you keep this best part in conjunction with your stated recommendations above? Or, would you change it? Why or why not?

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VITA

Heather Saxon was raised in Albuquerque, New Mexico and graduated from La Cueva High School in 2004. Heather started undergraduate classes in May 2004. In May 2008, she earned her Bachelor of Science from the University of New Mexico in psychology, minoring in biological anthropology. During her undergraduate studies, she worked full-time at a local non-profit serving individuals experiencing homelessness, trauma, and severely disabling mental health illnesses; she remained dedicated to this work for approximately seven years. After graduation, she explored two long-time passions: professional photography and freelance writing for the arts section of a local newspaper in Albuquerque, the Local iQ, for a handful of years. In June 2012, Heather began cognitive, clinical and translational neuroscience research with Dr. Vincent Clark where they investigated learning and memory using tDCS methods, as well research for individuals experiencing blepharospasm and low-invasive interventions for symptom mediation and reduction using fMRI methods. In August 2014, Heather began graduate studies at the University of Missouri on a 5-year fellowship. During this time, she collaborated with three departments on mindfulness research for doctoral and law students. She earned her M.A. in May 2016 with a focus on mindfulness for homeless adolescents. In August 2017, Heather conducted neurophysiology research on the anterior pituitary and stress for about one year. In July 2019, Heather earned the title E-RYT-200 (Experienced-Registered Yoga Teacher) specializing in yoga as a healing intervention for trauma exposure among adolescents and adults. She will earn her Master of Public Health through the School of Health Professions and Graduate Certificate in Participatory Health Research through the Sinclair School of Nursing in December 2019.