

NEUROSCIENCE *and* PEACEBUILDING

Exploring the Neurobiological Dimensions of Violent Conflict
and the Peacebuilding Potential of Neuroscientific Discoveries

PART III: TRAUMA

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NeuroPeace is an online, open-source series focusing on research and practice at the nexus of neuroscience and peacebuilding. *NeuroPeace* includes articles and essays by scholars and practitioners exploring how neuroscientific insights can inform peacebuilding processes, including supporting dialogue, fostering reconciliation, and preventing violence, as well as addressing the fundamental causes of harmful conflict and barriers to lasting peace.

This part of *NeuroPeace* is the third of three-parts of an edited volume that brings together a group of researchers in neuroscience to share—in an accessible and engaging way—their work and how it might be relevant to those working to prevent wars, terrorism, and violent conflict, and to help societies and individuals heal in the aftermath of violence. The series covers a range of topics grouped under three broad themes: Individual Aggression (*NeuroPeace* No. 1), Group Dynamics (*NeuroPeace* No. 2), and Trauma (*NeuroPeace* No. 3).

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Transmission of the Effects of Trauma across Generations

Implications for Individuals and Society and Its Role in Violent Conflict

Ali Jawaaid and Isabelle M. Mansuy

Life experiences are important determinants of our behaviors. While positive experiences, such as having a loving family, a stress-free work environment, and harmonious social interactions are beneficial, negative experiences, such as poor living conditions and traumatic events, can impair the quality of life. Notably, psychological trauma, defined as an overwhelming stress that is beyond an individual's ability to cope, can have long-lasting effects on mental and physical health. Such experiences affect the exposed individuals and increase their susceptibility to diseases and may also affect their offspring, in some cases across several generations, even when these offspring have not been exposed to any trauma themselves.¹ This mode of inheritance challenges the conventional concept of heredity that was thought to implicate only genetic factors. It does not depend on the DNA sequence that serves as the genetic code, but rather implicates mechanisms that alter the activity of the genetic code without changing the sequence; this is known as epigenetics. These pathways are activated in response to different environmental exposures, and their change can be stably transmitted to the offspring and lead to specific traits in this offspring, sometime across generations.² This form of transmission is called transgenerational epigenetic inheritance (TEI) when affecting individuals across multiple generations, and intergenerational epigenetic inheritance when affecting only the direct offspring.

While the idea that symptoms induced by psychological trauma are heritable has long been hypothesized, it is only recently that the biological basis of their long-term and potentially heritable effects has been established. Trauma exposures may occur in childhood or later in life, for example, in the form of physical or sexual abuse, deprived parental care, natural disasters, or forced displacement, and can involve additional factors such as military combat exposure in adulthood.³ These experiences, both in early and adult life, are major risk factors for mental disorders but can also alter physical health. A critical consequence of psychological trauma in humans is the development of post-traumatic stress disorder (PTSD) that is often comorbid with depression and anxiety⁴ and is associated with a greater prevalence and incidence of dementia.⁵ Beyond the brain, chronic traumatic stress also leads to harmful effects on other body functions. PTSD is a risk factor for cardiovascular and cerebrovascular diseases, gastrointestinal dysfunctions, rheumatoid arthritis, and cancer.⁶ Importantly, trauma can activate a number of pathways that may carry the effects of trauma to reproductive organs and the germ line. Consequently, changes in different tissues, organs, body fluids, and pathophysiological pathways after trauma could be mediators in such communication.⁷

The concept that psychological trauma leads to effects that are potentially heritable has immense implications for society, considering how many individuals have been traumatized by current and recent human conflicts. This article discusses the concept of epigenetic inheritance in the context of features resulting from such trauma exposure and their implications for an individual's life and for society. It reviews studies in animals and humans on the inter- and transgenerational transmission of the effects of psychological traumatic exposures by addressing the question of how trauma exposure and associated emotional and cognitive perturbations can leave traces in the germ line. The question of “windows of opportunity” at different stages of life, from childhood to adulthood, during which the transmission of the effects of trauma may be prevented, is also discussed. Importantly, the article elaborates on the implications of research on the inheritance of the sequelae of trauma linked to political and ethnic conflicts, on what peacebuilders can learn from the field of epigenetic inheritance, and on how they can collaborate with scientists to enrich strategies and policies with biological insight to help promote peace.

Introduction to Epigenetics

Epigenetics is a branch of biology that studies heritable changes that do not involve any alteration in the DNA sequence. These changes are thought to be transmitted by a combi-

nation of chemical modifications of the DNA (such as addition of methyl molecules; DNA methylation); similar modifications of histones, proteins that surround DNA molecules, and RNA molecules that propagate the genetic code present in DNA sequences.⁸

DNA Methylation

DNA methylation is a process involving the addition of methyl groups to DNA molecules that prevent DNA expression machinery from binding to DNA. Methylation is typically associated with gene silencing.⁹ However, occasionally methylation can also promote gene expression under certain conditions.¹⁰ DNA is dynamically methylated and demethylated through complex mechanisms in response to different exposures, sometimes leading to transient forms that are also functional. Recent research has shown that exposure to trauma can affect DNA methylation, generally for all the genes and sometimes for some specific genes,¹¹ making it a candidate mechanism for long-term and possibly inherited effects of trauma.¹²

Histone Modifications

Histones are DNA-associated proteins that surround DNA and keep it in a tightly packaged silent form. However, different molecules can modify the affinity of histone molecules to DNA, hence altering the accessibility of DNA-expression machinery to DNA.¹³ These modifications include acetylation (addition of acetyl group), methylation (addition of methyl group), phosphorylation (addition of phosphoryl group), ubiquitination (addition of universal ubiquitin protein), and SUMOylation (addition of small ubiquitin-like modifiers).¹⁴ Some of these modifications open up the histones favoring gene expression, whereas others make the histone mesh around DNA even tighter, thus preventing it from expression.¹⁵ Here, too, traumatic stress has been found to affect histones that surround the genes important for behavioral responses in animal models.¹⁶ Pre-clinical studies suggesting the use of histone deacetylase (HDAC) inhibitors (which strengthen histone acetylation) in trauma and anxiety therapies provide further support for a role of histone regulation during and after traumatic stress.¹⁷

RNA

RNA molecules propagate the genetic code present in DNA molecules to proteins; any disruption in the process is another way of altering gene expression without changing the

genetic code. The RNA molecules carrying the information coded from DNA are called coding RNAs, which can be regulated by some other RNAs that do not carry any genetic information. Two classes of such non-coding RNAs (ncRNAs), small and long ncRNAs (lncRNAs) are especially relevant here. Among small RNAs, microRNAs (miRNAs) act by degradation or repression of messenger RNAs (mRNAs) that are directly produced by DNA based on the genetic code.¹⁸ lncRNAs can interfere and compete with the functions of miRNAs, but they can also influence mRNA stability and processing.¹⁹ Both miRNAs and lncRNAs have been implicated in mediating the long-term effects of trauma exposure in experimental mice.²⁰ Further, studies on PTSD patients have also highlighted a potential involvement of miRNAs as mediators and/or moderators of the effects of traumatic stress.²¹

All these epigenetic mechanisms operate in different cells of the body, including the germ cells that are specialized in reproduction, such as sperm and egg. The activation of epigenetic pathways in such cells could therefore be implicated in the transmission of the effects of trauma to the progeny. Next, we review the epigenetic factors that are known to be modified by traumatic or stressful exposures in the germ line and discuss the importance of these findings.

Epigenetic Mechanisms in the Germ Line

Early life trauma in mice alters the level of DNA methylation of genes involved in signaling cascades important for stress regulation and cognitive processing. Similar alterations in DNA methylation are also present in the brain and the sperm of the offspring,²² suggesting that they have been transferred from father to offspring.

Similarly, environmental stressors are known to modulate chemical modifications of histones and related proteins in *D. melanogaster* (fruit fly) and *C. elegans* (earthworm).²³ However, in sperm, most histones are replaced by another class of proteins called protamines in rodents and humans; therefore, the contribution of histones to epigenetic inheritance might be limited.²⁴

Today, RNA is the major factor shown to have a causal role in the transmission of acquired traits. Sperm RNA has been implicated in the transmission of the effects of traumatic stress from father to offspring.²⁵ Thus, injecting sperm RNA from male mice exposed to trauma in early life into control fertilized oocytes can recapitulate the behavioral and metabolic symptoms in the resulting mice and their progeny.²⁶ In some cases, injection of 9 miRNAs known to be upregulated in sperm by adult paternal stress can alter

the level of stress hormone corticosterone in the resulting animals.²⁷ Further, sperm miRNAs have also been shown to mediate the effect of parental environmental enrichment (EE) on improving cognition in the offspring,²⁸ a paradigm that is also known to prevent the transmission of some of the effects of trauma in mice.²⁹ Thus, sperm RNA may be a common factor for the transmission of positive and negative effects of life exposures, a mechanism that provides new perspectives for heredity.

Inheritance of the Effects of Trauma in Animal Models and Humans

A growing body of evidence has shown that the effects of trauma and adversity can be transmitted to subsequent generations in animal models and involve the germ line. It is important to consider that intergenerational transmission of the effects of trauma can be independent of the germ line and may involve social transmission and acquisition of behavioral or physiological patterns from parent to offspring. True inheritance of the effects of traumatic stress involves transmission through germ cells and implicates epigenetic mechanisms.³⁰

In rodents, trauma affects behavior and metabolism of subsequent generations through complex epigenetic mechanisms that remain partially understood. Similar effects may exist in humans, but evidence is less abundant and knowledge about the mechanisms is very limited. This section summarizes pertinent evidence in support of inter- and trans-generational inheritance of the effects of trauma in animals and humans.

Rodent Models

Inheritance studies typically use a nomenclature that labels the offspring produced from the first genetic cross as F1 (filial 1) and subsequent generations involving breeding of affected F1, F2, F3, and so forth. Trauma has been induced in such animal studies by interfering or interrupting maternal care or by conditioning animals to unpleasant and fearful stimuli.

In mice, altering maternal care by stressing the mother during lactation has been associated with diminished social interaction in the offspring due to sub-optimal maternal care. In addition to behavioral anomalies, the male offspring also had alterations in oxytocin and corticosterone, two hormones implicated in regulation of stress and social bonding in mammals, whereas the female offspring had altered prolactin, a hormone

important for lactation.³¹ Similarly, inducing post-partum depression in lactating mothers through daily restraint and night time illumination was associated with the inheritance of depressive behaviors and altered metabolic pathways in the F2 offspring.³²

Our model of unpredictable maternal separation combined with unpredictable maternal stress (MSUS) is one of the best models of transgenerational inheritance in mice. This model shows clear germ line dependence, cause and effect relationship, and affects up to four successive offspring generations. For this paradigm, newly born mouse pups (F1) are exposed to traumatic stress by being separated from their mother (Fo) unpredictably and during separation, the mother is exposed to unpredictable stress. This chronic traumatic exposure during the first two weeks of life leaves long-lasting effects on behavioral response in the offspring, some of which are transmitted to descendants across several generations. F2, F3 and in some cases F4 MSUS mice have depressive-like behaviors, altered response to aversive environment, more risk-taking behaviors and impaired social abilities.³³⁻³⁵ F2 animals also have cognitive deficits accompanied by alterations in synaptic plasticity as well as in serotonergic circuitry.³⁶ In addition to behavior, glucose and fat metabolism in the offspring are also altered by MSUS (Gapp et al., 2014; van Steenwyk et al. 2019).^{33, 37}

Adversity in adult life can also induce behavioral deficits that can be transmitted to the offspring. Chronic stress induced by disrupting social hierarchy in adult mice alters social behaviors across three generations.³⁸ Chronic social defeat can also induce depressive behaviors in the offspring (F1) of stressed male mice (Fo). Some of these effects could be transmitted by *in vitro* fertilization (IVF), suggesting their dependence on germ cells (Dietz et al., 2011).³⁹ Similarly, traumatizing mice by exposing them to undesirable odors could induce a behavioral sensitivity to the odor in their F2 and F3 offspring that was accompanied by changes in their olfactory systems and showed germ line-dependence (Dias & Ressler, 2013).⁴⁰ Collectively, these results strongly suggest germ line-dependent transmission of the effects of trauma across generations.

Human Studies

Transmission of the effects of trauma across generations in humans has been a subject of interest for long, but only recently has an epigenetic basis of such transmission been considered. However, many questions about epigenetic inheritance in humans have been raised due to a lack of causal associations and mechanistic explanations (Jawaid et al., 2018).⁴¹

Like in animals, trauma in a parent early in life seems to be a critical determinant of offspring behavior in humans. Low maternal bonding and maternal stress have been associated with behaviors indicative of borderline personality disorder in the children of exposed people in a German study.⁴² A Swedish study showed that parental death during the pre-pubertal period in boys was associated with prematurity and low birth weight in their children.⁴³

Exposure to violence, such as genocide, is another inducer of potential transmission of psychopathology in the offspring of trauma-exposed individuals. Some older reports indicated increased psychiatric illnesses in children of Holocaust survivors.³⁴ Recent studies from Rachel Yehuda's research group have demonstrated clear neuropsychiatric impairments in the Holocaust offspring and grand-offspring and provided initial evidence this is accompanied by a change in DNA methylation in a specific gene (FK506 binding protein 5), which regulates sensitivity to stress hormones in humans.⁴⁵ The offspring of Holocaust survivors, in particular women survivors, demonstrate increased susceptibility to PTSD, and have lower levels of the stress hormone cortisol at baseline.⁴⁶ Parental exposure to genocide was similarly associated with increased anxiety and depression in Cambodia and Rwanda.⁴⁷

Besides exposure to genocide, forced displacement is another traumatic exposure that might be linked to intergenerational inheritance of behavioral dysfunction in humans. The children of individuals who developed PTSD after forced displacement have implicit avoidance to displacement-related stimuli.⁴⁸ Similarly, some symptoms of traumatic stress are transmitted to the offspring of Latin American immigrants,⁴⁹ and a Swedish study found increased depressive and somatization symptoms also affect the children of immigrants exposed to torture.⁵⁰ A recent study on the children of Finnish evacuees during World War II showed an increased risk of psychiatric hospitalization in women whose mothers were evacuated compared to those whose mothers were not evacuated.⁵¹

Finally, combat trauma has been proposed as an important stressor leading to heritable behavioral dysfunction in humans. Some descendants of World War II⁵² and Vietnam war veterans⁵³ exhibit violence and hostility that closely correlate with the intensity and duration of exposure to combat trauma in their parents. Similarly, some children born to veterans of the Serbian-Bosnian conflict show a multitude of developmental, behavioral, and emotional problems.⁵⁴ Furthermore, a recent study of the offspring of prisoners of war during the American Civil War showed an increased mortality in the male progeny.⁵⁵

While none of the above studies provide mechanistic evidence for germ-line dependence of the transmission of the effects of trauma in humans, two studies are noteworthy for showing that the germ line epigenome can be altered by trauma exposure in humans. The first study provided evidence, for the first time, that certain miRNAs are altered in the sperm of men who had higher scores on adverse childhood experiences questionnaire.⁵⁶ The second study is our ongoing investigation of epigenetic markers in body fluids of children with paternal loss and maternal separation residing in an orphanage that showed changes in a number of serum miRNAs known to be implicated in behavioral and metabolic regulation.⁵⁷ Importantly, these miRNAs are also affected in association with trauma in sperm of adult men.

With the rapid accumulation of epidemiological studies and the recent evidence showing epigenetic alterations in body fluids and sperm of trauma-exposed populations, it is becoming increasingly conceivable that effects of trauma are transmissible in humans. It is then important to consider what are the potential mediators that carry the effects of trauma to the germ line.

The Role of Blood in Transmission of the Effects of Trauma Exposure and Disease Susceptibility

While changes in the germ-line epigenome have been proposed as vectors of inheritance of the effects of trauma, the specific mechanism by which centrally activated effects of trauma are carried to the germ line remains unknown. A crucial role here could be played by soluble factors in blood that could communicate with cells in gonads. These factors may be released by the brain or other organs in response to stress and act via receptors such as adrenergic receptors, MR, gonadotropin-releasing hormone (GnRH) receptor or arginine vasopressin receptors, which are present on germ cells.⁵⁸

Among these circulating factors, hormones could play a role, because trauma is known to alter the circulating hormonal milieu and hormonal treatment has been shown to change sperm ncRNA content.⁵⁹ Cytokines constitute other important circulating factors to consider, because they can modulate the barriers in the body.⁶⁰ Cytokine receptors can also be detected on germ cells.⁶¹

However, in our opinion, the most prominent candidate carriers for transmission of trauma signatures to the germ line could be circulating RNAs and metabolites. Circulating RNAs, especially ncRNAs, are biologically active in different body fluids and are

carried either packaged in extra-cellular vesicles (EVs) or in conjunction with lipoproteins or Argonaute proteins. Interestingly, fat metabolism, which is consistently altered in many transgenerational models, is closely related to lipoproteins, as well as, extra-cellular vesicles. Two-thirds of all such vesicles in mammals originate from the adipose tissue,⁶² whereas, lipoprotein molecules are known to carry RNAs.⁶³

Another important carrier of signaling to the germ line could be circulating metabolites. A remarkable overlapping set of circulating metabolites are altered in mice and humans after early life trauma. Importantly, these metabolites can alter nuclear receptor signaling in the germ cells.³⁷

A possible role for blood as a medium for transmission for the effects of trauma to the germ line has important implications for transmission of disease susceptibility in humans. Furthermore, it also brings forth potential opportunities for intervention because mediators of transmission can be targeted for diagnostics and therapeutics in the blood. This is also pertinent when we consider the potential implications of the epigenetic transmission of the effects of trauma on society.

Implications of Epigenetic Inheritance Research for Society

The idea that traumatic experiences can have long-lasting sequelae on mental and physical health and well-being in exposed people and possibly their children and grandchildren has far-reaching implications for human civilization and society. Numerous religious, political, and ethnic conflicts have plagued all corners of the globe over the past hundred years, and the picture today remains grim, with violent conflicts affecting many countries, from Afghanistan to Cameroon, Nigeria to Palestine, Pakistan to Syria, Ukraine to Yemen. In addition to the consequences for the local civilian populations, military personnel and their families are also chronically exposed to trauma. In addition to direct war combat, displacement, forced family separation, ethnic violence, and natural disasters can also be traumatic. Recent research has identified epigenetic alterations in people exposed to genocides in Africa or the Holocaust, but our knowledge is still limited and no studies have been conducted on current conflicts. Efforts to provide preventive and remedial measures in affected populations are also limited, and there is no routine psychological or metabolic assessment of the affected children.

To illustrate the potential of preclinical research in animal models for better understanding the medical impact of human conflicts, we will take the example of a recent difficult situation in North America: namely, the family separation crisis at the US-Mexico border in 2018, which created distressing conditions for many families. Concern was raised in scientific circles about the long-term consequences of such detention on the mental and physical health of the children exposed to separation.⁶⁴ This situation had many similarities with a mouse model of early trauma showing inheritance of behavioral and metabolic symptoms across generations (the MSUS model). This model suggests parental separation and detention could engender life-long psychological consequences, not only on separated children, but also on these children's descendants. Translating the knowledge gained from such mouse studies can help us anticipate their children or even grandchildren could be at risk for metabolic disorders and psychopathology, such as depression and increased risk-taking during adulthood that would compromise their life. We ourselves have recently conducted a study with children residing in SOS Children's Villages in Pakistan. These children experience trauma in the form of paternal loss and maternal separation and have increased anxiety, pro-depressive symptoms and attention deficits, as well as decreased high-density lipoproteins in blood. Further, some micro-RNAs known to be altered in serum by early trauma (MSUS) in mice are similarly altered in the serum of these children, suggesting conservation of molecular pathways related to fat metabolism and non-coding RNAs in trauma in mice and humans. The wide-ranging behavioral, metabolic, and molecular perturbations present in these children raise the possibility that their adult lives or even the lives of their offspring may show susceptibility to numerous health complications. Indeed, incubating germ cell-like cells in culture with serum from these children leads to transfer of some molecular aberrations to the incubated cells, thereby suggesting the possibility that the legacy of their painful experiences may persist.^{57, 65}

The biological routes by which the effects of trauma can be transmitted from parent to children remain only partially understood. While germ cells likely contribute by carrying epigenetic alterations that are passed to the offspring, other biological means, such as body fluids, can probably also contribute. Maternal milk during lactation is one possibility. Studies in mice, primates, and humans have shown that mothers transmit biologically active compounds during lactation that can influence brain development, behavior, and temperament in their offspring.⁶⁶ More studies are required, but this could be a point of concern for the pregnant and breast-feeding mothers in conflict regions and women employed in the army or serving in peace-keeping forces.

Although trauma exposure can be detrimental overall for the exposed individuals, it may lead to the development of adaptive behaviors beneficial for them and their offspring in some conditions. In mice, there is evidence that adaptive behaviors, such as improved behavioral flexibility and goal-directed responses, can appear in trauma-exposed individuals and their progeny, and can help them cope with challenging situations.²⁵ Likewise, human studies have shown that grandchildren of immigrants can have better academic performance.⁶⁷ However, more mechanistic studies are needed to identify the pathways that confer the transmission of resilient behaviors to the offspring and determine whether any intervention could favor such “positive transmission” after exposure to trauma. Of particular importance is the optimal time for any efficient intervention.

Windows of Opportunity

With the new knowledge gained on molecular pathways altered by trauma and potential mechanisms for their inheritance, it is now possible to consider behavioral intervention, dietary supplementation, and/or pharmacological manipulation of trauma-exposed populations. Animal studies suggest that exposing trauma-affected males to an enriched living environment before conception can prevent the transmission of some of the effects of trauma to the offspring.²⁹ Moreover, some brain chemicals known to increase social bonding, such as oxytocin and vasopressin, can reverse the intergenerational effects of chronic social stress in mice. F2 female offspring of mothers exposed to such stress have increased repetitive/perseverative and anxiety behaviors and deficits in social behavior. The treatment of F1 mothers with oxytocin following chronic social stress prevents transmission of repetitive and anxiety behaviors in F2 offspring, whereas intranasal vasopressin treatment in F1 dams showed positive effects on behavioral deficits and anxiety.⁶⁸

Despite this limited evidence, these studies raise hope that transmission of trauma symptoms in humans could be partially preventable. The challenge is to use such encouraging pieces from animal studies to design clinical and community-based interventions preventing the transmission of trauma symptoms in humans. In an attempt to envision this, we will use the hypothetical example of war orphans from a conflicted region without parental care and chronically exposed to adverse conditions to identify potential windows of interventions. Based on our work in mice and humans with early life psychological trauma, it may be predicted that such a child will show a greater susceptibility to psychological and physical disorders and may eventually transmit those susceptibilities to their own children.

Potential helpful interventions include:

1. Psychological screening of the child, followed by appropriate psychotherapy and dietary supplementation. Psychological intervention could include multi-modality stimulation, a human-appropriate equivalent to environmental enrichment employed in rodents.
2. Ongoing screenings and interventions could be helpful as the child grows to adulthood and plans to conceive. The screenings could include germ-line assessments for epigenetic signatures of trauma known to persist in adulthood and to be associated with specific disruptive phenotypes in the offspring.
3. The offspring of the initial war orphan could then be screened for atypical behaviors, and neuropsychiatric and/or metabolic abnormalities that could be predicted from epigenetic analysis of the parental germ line and offered proper treatment, wherever necessary.

It is noteworthy that none of these interventions have been tested yet in humans and require careful assessment and evaluation before they can be incorporated into practice. There might be multiple challenges to implementing such interventions, starting from which platform to use for wide-scale screening of psychological impairments in trauma-exposed individuals, to ethical considerations surrounding germ-line evaluations. Organizations working at the global scale, such as the World Health Organization (WHO), the United Nations, the United Nations International Children Emergency Fund (UNICEF), and the United Nations High Commission for Refugees (UNHCR) could play a major role in advocacy and implementation of these interventions in regions of instability and conflict. One can envision future clinical settings employing stringent screening through psychological and emerging molecular biomarkers of trauma to predict the long-term sequelae in vulnerable communities, such as immigrants who have been subjected to forced displacement. This could be followed by offering counseling, prophylaxis, and/or therapy to individuals carrying epigenetic signatures of trauma exposure and their offspring in the future.

At the community level, some noteworthy examples of initiatives that could prove helpful in preventing and/or reducing the propagation of trauma symptoms in humans include the recommendations of the Council of Europe for immigrant populations (https://www.coe.int/t/democracy/migration/ressources/recommendations-resolutions_en.asp) and the recovery and well-being advice initiative by the Ministry of Youth Development in New Zealand (<http://www.myd.govt.nz/resources-and-reports/recovery>

-and-wellbeing-advice.html), which was launched after the 2019 Christchurch attack. The programs use positive psychology-based interventions to improve the integration of refugees or help people cope with trauma respectively. An important consideration here could be incorporating assessment of epigenetic markers of trauma in body fluids (blood, saliva), which could be longitudinally measured to test if such interventions can reduce the epigenetic alterations caused by trauma exposure.

Further to preventing or reducing the sequelae of trauma exposure, knowledge gained from epigenetic research can be used to promote human rights and lower factors leading to trauma and victimization. In humans, violence often runs in families,⁶⁹ suggesting that inflicting violent or exclusionist behaviors may also be genetically or epigenetically transmitted. If this is true, a possibility to alleviate the transmission of such behaviors by acting on the epigenome may be envisaged. For example, virtual reality (VR)-based interventions may be attempted to help raise the empathy of community leaders and/or reduce their negative prejudices about individuals from other ethnicities.⁷⁰ We hypothesize that this could be achieved by designing VR modules in which people from opposing communities could be engaged in peacebuilding activities. Another idea could be constructing VR modules where persons could virtually witness themselves and their family members belonging to a race they otherwise have reservations against. It will be interesting to see if such interventions are successful, lead to long-term epigenetic changes, and have any positive effects that could be heritable. It is the responsibility of the scientific community to start assessing the feasibility and applicability of such interventions to promote human rights.

Conclusions and Outlook

Scientific research in the last decade has established that the sequelae of trauma exposure can be heritable. The role of epigenetic factors as potential mediators of such transmission and the molecular components responsible of their induction in germ cells have started to be identified. But many questions and challenges still remain unaddressed in the field. First, the nature, severity, and extent of symptoms in the offspring of individuals exposed to trauma need to be carefully examined, because they likely include not only psychological but also physical disorders. Second, individual differences in the expression and transmission of symptoms need to be carefully examined. Increasing evidence from human studies suggests that only a fraction of individuals develop PTSD after exposure to trauma while a few individuals become more resilient (a phenomenon described as post-trau-

matic growth.⁷¹ It is possible that transmitted traits are different in trauma-susceptible versus resilient individuals. Third, accessible biological fluids such as saliva, blood, and semen could, under appropriate circumstances, be analyzed in traumatized human populations and, ideally, also their offspring to determine if the alterations observed in animal models are relevant in humans.

Finally, we recommend the formation of think tanks that bring together peace-builders, biologists, clinicians, and sociologists to translate scientific knowledge into concrete long-term humanitarian efforts and policy frameworks. It is also urgent that peace-builders and human rights activists utilize available forums to inform the public about the impact of trauma across generations, thereby sensitizing the public to the problem. Anyone witnessing a child survivor of trauma should know that trauma persists, propagates, affects the whole body, and may be transmissible. The only known way to prevent generations of victims suffering from trauma is to build a society based on peace.

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The Neurophysiology of Individual and Collective Trauma

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This article focuses on the neurophysiology of individual and collective trauma and offers peacebuilders, communities, and readers practical tools to recover from secondary (witnessed) or direct trauma. We include real-life examples of how to work with trauma individually and collectively through vignettes that we have collected from peacebuilders and therapists. We present exercises that peacebuilders and readers can use to increase resilience and recover from direct or secondary trauma.

In a world full of interpersonal conflict, political upheaval, natural disasters, and social and environmental stressors, trauma impacts most of the globe. Traumatic stress and post-traumatic stress disorder (PTSD) can occur when a person experiences a real or perceived life-threatening event.¹ Both mental health and physical health symptoms can be affected.² Many people experience ongoing symptoms that may include insomnia, hypervigilance, erratic display of emotionality, numbness, dissociation and disconnection, visual or somatic (body) flashbacks, negative thoughts about self and world, reckless or self-destructive behavior, detachment from social groups and others, and the avoidance of triggers that remind them (consciously or unconsciously) of the traumatic event.³

The article provides an overview of the neurophysiology of trauma. It reviews standard treatments of trauma in the field. We focus on a neuropsychological approach to trauma found in practices such as Somatic Experiencing. This approach is biological and theorizes that trauma is not in the event, but remains potentiated in associative (implicit) memory triggering ongoing nervous system responses primed for our survival.⁴ Animal models show that animals are routinely threatened in the wild, but have an innate capacity to return to a resilient state of relaxed readiness until the next threat.⁵ Human beings may disrupt this natural cycle through cortical (cognitive) control and inhibit a nonconscious neurogenic and somatic (body-oriented) depotentiation of survival physiology after a threat has passed.⁶

Interoception, or awareness of one's own bodily sensations, can give us access to direct signals from our implicit (nonconscious associative emotional/motor and procedural) memory.⁷ These interoceptive signals are involved in ongoing bidirectional communication between our brains and bodies that register if we are in life threat, danger, or safety.⁸

The threat response cycle is adaptive during direct trauma, but may create maladaptive imprints if unresolved, leaving individuals in constant patterns of hypervigilance, flight, fight, and freeze long after a real or perceived life-threatening event has passed.⁹ Efforts to address trauma, however, do not have to wait until peace is fully restored. In many areas where conflict continues, there exist pockets of “relative safety” where individuals and communities can practice nervous system regulation and mitigate chronic stress and numbing. We use the term “relative safety” because in unstable areas such as conflict and postconflict zones, a natural and healthy response will be a level of hypervigilance. However, there will be pockets where individuals and groups can settle, eat meals together, and feel protected by trusted friends and community members.

Heightened states of stress and dissociation disrupt higher-order executive thinking.¹⁰ For peacebuilders, negotiations often break down when individuals are flooded by strong emotions and potentiated neurophysiological states of fight, flight, and freeze. Regulation tools in group settings have been beneficial in high-conflict regions to aid in the neural circuitry of social engagement and communication.¹¹ We examine the long-term effects of trauma within communities. We present group healing exercises adapted to cultural norms that restore resilience through the neuroanatomy of the completion of the threat response.¹² We also present an approach to a group process that helps identify cultural resources and interoceptive savoring of them. Reconnecting to a communal sense of resources is vital to increasing resilience and rebuilding the community and social fabric.

Democratic Republic of the Congo: He must have been 10-12 years old. Most people there didn't really know their age anyway. He came to our hospital with his father. Their house had been attacked by rebels where they were held at gunpoint. His mom and sisters were killed on the spot. He and dad took off amidst a rain of bullets. His dad was wounded and they came to our hospital. This boy had the deer in the headlights look, totally terrified. He told me, “I am scared and I am scared all the time.” I was not working with him. I was supporting the counselor working with him. The counselor called me because he didn't know what to do. I basically spent some time helping the boy notice he survived. How he had made it. How he'd been so brave. I believe I said, “Look at how you're here and you made it despite all the

danger. Notice in your body how you're responding to that. Where do you feel the survival from a felt sense?" So much horror, we can't erase the atrocity of the loss of the family. Yet there was an unbelievable shift in that kid. To realize he had run for his life and had made it. He connected to a feeling of strength in his body and all of a sudden a smile lit up his face. I still remember his face. It was such a powerful moment. His eyes softened, and almost all at once he was taller and had more presence. He was in his body. His posture opened and his spine elongated upward. I did the smallest intervention and he was on his feet. He still had a lot of grieving to do but in the hospital he was he was totally different. He was chatting with everyone and socializing which he hadn't been doing. He'd been totally withdrawn.

—Joelle Depeyrot, *Somatic Experiencing Practitioner (SEP)*

Trauma Overview

"Trauma" is defined by the American Psychological Association as "an emotional response to a terrible event like an accident, rape or natural disaster. Immediately after the event, shock and denial are typical. Longer-term reactions include unpredictable emotions, flashbacks, strained relationships and even physical symptoms like headaches or nausea. While these feelings are normal, some people have difficulty moving on with their lives."¹³ Types of events that can trigger a traumatic response are, but are not limited to, war; oppression; direct or indirect experiences of violence, rape, and sexual abuse; natural disasters; displacement; medical trauma; physical injury; accidents; living with chronic illness; developmental and attachment trauma; adverse early-life experiences, transgenerational and intergenerational trauma; and emotional abuse.

Traumatic stress is a response in the human body, brain, and nervous system to an overwhelming event where one's life or bodily integrity is perceived to be threatened or when one witnesses violence or death.¹⁴ The response to traumatic events and their sequelae can range from a short period of adjustment to severe reactions in which day-to-day functioning is disrupted for a month, years, or even for decades.¹⁵ Judith Herman describes trauma to be any experience where one is "rendered helpless by overwhelming force."¹⁶ Symptoms vary and the severity of the symptoms cannot be predicted by the nature of the traumatic event. A small fender bender could stimulate a massive reaction in one person, yet for others, something as seemingly traumatic as witnessing a violent shooting may not present with symptoms at all. Traumatic symptoms can include anxiety, rage, recurrent intrusive thoughts about the event, flashbacks, nightmares, social withdrawal, numbing, dissociation, avoidance of reminders of the event, feelings of powerlessness,

and aggressive or violent impulses or behavior. Beliefs about the safety of the world and of other people can be profoundly altered. Traumatic stress affects relationships, social life, and work. Intensity of symptoms can decrease during less stressful times, and emerge with greater intensity with an increase of stressors or when encountering a trigger.¹⁷

The *Diagnostic and Statistical Manual of Mental Disorders—V* describes PTSD and acute stress disorder as two mental health diagnoses which drive multiple symptoms after overwhelming traumatic events. PTSD can manifest one month after an event, or many years later. The criteria for PTSD involves four symptom clusters that include intrusive memories, avoidance, negative changes in thinking and mood, and changes in physical and emotional reactions.¹⁸ Traumatic symptoms can manifest in many different ways. Multiple traumatic events and developmental trauma can create complex trauma.¹⁹

A person may feel traumatic stress by directly experiencing a traumatic event, but also by exposure to secondary trauma. Secondary trauma (also known as “vicarious trauma” or “compassion fatigue”)²⁰ occurs when a person learns of a traumatic event that occurs to someone close to them, or by witnessing or hearing about shocking events secondhand. Peacebuilders and policymakers may not directly experience trauma, but are greatly affected by the stories they hear and the ongoing violence and oppression they witness. It is vital that peacebuilders and policymakers who are routinely exposed to violent and dehumanizing stories and images work to alleviate their own traumatic stress. Witnessing a tragic event directly or indirectly can lead a person’s body to react “as if that could have been me!”²¹ The more another person or an experience matches one’s own lived experience, the more likely secondary trauma may affect them. For example, physicians may be more affected by seeing someone die who is around their own age range, of the same gender, or has children of the same age than witnessing the death of a person with dissimilar demographics. In secondary trauma, a person’s neurophysiology may become kindled into a stress response in relationship to what one has seen and heard.²² Taking time after each encounter to use the stabilization, internal tracking, movement, and touch exercises are recommended.²³ These skills will be presented throughout this chapter. Symptoms from secondary and primary trauma can range from mild distress to severe impairment.²⁴

Treating Trauma in Peacebuilding Efforts

There are many useful approaches to healing trauma that are used in peacebuilding efforts. These include, but are not limited to, psychoeducation and social work models,

critical incident stress debriefing, exposure therapy, cognitive behavioral therapy, and eye movement desensitization reprocessing. These techniques are used widely throughout the world to manage primary, secondary, and collective trauma.

One of the most extensive models used in the field is a psychoeducational and social work model.²⁵ Trained therapists and professionals teach others about the effects and origin of their traumatic responses. They take time to listen to those affected and offer support in finding the resources they need to recover. They provide a safe emotional environment where trauma survivors can speak the unbearable so they are not in isolation with their pain.

Another very extensive model is called critical incident stress debriefing.²⁶ Teams are often brought in after large-scale tragic events. Participants are asked to recount the story of their traumatic event from start to finish. They are asked details and given time to feel their distress. The goal is to access the event's impact on the individual and to allow them time to reflect. These sessions last between one to three hours.

Exposure therapy is also widely used.²⁷ It requires a trauma survivor to recall and construct a detailed trauma narrative that they rehearse. As they repeat the details of the horrific event they may become more and more desensitized. Over time, they may be able to tolerate the memory of the event without feeling flooded, numb, or symptomatic.

Cognitive behavioral therapy offers individuals tools to observe the thoughts that they have about themselves, the world, or meanings they make around events in their history.²⁸ Because the impact of trauma often distorts a sense of someone's identity and the world, working to support someone to overcome cognitive dissonance and distress can be helpful in recovering from trauma. Watching and adapting one's thought patterns is practiced. Negative cognitions are examined in relationship to physical feelings as well as harmful behaviors. For example, a person thinks, "I am garbage," which cascades into a feeling of depression, which leads to a suicide attempt. CBT therapy would work with shifting the thought, physical feeling, and behavior to change the person's outlook and increase feelings of self confidence and wellbeing.

Eye movement desensitization reprocessing (EMDR) is another approach to trauma healing in the field based on using bilateral stimulation (eye movement, tapping, sound, or vibration) to elicit changes in the distress related to the worst part of a traumatic event.²⁹ A person identifies the "target" image and evaluates the amount of distress they are in based on several measures, such as physical (somatic) symptoms, negative thoughts, and emotional distress level. The EMDR therapist has the person hold the image in their mind

and does a “set” of bilateral moments and then uses free association of “what do you get now?” to move the person forward through time. Over time and multiple sets, the distress level tends to gradually decrease until the person no longer feels triggered when thinking of the event.

These modalities to healing trauma have been useful all over the world. Another approach that is widely used in multiple settings and has proved effective is a body-based model of trauma recovery known as Somatic Experiencing. The rest of this chapter focuses on this approach.

The Neurophysiology of Trauma and Treatment

Our presentation of the neurophysiology of trauma moves from a traditional emotional and behavioral model of mental health to a psychobiological perspective. It draws on the fields of ethology (wild animal behavior), interpersonal neurobiology, and psychology with an emphasis on the trauma resolution model called Somatic Experiencing developed by Peter Levine.³⁰ We examine trauma from the lens that trauma is not in the event itself but is held in ongoing signals in the autonomic nervous system that is deeply rooted in our biological imperative for survival.

A classic neuroscience example of a survival network tells a story of a person walking in a forest.³¹ Let us revise the example to describe a peacebuilder walking in a wooded area on one’s way to a community meeting. There have been attacks in the woods, but it has been a while since there have been any incidences, but one is on alert for potential danger. One takes in the environment through the five senses: smelling the wet leaves; seeing the lush greens and deep browns of the trees and forest floor; hearing the sounds of birds, insects, and wind; subtly tasting the fresh loam from the dirt that one can kick up; and feeling the cool air on the skin. All is peaceful for some time, but all of a sudden one finds oneself frozen mid-step, and suddenly pulling one’s weight backwards. One’s heart rate has increased, palms are sweating, and visual perception has become sharper. This metabolic burst of energy pumped blood to the muscles so that mid-step one stopped and pulled away quickly. The mouth is dry and one is looking at the ground, wondering what is that strange shape down there. Brain and body, based on biology, have just protected themselves (before one even knew one needed protecting) based on thousands of years of evolution. A novel (or new) stimulus came through one or some of the five senses and was perceived as threatening. This information went directly to the amygdala, or the warning center of the brain, that sets the alarm to respond to danger.³² It engages the HPA

(hypothalamic-pituitary-adrenal) axis for energy and increase stress hormones such as cortisol and norepinephrine.³³ The senses focus on the stimulus through orienting—first defined in scientific literature as the “what is it?” reflex.³⁴ Does one approach or avoid? Does one vocalize, fight, flee, or freeze? The brain is concurrently sending information to the prefrontal cortex and comparing it with information on the shape seen below. Is it moving? Does it have a certain repeating pattern? What shape is it? And then one’s memory kicks in and recalls that, based on its “data bank,” the object below is indeed an oblong half buried stone and not a landmine. The neocortex sends information back down to the primitive amygdala to “stand down” or diminish the alarm. The HPA/axis and stress hormones are inhibited and the body starts to feel jittery and shaky as a release happens from the high state of alert in one’s body. The breath deepens and the heart rate lowers. And there is a return to a more relaxed but ready state.³⁵

If the brain and body are constantly kindled into hyperactivated (overly responsive) or hypoactivated (underly responsive) trauma states, individual and community growth are often stifled.³⁶ When there is high survival activation (fight, flight, and freeze) in the nervous system the neocortex shuts down.³⁷ Primitive brain structures related to fear and arousal remain active. One area in particular, the amygdala, continues to fire.³⁸ The work of peacebuilders on reconciliation, transitional justice, and other techniques is often hampered by the effect of traumatic stress on individual and collective processing. Traumatized individuals have less access to the neocortex and rational decision making³⁹ that may be necessary to reach a new agreement or peace accord.

Practical tools can be used to work with individual and collective trauma by recalibrating the nervous system. The nervous system can be supported to transition out of traumatic stress physiology and back into homeostasis—or a person’s natural baseline state of regular breathing, normal heart rate and balanced metabolic functioning. Peacebuilding efforts have the potential to have more effective outcomes if the neurophysiology of traumatic stress is addressed directly.

Whether working in the field as a peacebuilder or employed in a government agency, academic office, or some other discipline, humans respond to their own and others’ stress signals all the time. Stress is not a cognitive experience; in fact, one should be able to register the feeling of stress in the body. However, many people consciously or unconsciously ignore and override their sensory awareness. Awareness of the body’s internal sensations is called interoception.⁴⁰ A part of the brain called the insula lights up in an fMRI (functional magnetic resonance imaging machine) when one becomes consciously aware of a sensation.⁴¹

Interoception

Sara Lazar shows that long-term meditators have a thicker right anterior insula.⁴² This area of the brain can thicken while practicing mindfulness. This is not only beneficial for knowledge and a sense of oneself, but it also may enhance the ability for people to respond more sensitively to others and improve social bonds. People who can sense their heart beats better also score higher on sensing their own negative emotions.⁴³ Terasawa and his research team⁴⁴ showed that interoceptive sensitivity predicted a person's sensitivity to the emotions of others. When other people feel felt, as interpersonal neurobiologist Dan Siegel⁴⁵ suggests, they can resonate, understand, and communicate better with other people.

Somatic exercises (such as that presented in the box below) that focus on interoception, or the brain's ability to consciously attend to sensation in the body, can begin to reconnect a person to their capacity to settle or engage movements that contradict the felt sense of helplessness and immobility.⁴⁶

Field Exercise 1: Identifying Paired Opposites in the Body

Identify one area that feels:

- Warm and another that is cool
- Tight and another that is relaxed
- Fast movement (vibration or fluid feelings) and another with more slow movement
- Fast breath and wait for a more open slow breath comparatively (do not take it consciously)

Identifying basic embodied sensory paired opposites after a traumatic event can be helpful.⁴⁷ As people become more aware of their internal state, they recognize that they feel as if the trauma is still occurring because their bodies are physiologically still responding *as if* the trauma is still happening.⁴⁸

This article explores how to use neuroception to shift chronic stress or numbed bodily reactions, which is often the missing key to helping survivors reconnect to their essential self and resilience.⁴⁹ Peacebuilders can work on secondary trauma as well as direct trauma through reestablishing their own neuroception of safety. The neuroception of safety, according to Stephen Porges,⁵⁰ is how neural circuits distinguish whether situations or people are safe, dangerous, or life threatening.

Thailand: After the tsunami, a boy named Niran said that his heart was always beating fast like when the wave came. Ale asked him to put his hand on his chest and to notice his body sensations. Niran closed his eyes and placed his hand over his chest and heart. In a minute he took a spontaneously deeper breath. His eyes fluttered softly and his muscles slowly relaxed. Ale gently encouraged him to allow the internal shifts and to stay connected to himself on the inside. When Niran opened his eyes, they were brighter. He had visibly connected more to the ground underneath him and his heart rate was back to normal. He ran off to play with the other kids and didn't show signs of heightened arousal through the day.

— *Summary from a video from Trauma Outreach Program
and the Foundation for Human Enrichment Team*

Before explaining how to release traumatic stress from the body, we need to return to how trauma is registered in the body. Animals are routinely traumatized in the wild. Most of them have an innate ability to re-regulate and return to an alert but relaxed state so they can graze or hunt or do other relevant survival behaviors.⁵¹ Humans, on the other hand, regularly form psychological and complex physiological symptoms/syndromes triggered by traumatic or overwhelming life events.⁵² Unlike animals, we have a powerful neocortex, or thinking rational brain, that can override the natural release of stress from our bodies.⁵³ Human beings disrupt an innate process of down-regulation after a real or perceived life threat has passed through cortical (cognitive) control. The neocortex can inhibit movements and sensations that help restore the nervous system to baseline homeostasis.⁵⁴ If allowed, the release cycle aids an individual to return to a state of relaxed readiness.

The Threat Response Cycle

When threatened, the body will go through a predictable sequence called the “threat response cycle” in order to protect itself. This occurs very rapidly before the cognitive brain can add input to modify a behavioral response.⁵⁵

The threat response cycle can be triggered or remain potentiated through implicit (non-conscious) procedural (movement based) and associative (emotional and motor) memory.⁵⁶ These states can become symptoms. Survival states that remain engaged affect people in a myriad of ways. For example, many people remain with a heightened startle response; they are on high alert and jump or tighten their musculature repetitively. Individuals can become hyperoriented to all stimuli that remind them of an event, or tune

Threat Response Cycle

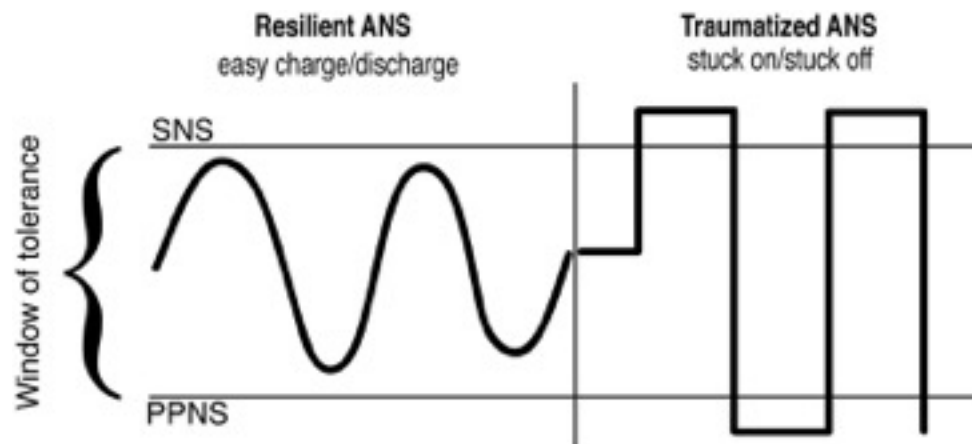
- Novel Stimulus
- Startle (arrest of movement to not be detected by predators and minor increase in sympathetic nervous system tone for action if needed)
- Defensive Orienting (wide and then defensive orienting to locate the threat)
- Social Engagement option for communication and verbal protection when viable
- Active Defensive Responses - Fight and/or Flight
- Passive Defensive Response - Freeze (immobility)
- Discharge, or release of highly potentiated survival states through autonomic markers (shaking, trembling, tingling, buzzing, heat, sweating, burping, yawning, deeper breathing)
- Return to Exploratory Orienting (relaxed but ready)

everything out making them susceptible to other attack or re-enactment because they can no longer discern who or what is safe or dangerous. Many people can be triggered into or remain in protective and reactive states of rage or anger. Others are in a perpetual state of terror, flight, and withdrawal. They are always anxious and their life choices become more and more limited.⁵⁷

The Autonomic Nervous System and the Window of Tolerance

To elucidate this point, consider the window of tolerance chart below.⁵⁸ The space between the lines above and below represent an individual's range of tolerance. The range, or window, can be more limited through adverse psychosocial factors, such as poverty, exposure to trauma (especially at young critical periods), homelessness, joblessness, poor health and access to healthcare, systemic oppression, marginalization, and more. The upward arrow represents the sympathetic nervous system (SNS). The SNS is responsible for excitation. The lower arrow represents the parasympathetic nervous system (PNS). The PNS is responsible for relaxation. In a regulated nervous system and under conditions of relative safety, the autonomic nervous system (ANS) will flow between states of excitation and relaxation throughout a day.

Figure 1. Window of Tolerance Chart⁵⁹



When a threat occurs, the body goes into a state of high sympathetic arousal to protect itself. If the threat overwhelms a person with too much intensity and speed, or, as in developmental trauma, where abandonment and neglect offers little contact and care for too long, a person will go into a passive defensive response of freeze.⁶⁰

Interoceptive states of freeze are parasympathetically dominant; however, when people shift out of freeze and helplessness they often experience similarly high states of sympathetic activation and feelings of active protective responses.⁶¹ These are psychological impulses which they had or partially attempted before their bodies went into the freeze.

A person may be triggered into freeze by certain situations that have similarities to the original traumatic event or relationship. Or a person may remain at baseline in a state of chronic freeze. After an unresolved neurophysiological trauma response, activated survival responses kindled in the ANS can remain active for days, months, years, decades and even lifetimes.

Many people do not recognize they are in a traumatized state especially if they dissociate from their bodies.⁶² Dissociation is a mental process that causes a lack of connection in a person's memory, thoughts, emotions, experiences, and/or identity. Not all people who freeze dissociate. But many people who freeze concurrently disconnect psychologically from their internal experience. It is also known in psychological terms as "derealization."⁶³ This can be primary, meaning that people cannot feel any of themselves, or secondary, meaning that only part of their experiences are inaccessible.⁶⁴ These dissociated elements of experience could be emotional (e.g., cannot feel sadness, only anger and

fear), behavioral (e.g., not aware of the look of anger in their face or their hands clenched), sensory (e.g., not able to feel the tightness in their belly but are having trouble eating and sleeping), image (e.g., cannot imagine positive or negative events in their mind's eye or recall dreams), or meanings (e.g., distorted belief about self or world).⁶⁵ In order to access interoceptive awareness, movement, vestibular (balance) exercises, kinesthetic awareness (the relationship of the body and body map as it moves through space), and proprioception can build a person's capacity to sense themselves in the present moment. If a person moves their body, there is more input to the brain about the physical self, and they can feel more. There are many ways in which movement is traditionally used for healing in group connection, such as dance, drumming, group activities like sewing and culturally relevant games, clapping in agreement, and moving in celebration.⁶⁶

According to researchers Mardi Crane-Godreau, Peter Payne, and Peter Levine,⁶⁷ the primacy of movement, proprioception, kinesthetic awareness, and interoception can counteract trauma physiology. Because the nervous system is firing *as if* the organism still needs to engage in survival based strategies, using images or movements of self-protection can lead to a completion of defensive and survival responses. It creates a new associative memory network based on success and agency. The next time something occurs similar to the trauma, the neural networks and lower brain will have full access to protective plans that are not potentiated to a past response.

Once a person can feel their body they can begin to notice what is happening in the ANS. Is their breath shallow? Is their heart rate high or imperceptible? Do their limbs feel electric or like stone? Do they feel weak or vapor-like? Or do they feel hot and constricted? Do they feel warm and relaxed with deep full respiration?

Field Exercise 2: Interoception and Observation of SNS, Transition between States, and PNS: AKA, What Goes Up Must Come Down

Have a companion do some vigorous exercise. Ask them to report the sensations that they feel in their body when they are experiencing elevated sympathetic tone. Look at them. What visually is seen in their skin tone, pupil size, respiratory rate, pulse, and musculature? Does this match the sensory description words they are sharing? Then wait. See them shift toward the parasympathetic. This phase is very important in healing trauma. When tracking or following a person's physiology they can feel through their sensations signals of release and down regulation. Learn to follow the sensations of release over other sensations, especially if a person's attention is drawn to stress physiology. Notice shaking, vibration, flow, temperature

change, and decrease in respiration and pulse. Ask them to report what sensations they notice in that transition. Then look at the person's body in a parasympathetic state. What visually is seen in their skin tone, pupil size, respiratory rate, pulse, and musculature? Does this match the sensory description words they are sharing?

It is possible to do this exercise to track one's own physiology. If doing this exercise on oneself, say the descriptions of one's internal sensations out loud. Listening to sound of one's narrative will allow the sensory experience to be savored more consciously.

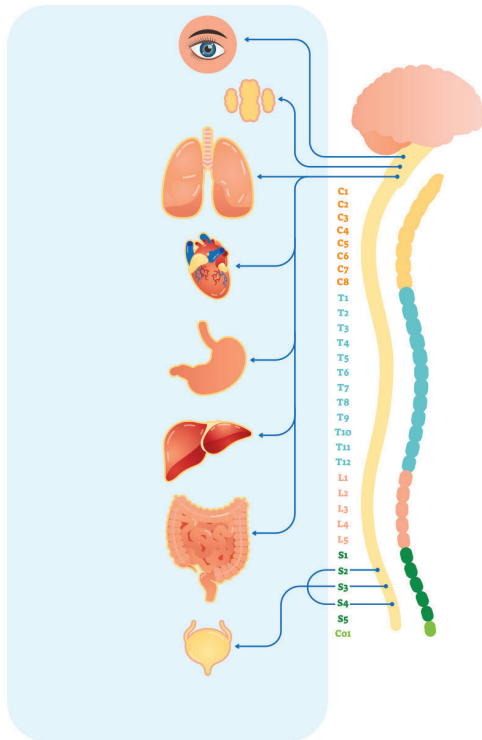
Figure 2 presents a chart by Kelly Knight and Colter Elis and their research team of physiological responses one can track in the ANS (Blakesee, et. al, 2018)

Peacebuilders and readers can learn how to identify if a trauma survivor or one's own physiology is stuck in high sympathetic tone or freeze. These internal states can change using interoceptive exercises. A traumatized individual can stabilize his/her/their ANS state. Simple exercises such as feeling the ground beneath ones feet, sounding a vibrational noise with the out breath until a new breath comes in and fills the lungs with oxygen, self touch or touch by other,⁶⁸ gentle movements, or orienting (looking or using other senses to explore the current environment consciously) are highly effective interventions to begin to restore a sense of embodied homeostasis.⁶⁹

Stabilization can be calming but also it can contribute to a person feeling more energized. For some people who have been shut down they may feel more alive and those who have been dissociated may feel more present. It is also important to note that some people will begin to feel more agitated or disorganized through the invitation to sense their bodily cues.⁷⁰ If this is the case, movement as well as orienting through one of the five senses in the present moment may be an initial step toward healing. One that does not include directly drawing attention to interoception.⁷¹

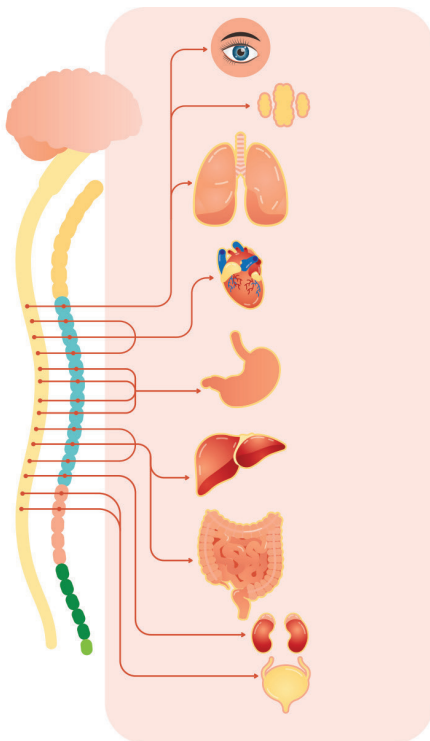
Polyvagal Theory

The rest of this chapter will focus on polyvagal theory and healing trauma. It is a modern neurobiological approach to healing from stress and trauma. It expands the understanding of the neuroanatomy of the threat response cycle. Polyvagal theory, which was devised by Stephen Porges,⁷³ emphasizes the vagal nerve's special capacity to regulate emotions and the ANS of humans and mammals. A polyvagal theory lens is applied in Somatic Experiencing trauma therapy and many other therapies.⁷⁴ The model also helps build a



PARASYMPATHETIC NERVES

- Constrict Pupils
- Stimulate Saliva
- Constrict Airways
- Slow Heartbeat
- Stimulate Activity of the Stomach
- Inhibit Release of Glucose
- Stimulate Gallbladder
- Stimulate Activity of the Intestines
- Contract Bladder



SYMPATHETIC NERVES

- Dilate Pupils
- Inhibit Saliva
- Relax Airways
- Increase Heartbeat
- Decrease Activity of the Stomach
- Stimulate Release of Glucose
- Inhibit Gallbladder
- Inhibit Area of the Intestines
- Secrete Epinephrine and Norepinephrine
- Relax Bladder

Figure 2. Physiological Responses That Can Be Tracked in the ANS

Field Exercise 3: Stabilization Exercise

Lead someone in one or all of the following exercises:

Orienting: “I’d like to invite you to look around. Use your head, neck, and eyes to move around the room as if they had a mind of their own.” You can ask, “As you look around, what sensations do you notice in your body?” Notice if orienting around or to a specific object/area in the room is helpful to the ANS, eliciting either feelings of aliveness or calm. If the person feels better you can ask, “What is the calm/aliveness/better feeling in your body like? Where do you feel that? What sensations are there? Would you be willing to take some time enjoying or simply being with that experience right now?” If a person reports they feel less tight, please ask them for a positive qualifier, like “more relaxed” or “open.” People can more often name and identify negative states more easily than pleasant or neutral ones. Note that some people will find their visual field uncomfortably activating. Instead, they can orient through other senses such as sound, scent, and tactile exploration of objects.

Grounding: “I’d like to invite you to feel your back, seat, and feet. Can you sense a quality of weightedness? Which one has a stronger connection to gravity, your feet, seat, or back? Would you be willing to place your attention there? Are you hovering above the chair/ground or allowing it to support you?” This exercise can often help people connect to their parasympathetic nervous system’s function of rest and digest. You may see a person breathing more deeply and observe musculature relaxing and sinking into the surface they are making contact with. If they settle you can ask, “Where do you feel that settled feeling? What sensations are there? Would you be willing to take some time enjoying or simply being with that experience right now?”

Self-contact: “I’d like to invite you to notice where your hands are falling naturally. Is this position of your hands familiar to you? Feel them and take in if it is comforting in some way.” If it is helpful you can ask, “Where do you feel that comforting or better feeling? What sensations are there? Would you be willing to take some time enjoying or simply being with that experience right now?” You can also direct a person to put their hands (or a trusted other’s hands, if appropriate) over their heart, stomach, or brainstem (base of the skull). This can feel very stabilizing for some individuals.⁷²

neuroanatomical framework on how to increase internal resilience, return to self-regulation, and foster a more socially engaged state where cooperation and peacebuilding can actually happen.

Polyvagal theory is based on neuroanatomy and research observation. Although supported by multiple studies, it is still being actively researched. The application of this

work goes beyond the polyvagal system with research on the effect of vagal tone stimulation to increase mood and reduce depression. Both exercises that increase vagal tone (reference) and vagal stimulators are being utilized to treat a wide array of depressive and deregulation symptoms.

Polyvagal theory suggests we have two pathways (hence, *poly* meaning many) to downregulate defense and promote the calmness needed for social engagement within the human nervous system. One is a passive pathway and the other an active pathway.⁷⁵ Through the neural auspices of the *neuroception* of safety, facial and vocal cues not only signal safety to others, but also enable one's own nervous system to accurately read the facial cues, vocal resonance, and bodily gestures and postures of others that signal they are safe to be in proximity to.⁷⁶ When we can read the cues of others accurately and with nuance, that in turn will make us feel safer. The word *vagus* means “wanderer” in Latin, as was thus named due to its extensive network of the very long vagus nerve which meanders from the brain to the neck and throughout the torso of the human body.

The vagus nerve is well-known for its capacity to regulate the heart rate and maintain homeostasis in the parasympathetic nervous system. However, Porges⁷⁷ also found that one branch, the *ventral vagus*, has distinctive functions that help increase prosocial behaviors and reduces hyperarousal and hypoarousal when the nervous system perceives safety. Yet when we perceive life threat, the other branch of the vagus, called the *dorsal vagus*, shifts to a very different life-preserving “shutdown” function. This branch inhibits prosocial behavior but allows us to evade a life threat by feigning death, getting very still, conserving energy, and numbing sensations and affect (emotion) associated with extreme distress.

The human ANS evolved sequentially over hundreds of millions of years to include the dorsal vagal system, the sympathetic system, and the ventral vagal system. The oldest of the three is the ancient dorsal vagal system which evolved 600 million years ago.⁷⁸ The dorsal vagus (originating at the dorsal or “back” side of the brainstem) and the ventral vagus (originating at the “front” of the brainstem) branches are both parasympathetic systems. These two specialized vagal circuits vary in function from immobilization behaviors when life threat is detected in the dorsal vagus, to the pro-social behaviors of the ventral vagus that signals safety to ourselves and others that allow mammals to connect in proximity to each other with safety, to share food, connect, sleep together without fear, to reproduce, and engage in intimate bonding.

Through the automatic neural process of neuroception, safety, danger, and life threat are subconsciously detected. Once detected, the ANS activates defenses or alternatively engages in socializing behaviors, emotions, and postures. The ANS can assess danger or safety within milliseconds and moves toward fight or flight in the sympathetic branch, freeze in the dorsal branch, or toward social engagement in the ventral vagal system. We can also have faulty neuroception, which we see commonly in survivors of trauma, where a person neurocepts danger based on triggers in unconscious (implicit) memory from the past. This faulty neuroception is one of the factors that fuels the rekindling of conflict.

Sympathetic Branch

The sympathetic system evolved 200 million years ago, and is a system of mobilization in animals including reptiles, mammals, birds, and fish.⁷⁹ It serves to mobilize us into movement to hunt for food, to find a mate, and to engage in active defenses to protect oneself, one's family, and one's community from danger. The sympathetic system, when without fear, allows us to experience the charge of excitement, joy, exuberance, and elation brought about a meaningful upcoming event or a special celebration, or the powering up we may feel while engaging in active sports, dance, or performance.

When a person moves into mobilization with fear, the subconscious neuroception of danger signals the sympathetic system to mobilize into action.⁸⁰ Affect can range from low intensity feelings such as mild worry, irritation, and frustration, to high intensity feelings with hyperarousal, of anger, anxiety, panic and rage. These intense emotions power the energy needed for physical defense. The active defensive behaviors of higher sympathetic tone include *fight* to stave off danger by directly engaging in conflict physically or with words, and *flight*, the evasion maneuvers to flee from danger through running, dodging, hiding, or ducking.

Fight physiology includes muscle tension of the head, neck, shoulders, arms or legs, darting hypervigilant eyes with a confrontational glare, tense facial muscles, rigid posture, and a readiness to pounce. *Flight physiology* also has tension in the same muscle groups, but the muscles tense in preparation to move toward escape and thus eyes are evasive and scanning for an exit like a door or a window. There may be affect such as fear, anxiety, or panic.

Dorsal Vagal Branch

When fight or flight are deemed as ineffective or unavailable, but threat is still perceived, neuroception moves from danger to life threat. If one's life is in danger, the more drastic dorsal vagal response is engaged. The survival behaviors offered by the dorsal vagal system differ from that of the sympathetic branch as they are passive rather than active defenses. This happens when fight or flight defenses are assessed as no longer working to preserve life. When hyperarousal increases too much to overwhelm (which varies by person and by situation), a “switch” is flipped and the ANS shifts to dorsal dominance. At that point, *immobilization with fear* occurs. We see immobility with fear in mice, rabbits, and opossums when they feign death as an evolutionarily clever way to survive when fight or flight are not successful. This is also known as *thanatosis*, or a freeze response. Here death seems imminent and the body and mind shift into an energy conservation mode in which oxygen consumption is greatly reduced. In humans faulty neuroception of life threat can trigger the dorsal immobilization system unnecessarily which depletes the nervous system, immune system, and psyche of the individual from prior under-negotiated traumas.⁸¹

Immobility without fear is part of intimate pair bonding, sexual intimacy, nursing a baby, healing from an injury or infection, rest, deep meditation states, when we can be immobile (not moving, not in active defense) with closely bonded mates or friends. This is a state not associated with overwhelm.

The dorsal branch of the vagus nerve primarily innervates the subdiaphragmatic organs of the intestines, intestinal wall, stomach, gall bladder, and liver as well as the heart, lungs, and lower esophagus.⁸² This is the *unmyelinated* (slower transmitting) part of the vagus nerve which activates under real or perceived conditions of life threat (neuroception of life threat). It allows humans and animals to go into a state of freeze with accompanying bradycardia (very slow heart rate), lowered blood pressure, and reduced oxygen blood levels. This serves in situations of perceived life threat to cause the predator to lose interest in us as a source of food, as dead or inert animals for many predatory species is not consumed. This can give the animal a chance to run away after they sense the predator becomes distracted and reboot their physiology to make a mad dash toward safety. It also floods the animal with analgesia, which numbs the creature to pain if it is killed or injured. Research shows that animals have a natural process to come out of the dorsal state.⁸³ Humans also go through this same process if they are given time, support, and allow their bodies to release the stress.⁸⁴

Porges⁸⁵ describes it as a metabolically expensive branch due to how the low oxygen state affects our physiologies, and as such it is not ideal to go into the freeze response for more than a few minutes. Those in refugee camps and in conflict zones may spend time immobilized physically due to curfew restrictions at the camp or in their village. When in immobility, the nervous system may perceive life threat when it is and even when it is not there. In this dorsal state, when we are subjected to more and more stress, it becomes a downward spiral, and we can become habituated to dorsal physiology as normal. In this case we need to bring attention to the *relative* safety cues provided by the people and environment around us. When we attend to the safety cues, social engagement and the increased vagal tone move the ANS in an *upward* spiral toward increasing well-being and resilience.⁸⁶

The freeze response is an under-recognized state in human trauma. Ellert Nijenhuis and colleagues⁸⁷ wrote one of the earliest scientific papers on the phenomena of freeze in human beings as correlated to the more well researched science of freeze in animals. There are countless studies in neuroscience with shocks and rodents that have proven to pair an unconditioned stimulus to a conditioned response.⁸⁸ The scientist pairs a buzzer to a foot shock and the rodent freezes (unconditioned stimulus) and then later sounds the buzzer without the shock and the rodent still freezes (conditioned response). The same conditioned responses with freeze can occur, and regularly does when there is unresolved trauma physiology in human beings. More studies on the freeze response in humans and not only in rodents are needed to fully examine the function of the dorsal vagal branch. However, ethically studying freeze in a laboratory would raise ethical concerns for the safety and well-being of research participants.

Psychoeducation about neuroception in humans can be helpful for peacebuilders and the communities in which they are living. Sharing that a person's body, just like an animal, went into a state of freeze to protect themselves and that they survived doing just this protective behavior, can help them when dealing with shame, confusion, and self-doubt. It can help frame their experience and ongoing symptoms in a non-pathologizing framework.

Working through the interoceptive state of freeze (dorsal), and the transitional autonomic release (shaking, trembling, tingling, vibration, warmth) can help return a person back to the neuroception of "relative safety." Neuroception of safety helps down-regulate arousal to allow some settling so rest, restoration, and digestion can occur to some degree. Engaging the sensory awareness in the body is a key for a person to rec-

United States: We were serving people post-hurricanes Rita and Katrina. There was a soldier who had just returned from two deployments in Iraq. Due to hurricane displacement, he came back to find his family scattered throughout six states. His house was gone: Everything was gone. His hand was visibly shaking. Looking at his hand he said, “Are you saying this is normal?” “Yes sir” answered my colleague, “I am telling you this is normal.” His hand stayed up and he said, “Are you telling me I am not insane?” “Yes sir I am telling you you’re not insane.” And to this day it still chokes me up. And then he said, “Are you telling me I’m not a coward?” “Yes sir I am telling you you’re not a coward.” He put his hand down and then he allowed his body to gently shake until it stopped. It happens that these “symptoms” are normal. But people don’t allow their bodies to shake and release stress. For soldiers, sensations can feel downright dangerous, and at one time were. In the First World War, my father told me, if a man started trembling he’d be placed against a wall and shot. Shaking and trembling to come down out of survival physiology is what a healthy animal does. When you step on military ground you are working with people who are trained to ignore instinct.

—Giselle Genillard, *Somatic Experiencing Practitioner (SEP)*,
SOS International Director

ognize their sense of relative safety in the moment. When in a conflict zone when active combat is not happening for instance, access to the capacity of the senses to take in cues of relative safety in the present moment is essential to shift from the dorsal vagal state and into the more adaptive and restorative ventral vagal system. Close intimate relationships help to *neurocept* safety. Practice recognizing cues of safety can be facilitated by peace-builders and body awareness exercises can be crucial in shifting a faulty neuroception of danger or life threat to one of neuroception of safety.

Ventral Vagal System

When our subconscious detection system of neuroception discerns safety in our environment and within our own physiologies, our ventral vagal tone increases. Nerves connected to the vagus throughout the viscera tell the brainstem and cortex it is safe to come out of hypervigilance and shutdown. The ventral vagus system inhibits the defense systems of fight, flight, and freeze and enable us to socially engage with trusted others with ease and the feeling of safety.⁸⁹ It influences facial movements to express the relaxed yet alert internal state that expresses pleasure, interest, and curiosity. The natural melodic vocal intonations (*prosody*) characteristic of playful connection with friends and family are part of the ventral state. Eye contact is soft, relaxed, and includes a wider peripheral

view rather than centrally focused vision, and a person in this state naturally takes in their surroundings more. The body, when the ventral vagal branch is dominant, also exhibits postures and gestures that in their relaxed non-predatory stance, signals safety to others.

Creating the initial conditions for ventral vagal dominance can be achieved by finding and placing conscious attention on safety cues rather than by removing the perceived threat.⁹⁰ This is a key point. Attending to only threat in a pre-conflict or postconflict zone can produce more dysregulation, discord, or dissociation. If attention, however, can be directed to linger on the small orienting moments; a smile or perhaps the sensation of a reassuring hand on one's shoulder, or the words of a song that come to one's lips, this can promote the ventral state. Bethany Kok and Barbara Frederickson⁹¹ found that positive emotions increased vagal tone and resilience (measured through heart rate variability). This fostered improved social engagement in an upward spiral in which vagal tone engendered a state of well-being, and that well-being increased the vagal tone further. A robust social engagement system has easier and increasingly stable access to cues of safety. For peacebuilding to happen, the more stable the social engagement system, the better. Frederickson et al.⁹² with 9/11 survivors, in a similar finding, discovered that a reciprocal relationship between vagal tone and positive emotions existed: positive emotions increased vagal tone and in turn, increased vagal tone increased positive emotions. The neural exercises to increase vagal tone are the beginning of creating a new resilience upon which building peace can happen.

Due to an interface between the heart and lungs with the neural circuits that control the expressions and vocalizations of the face and neck, we can see the state of the nervous system and emotional well-being on our faces. Porges⁹³ describes this as the face-heart connection. The facial muscles, middle ear, muscles around the eyes that influence eye expression, pharynx (swallowing) and larynx (vocal pitch) are innervated by cranial nerves that grow out of the same area of the nucleus ambiguus in the brain stem where the ventral vagus originates.⁹⁴ This is the somato-motor segment of the ventral vagus. The heart rate, blood pressure, blood gas levels, and lungs are all regulated by the vagus as well. When we see a friendly face, someone we know is safe for us to confide in for instance, our default fast heart rate of 90 beats per minute slows down, through what is called the *vagal brake*, so that we can slow down for connection and bonding. This takes us out of the fight/flight machinations of the sympathetic defense circuitry to a slower heart rate of approximately 74 beats per minute where intimacy and relaxation can take place without fear.⁹⁵

Communication and listening to each other is essential for peacebuilding and reduction of conflict. Auditory shifts in mammals allow the bass tones of predator footsteps, a roar, grunt or growl, to be detected and thus to evade a predator. This dampening via the middle ear muscles also occurs when the ANS is sympathetic or dorsal vagal dominant. The ventral vagal system allows us to shift out of hearing exclusively bass tones when we neurocept safety. Then we can hear, listen, and communicate with others with ease, which further down-regulates hyperarousal.

Peacebuilders can support a shift in a traumatized individual's state via tracking (attending to internal awareness) or following interoception. However, mindful awareness itself is often not enough. For many people internal tracking with no aim can exacerbate traumatic symptoms.⁹⁶ Willoughby Britton and her lab at Brown University⁹⁷ recently studied a large number of meditators who were traumatized by mindfulness practices. Meditators were encouraged to follow internal states of dysregulation and dissociation with no tools to deal with their distress. Many suffered severe psychological and physical symptoms after mindfulness retreats and courses. Often trauma survivors must be directed to non-threatening stimuli inside and outside their bodies and away from the sensations of traumatic activation.⁹⁸ They can also benefit by working through their non-conscious responses in their body and what are known as somatic markers.⁹⁹

Implicit and Explicit Memory

According to Antonio Damasio,¹⁰⁰ bodies have somatic (body-oriented) markers that determine not only how people feel about themselves and their environments, but also how they will respond to most situations in their lives. Humans believe that we do this consciously, but a multitude of our individual and collective responses are based on the brain's interpretation of unconscious bodily states.

Somatic markers develop throughout our lives and have great power to sculpt our reactions as they are at the foundation of the earliest sense of self. Infants primarily learn through implicit, or nonconscious, memory.¹⁰¹ They are surrounded by sound, movement, and emotional cycles of caregivers attunement (sensory and affective responsiveness) and misattunement.¹⁰² Peter Levine's Somatic Experiencing,¹⁰³ as well as other somatic psychological approaches, focus more on resolving the implicit imprint of relational trauma in the body, before working on explicit cognitive meaning making.

Implicit and Explicit Memory

- Implicit memory (also known as “nondeclarative memory”) is nonconscious; present at birth; subcortical/amygdala-based; lacking a sense of recollection when it is recalled; is part of behavioral, perceptual, and emotional memory; can be registered in the body in some branches; and does not require conscious attention to encode.
- Explicit memory (also known as “declarative memory”) is conscious; develops in our second year and beyond; is cortical/ hippocampus-driven; there is a sense of recollection when it is recalled; if it is autobiographical, there is a sense of self and time; includes episodic (autobiographical memory); includes semantic (factual) memory; requires conscious attention to encode; and if it is autobiographical, requires the prefrontal cortex.¹⁰⁴

The implicit branch of emotional associative memory is connected to bodily states that can be accessed via interoception.¹⁰⁵ For example, a boy returns home after being captured and forced to work for a military camp. Although he and his family relocate to a safer area, he remains in a state of hypervigilance, always fearing that he and his family may be taken, or that he will be awakened in the night during another raid. His heart rate is high at base line and his palms are sweaty. His sleep is constantly interrupted when he jumps to benign sounds in the night. His body is responding as if there is an imminent attack and he experiences an ongoing heightened startle response, defensive orienting strategy (scanning), and flight/fear physiology. Any associations through the five senses that remind him of the abduction and the camp will trigger this alert and protective response in his body.

The implicit branch of the associative motor system is involved if the passive defensive response of freeze was engaged.¹⁰⁶ In this event, the boy would experience feelings of numbness, heaviness, rigid tenseness or hypotonic collapse, depression, and possible thoughts of self-harm, lack of a sense of future with the futility of going on living.¹⁰⁷

The boy may also have an explicit story about the abduction and his return to his family. He may be able to talk about the incident, but underneath his narrative his body would be responding in a state of agitation and/or freeze. A somatic approach to healing trauma is to work with the bodily signals in the ANS associated to unresolved cycles of threat. When a person can tell their story without feeling overwhelmed or disconnected, and express a full range of congruent emotions, then an integration and renegotiation

of the traumatic memory has taken place. This integration will allow the person to move forward in life and not be stuck in psychobiological traumatic re-enactment.¹⁰⁸

Growing up in a conflict zone, or being raised by parents who carry the psychobiological imprints of trauma, can impact a person's own regulatory capacity.¹⁰⁹ This is passed down in implicit non-conscious memory. Focusing on positive relational interactions between healers and community members can begin to help a person connect to their sense of trust within themselves to accurately “read” and respond to others. When infants in subsequent generations are exposed to unresolved trauma in their caregivers' nervous systems, transgenerational patterns of trauma can be passed down through somatic markers.¹¹⁰ (See the preceding article for a detailed discussion of epigenetic and transgenerational trauma.) Working directly with the somatic patterns of intergenerational trauma is accessible and changeable through the expression of an individual's nervous system function. That individual can break the cycle of transgenerational trauma and pass down secure attachments and a capacity for physiological and emotional regulation to future generations.¹¹¹

Working primarily with narrative to heal trauma may only go so far and may not heal the deeper implicit imprint of trauma.¹¹² Awareness that accesses bodily aspects of implicit memory and gives a person a new feeling of an experience of themselves and the world is often a necessary key to resolving trauma.¹¹³

Collective Trauma and Community Healing

“Collective trauma” is a term that describes the psychological impact of traumatic events on an entire group, community, or society. This could be from a single brief cataclysmic event, such as an earthquake or flood that destroys a town, or a systematic series of events such as a war, displacement, ongoing conflict, famine, genocide, structural inequality, school shooting, or the marginalization or enslavement of a people or culture over time.

Collective trauma alters the course of a people, of a way of life. The collective memory of trauma differs from individual memory, as it exists in group members whether they were present or not. The identity of group members can be significantly altered by the traumatic event or period of time.¹¹⁴ Through trauma, groups, communities, and cultures can lose touch with cultural customs, rituals, positive identity and pride, all of which have brought connection, life purpose, communality and both healing capacity and regulation capacity. Emotions, sensations and meaning about the impact of trau-

matic events may be felt immediately or, as in the case of transgenerational trauma, they may be felt or expressed fifty or two hundred years later in the psychobiologies of subsequent generations.¹¹⁵

There is a balance between familiar meaning-making strategies and embodiment strategies. One aspect of traumatic stress can be the continual attempt to reconstruct a narrative about the trauma in order to make cognitive, sequential sense of what happened to oneself, or to one's people. Trying to understand the meaning of the event can be a beneficial coping skill as the reappraisal of the trauma and its meaning for the group can orientate and contextualize their experience. It can be part of what builds connection between group members, and can help them strategize ways to create change.¹¹⁶

Sometimes telling the story can be dysregulating. Richard Mollica¹¹⁷ describes that, when he works with refugees and survivors of torture, the repetitive retelling of a traumatic story can overwhelm the client. "The psychotherapist is often bewildered by the exceptional individual who repeats his trauma story unremittingly. Since the therapist is so unsuspecting (and often so appreciative) of such open revelations, he can easily become entangled in these stories." He emphasized that when trauma stories are in an "untransformed state," that propels survivors to "become" their trauma story and stay stuck in a repetitive storytelling cycle with no development.

The body can tell a story as well. From a bottom-up (moving from a body and lower brain to higher order cognition) perspective, interoceptive and proprioceptive awareness are privileged before cognition. In this work, the trauma story is not elicited, if at all, until sufficient emotional and ANS regulation is present.¹¹⁸ The organic (unprompted) emergence of orienting, positive sensations, emotions, gestures, and the images related to them, which increase ventral vagal tone, are brought attention to and deepened. The focus is on the individual's nervous system and not on the story.¹¹⁹ The story is only employed in small amounts to help the ANS to "digest" the traumatic activation so that it can reorganize. So when a person or peacebuilder notices a small rise in activation, they can deliberately pause the narrative, and ask the person to return to the present moment and notice sensations. This slowed-down, incremental process prevents overwhelm and transforms the nervous system. New meanings are often generated from a new feeling state that were not possible before.

It is important for peacebuilders from other countries to be sensitive to cultural differences. Because of loss or denigration of cultural identity, incorporating cultural resources from the culture they are in, is encouraged as much as possible. Transcultural

Northern Ireland: I work with Relatives for Justice (RoJ) in Belfast. It's an organization created in 1991 by relatives of people killed in the North of Ireland by British soldiers. Today, it provides support inclusively to all relatives of people killed or injured by the conflict. Ciara was in her mid-forties with two children, and sought me out to help her deal with the anxiety and complex grief from the death of her twelve-year-old brother twenty years ago. He was shot and killed by the British army on the street when she was six years old. She suffered panic attacks, night terrors, and heavy debilitating sadness, and was preoccupied by the British government's silence in the role they played in his death. She slept excessively, using sleep as a way to shut down and disengage. For twenty years, she would wake up in terror, frequently hearing a voice say that her children would die. Her husband was physically and emotionally abusive. Ciara did not talk about the details of the day her brother was killed for some time. It was a poignant moment when we finally talked about the day her brother was killed. Ciara did not move her body in session, and when she did she moved robotically. So I was surprised when I saw her spontaneously swinging her legs. I encouraged Ciara to "let your legs do what they want to do." Ciara said, "It's interesting. I feel like my feet are dangling above the ground." I encouraged her to continue allowing the involuntary movement of the swinging of her legs, and to feel the sensations of that. As she allowed them to swing, she remembered that she had been swinging her feet back on that painful day. "I remember now, when I returned home from my friend's house, my father lifted me up into his arms, and my legs were dangling, just like this. I was in his arms when he told me that my brother was dead." Previously, she had regarded that moment "as one in which a terrible thing had struck her." With this new embodied memory, she felt something different. She could feel the protective arms of her father holding her.

—Brid Keenan, *Somatic Experiencing Practitioner (SEP)*, Gestalt therapist

psychiatrist Laurence Kirmayer¹²⁰ suggested listening to a person's elaboration on their own sensation experience, in order for the listener to avoid their own cultural assumptions about what that sensation means.¹²¹ For example, one of the co-author's experiences while working in the high temperatures of post-tsunami South India was that release into the parasympathetic from high activation was preceded by the sensation of coolness rather than the warmth she usually was accustomed to hearing about in other cultures. Coolness was often reported instead, yet was the same autonomic phenomena. In another example from the vignette below, Tibetans point to the chest when they speak of the mind, as they often use the same word when talking about the mind and the feeling heart.¹²²

Community Resources

Somatic community resources can help communities recover and reconnect. Due to the negativity bias in the human brain, especially following traumatizing events, conscious interoceptive attention on cultural, familial, and personal resources can be nonexistent or sorely lacking.¹²³ As the Transcultural Psychosocial Organization's Eisenbruch et al. asserted, "traditional healers have value as 'trauma therapists,'" as they possess culture-specific wisdom and practices that outsiders cannot offer, and this provides further safety and engagement.¹²⁴ Signals of safety include those communicated through eye contact, melodic vocal expressions such as singing, chanting, and humming, as well as gentle, prosodic speaking voices. The acts of making art, doing community restoration projects together, and engaging in cooperative interpersonal actions can be purposefully encouraged by the community itself through a variety of community gatherings, as they recognize the inherent value of ventral vagal tone. When one person can attune to the faces of others, read social cues of safety, and can express such cues through their own voice and face, the heart rate and breathing become more regulated among other members of the group.¹²⁵ Creating opportunities for such facial and vocal engagement enhances communal regulation.

Directing attention towards personal and collective resources, and implementation of collective orienting and resourcing practices that bring the community together and increase wellbeing can be explored with community members.¹²⁶ Community practices such as drumming, dancing, singing,¹²⁷ connecting to nature, call and response, games, group prayer, chants, rituals, religious and cultural observations, can serve to increase neuroception of safety. These can be identified, explored, and adapted in guided community meetings.¹²⁸ Porges¹²⁹ stated, "A careful investigation of many rituals results in the identification that the rituals are functional exercises of vagal pathways." These traditional practices, as many cultures appreciate, can bring a sense of enduring well-being. To ensure neural processing of these ventral vagal exercises, an invitation to pause and savor the experience can result in further increase in ventral vagal tone.¹³⁰ This well-being is enhanced when people build sensation-tracking capacity by using interoceptive exercises before and alongside them.¹³¹

India: In 2005, we had been working with the devastating aftermath of the Tsunami in India. There was a massive heat wave for five weeks. We were primarily working with Indian fishermen, but one day, one hundred Indian women from different cultural groups came to see us. These women were in different phases from shock, to denial, to anger. Their men were feeling lost. They couldn't go back to the sea because the freeze in their nervous systems was too great. They couldn't fish and bring food home so they couldn't help their families. Many men started drinking, and domestic violence increased dramatically. One group of twenty-five women walked into a group with me with their postures slumped and collapsed. I introduced the concept of resource and they looked blank. They were in villages with only one tree left, green tents, children and families gone, with only one cooking pot. Just so much loss. I asked them to look for a small resource and no one said a word. Then one woman straightened a little bit. She made a hand gesture, weaving them back and forth. I recognized it as the gesture for braiding hair. At that moment the light in many eyes sparked around the circle. They started to move, talk and look at one another, it was like a little candle flame had lit and was illuminating all around their circle. To be witness to that and particularly with no words just one gesture of braiding invisible hair. The chatting and connecting with one another continued. They walked out upright with saris wrapped elegantly around their shoulders. Even if trauma continued, they could share that concept of resources with those that were not there—that small gesture.

—Giselle Genillard, *Somatic Experiencing Practitioner (SEP)*,
SOS Internationale Director

Conclusion

We suggest that peacebuilders approach the impact of trauma from a neuropsychological perspective. As they work with implicit, not explicit memory, autonomic regulation can be increased to improve both individual and community health. Local community healing practices can be interwoven with nervous system principles to help restore regulation and well-being. Educating healers and community members to carry on the work so that outside support no longer is necessary will also contribute to stability. Facilitating individuals and communities to reduce trauma symptoms using a neurophysiological approach can improve interpersonal communication via social engagement structures, and can increase effective capacity to resolve future conflict.

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Conclusion

Why Peacebuilders Need the Help of Neuroscience

Colette Rausch

In 1998, I was working in Bosnia, which was trying to recover from three years of horrific war in 1992–95. An estimated one hundred thousand people had died, including eight thousand Bosnian Muslim boys and men from the town of Srebrenica. The massacre at Srebrenica was the largest in Europe since the Holocaust and was deemed to be genocide by the International Criminal Tribunal for the Former Yugoslavia (ICTY).¹ I was a US federal prosecutor at the time and was sent by the US Department of Justice to Bosnia to train judges, prosecutors, and defense attorneys on the provisions of the newly adopted criminal laws and procedures that had been reformed to comply with international standards. I spent six months traveling around the country, seeing hillsides and valleys pockmarked with mass graves, driving through desolate villages full only of the burned-out shells of homes, and working side by side with Bosnians who had lost families and friends to the war and had witnessed human depravity. Back in the United States, I found myself struggling to understand how a well-educated European society that had hosted the 1984 Winter Olympics and for decades had enjoyed peaceful coexistence among its ethnic and religious groups could become a place where neighbors turned on neighbors, families turned on families, and politicians manipulated the politics of fear and division that launched society on a path to genocide. I wondered if such a descent into horror could happen anywhere, including in my own country. Are we all susceptible to such violence? And if so, why and what can we do to prevent it?

I recalled hearing in Bosnia great frustration on the part of members of the international community, who would complain, “The war is over. Why don’t the Bosnians just get over it and rebuild their country? Why can’t they quit trying to revisit the past by calling for accountability of those responsible for the genocide?” When I heard such comments, I thought about the people I worked with, who did not seem to have political agendas or

obstructionist aims. There was something deeper, at an emotional or a unconscious level, that was driving their desire for justice and accountability.

Just before I left Bosnia, I traveled with senior members of the Attorney General's Office, Supreme Court, and Ministry of Justice to a conference in the countryside. We were staying at an inn, and after dinner, as the wine was flowing, the conversation around the table turned to the war. The tone of voices changed, becoming more solemn and less animated and body language became stiffer and less expressive. The room seemed to fill, physically, with memories to a point where I felt like I could not breathe or hold a thought. I had to leave the room. Once back in the safety of my sleeping quarters, I closed my eyes to block out what I heard. At the time, I wondered what had happened in that room that had had such a visceral effect on everyone around the table.

My experiences in Bosnia, and the questions they provoked, have ultimately led me here, to this project to explore the nexus of peacebuilding and neuroscience. Like many of my peacebuilding colleagues, I have often been confronted in conflict-affected societies by outlooks and behavior that seem to defy logic, and by emotions and attitudes that run so deep they cannot be plumbed. We peacebuilders arrive in a country recently torn apart by violence equipped with what seem to us to be eminently sensible plans and programs, but frequently we find that what we bring does not respond to local needs as local people frame them, or we offer technical fixes to issues that run much deeper. As a consequence, peacebuilding's track record over the past two or three decades can at best be described as "mixed." Most peacebuilding efforts ("interventions," to use the jargon) do not produce sustainable results. The question naturally presents itself: Why?

One of the chief reasons, it seems to me, is that peacebuilders, buoyed by technocratic skills and incentivized by donor expectations, fail to adequately factor the human element (the ways we think, the experiences we have, and our responses to those experiences) into their technical "fixes" or to fully understand how and why people behave as they do during and in the aftermath of violent conflict. This recognition of our overly technical approach leads naturally to a second question: How can we improve our understanding of why people behave as they do?

The search for an answer to that question has inspired this project. If any field of scientific exploration can help us discover why people behave in ways that to outsiders can seem illogical or inscrutable it is surely neuroscience. Every week or month brings another media report spotlighting another remarkable discovery by neuroscientists into the working of the human mind and the wiring of the human brain. The field of

neuroscience is both dynamic and revelatory. And as the articles in “Neuroscience and Peacebuilding” make abundantly clear, what neuroscientists are revealing can help peacebuilders not only better understand the people they work with in conflict-affected societies but also—potentially—translate that understanding into practical applications in those societies.

This article concludes “Neuroscience and Peacebuilding” by explaining what peacebuilders do and how, with the help of neuroscience, they might do it better. The article begins with a brief primer on peacebuilding that is intended to introduce non-peacebuilders to the field and to explain to all our readers—peacebuilders and non-peacebuilders alike—how we are using “peacebuilding.” The following primer defines the term; chronicles how the international community’s understanding of it has evolved; and describes the range of actors that conduct peacebuilding. The article then explains why peacebuilders need the help of neuroscientist by looking at the peacebuilding record and the experiences of peacebuilders. It presents examples from my own and my colleagues’ experiences in warzones to illustrate the kinds of neuroscientific knowledge and insights we can learn from and use. In some cases, neuroscience may confirm peacebuilders’ intuitive understandings; in others, it may deepen and refine their awareness; and in yet others, it has the potential to inspire new and previously unimagined peacebuilding approaches. The article concludes by spotlighting a variety of current peacebuilding tools and techniques and to show how they might be made more effective by incorporating neuroscientific discoveries.

A Peacebuilding Primer

What Do We Mean by “Peacebuilding”?

There is no universally accepted definition of peacebuilding. Within the peacebuilding field itself, definitions are seldom contradictory, but they tend to vary significantly in length and to spotlight different facets of what all peacebuilders seem to agree is an inherently multifaceted endeavor. Some definitions are short and focus on drivers of conflict, such as this from a global network of civil society organizations called the Global Partnership for Prevention of Armed Conflict: “Peacebuilding involves addressing social and political sources of conflict as well as reconciliation.”² Others are longer and center on different peacebuilding goals, such as this definition from the Organization for Economic Co-operation and Development, an intergovernmental body that includes many of the world’s wealthiest countries: “[Peacebuilding] includes activities designed to prevent

conflict through addressing structural and proximate causes of violence, promoting sustainable peace, delegitimizing violence as a dispute resolution strategy, building capacity within society to peacefully manage disputes, and reducing vulnerability to triggers that may spark violence.”³

The United States Institute of Peace’s *Peace Terms* (a glossary for the peacebuilding field) offers a definition that emphasizes the broad range of peacebuilding activities:

Originally conceived in the context of postconflict recovery efforts to promote reconciliation and reconstruction, the term peacebuilding has more recently taken on a broader meaning. It may include providing humanitarian relief, protecting human rights, ensuring security, establishing nonviolent modes of resolving conflicts, fostering reconciliation, providing trauma-healing services, repatriating refugees and resettling internally displaced persons, supporting broad-based education, and aiding in economic reconstruction. As such, it also includes conflict prevention in the sense of preventing the recurrence of violence, as well as conflict management and postconflict recovery.⁴

“Neuroscience and Peacebuilding” embraces an expansive definition of “peacebuilding,” using the term to mean *efforts to help prevent, manage, or resolve violent conflict in a society threatened by, experiencing, or trying to recover from war with another country or—and more commonly—civil war, insurgency, or some other form of internal conflict*. This is, purposefully, a broad definitional umbrella. Indeed, given that our aim is to explore any promising path along which neuroscience might help build peace, we use “peacebuilding” to encompass activities that are not explicitly mentioned in the definition—activities such as negotiating peace agreements and mediating between warring groups.

The Evolving Understanding of “Peacebuilding”

Like most definitions and fields of practice, that of peacebuilding has evolved over time and continues to evolve. Peacebuilding can trace its conceptual lineage to efforts to rebuild Europe in the immediate aftermath of World War II. In the 1950s and 1960s, the field of “peace studies” emerged and research institutions were established to explore and push back its boundaries.⁵ Against this backdrop of intellectual activity, the international community—often in the shape of the United Nations—began to experiment with different forms of “peacemaking” and “peacekeeping.” Broadly speaking, the former term came to mean efforts to persuade the parties to a conflict (whether two or more countries fighting an interstate war or a government and rebel forces locked in civil strife) to come together

and negotiate cease-fires and peace agreements. The latter term, “peacekeeping,” came to refer to the practice of dispatching troops and police from third-party countries to monitor the behavior of the signatories to those cease-fires and peace agreements, and to help establish security in societies struggling to reconcile and rebuild.

Peacebuilding is distinct from, and broader than, both peacemaking and peacekeeping. It is also a newer concept. Indeed, only in the past twenty-five years has peacebuilding gained recognition as a multidisciplinary field of study and practice. The impetus for this was the end of the Cold War and the civil wars that raged in the 1990s, which inspired considerable interest in finding new ways to tackle violent conflict. In 1992, the secretary-general of the United Nations, Boutros Boutros-Ghali, issued a report called *An Agenda for Peace*. The report was seen as a landmark statement of the international community’s expanding conception of peace and how to maintain or restore it. Among other influential contributions to the debate on what conflict resolution tools should be employed, *An Agenda for Peace* highlighted the need for preventive diplomacy and offered definitions of emerging terms, notably “post-conflict peacebuilding,” which Boutros-Ghali said “consists of a range of activities associated with capacity building, reconciliation, and societal transformation. Peacebuilding is a long-term process that occurs after violent conflict has slowed down or come to a halt.”⁶

In the twenty-first century, peacebuilding has also come to be linked to the field of development. Originally, “development” was used to describe efforts to promote economic prosperity and opportunity, and development had traditionally been seen as a separate paradigm from peacebuilding. But that view has changed as understandings of “development” have expanded to include concerns such as human rights, governance, and the environment,⁷ and as the recognition has grown that conflict (and its prevention, management, or resolution) and development are naturally linked in practice. Scholars led the way in tying the two notions together, with the *Journal of Peacebuilding and Development* first appearing in 2002. But policymakers subsequently followed suit and have linked development and peacebuilding in a variety of policy frameworks, including the United Nations’ Sustainable Development Goals (SDGs) initiative, adopted in 2015. SDG 16 is titled “Peace, Justice and Strong Institutions” and it seeks, by 2030, to “promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.”⁸ In 2018, the United Nations and the World Bank published a joint study, *Pathways for Peace*,⁹ that squarely aligns peace, security, and development, and that emphasizes the prevention

of conflict, which policymakers and funders of international aid have tended to neglect, focusing instead on managing crises and recovering from conflict.

The peacebuilding and development landscape is currently undergoing rapid change. “Traditional models of development, infused with Western values and led by government aid agencies, are being challenged by autocratic or private sector-driven models. . . . Traditional development actors—not just Western bilateral donors but also institutions such as the World Bank and the regional multilateral development banks—[are expected to] play a lesser role. New players will change the dynamics of global development to the disadvantage of the old powers.”¹⁰ It is too early to tell whether these shifts will lead to a dramatic and enduring transformation of the field, or whether the changes will prove less profound and more evanescent than they currently appear. Even so, there is no doubt that who does what, why they do it, and what they hope to accomplish is in flux. These changes have been gathering pace for the past two decades, if not longer, but they have recently accelerated sharply, in the process throwing numerous long-standing assumptions into doubt and creating uncertainty about where we are headed.

Who Does Peacebuilding?

Peacebuilding is conducted by a wide range of institutions and organizations, including international and regional organizations, governments, nongovernmental organizations (NGOs), and academic institutions. Those entities employ an even wider range of individual peacebuilders, from diplomats to military peacekeepers, human rights monitors to humanitarian aid workers, civilian police officers to economic development advisors.

The most prominent intergovernmental organization is the United Nations, whose mandate and emphasis is on providing assistance to national actors engaged in peacebuilding activities. Within the United Nations’ alphabet soup of agencies, the one that is most active in the peace process aspect of peacebuilding is the Department of Political and Peacebuilding Affairs (UNPPA), which is mandated to provide, among other things, assistance on mediation, preventive diplomacy, and peacemaking activities such as peace negotiations.

A wide array of other international and intergovernmental organizations (some global in scope, others restricted to a particular region) also play a variety of peacebuilding roles—albeit in most cases roles that are subsidiary to the organization’s purpose. Some of these entities (e.g., the International Monetary Fund and the Organization for

Security and Co-operation in Europe) offer financial or technical guidance to conflict-affected countries. Some are made up of member states with a governance structure designed to facilitate cooperation and problem solving amongst its members (e.g., the European Union, Council of Europe, the Arab League, and the Association of Southeast Asian Nations). Some have the capacity to take military action (e.g., NATO) or to deploy peacekeeping forces (e.g., the African Union).

These types of organizations are most effective when member states give them the resources they need and use them as a forum for resolving disputes and solving problems by taking coordinated action. Regional organizations tend to have legitimacy with governments and citizens within their regions, and this respect can be leveraged to great effect, especially when coupled with the local knowledge and cultural sensitivity the organizations typically possess. However, some intergovernmental organizations also have a reputation—often a well-deserved reputation—for being bureaucratically top-heavy, politically fractious, and under-resourced, and thus often slow-moving and ineffective.

Individual governments engage in peacebuilding activities through their contributions to intergovernmental organizations—with those contributions ranging from paying their “assessments” to contributing troops to a peacekeeping operation to lending political and diplomatic support to an initiative—and through bilateral support to a conflict-affected state that is typically channeled through their foreign ministries or development offices. A state may decide to offer such support for a wide variety of reasons. Some states may focus on strategic and economic national interests, and calculate that these can be advanced and their influence strengthened by providing aid or other help to a conflict-affected country. Other states may feel a moral obligation to intervene or seek to spread their values via aid.

A vast array of local, regional, and international NGOs play peacebuilding roles.¹¹ Some NGOs are specifically focused on peacebuilding, such as supporting peace processes, while others work on components that support peacebuilding more broadly, such as security, economic development, and human rights. Few, if any, of these NGOs command the power and resources available to wealthy states and well-resourced international organizations. But NGOs have their own advantages. Many NGOs, especially the smaller ones, have the independence, capacity, and lack of bureaucratic strictures to engage with agility and speed. They are also more likely than governments to take a long-term perspective and accept the need for painstaking and protracted peacebuilding work. And NGOs, especially

those that already have a presence in a conflict zone, can have a firsthand understanding of the realities on the ground, as well as close ties to local leaders and communities.

NGOs that play peacebuilding roles vary vastly in terms of their size, goals, and activities. Some are large and well-resourced international organizations that work in numerous places around the world and have a broad portfolio of activities. Some other NGOs are national, not international, organizations, operating within a single country and typically pursuing a relatively narrow agenda. Other NGOs are local organizations that operate within a single town or neighborhood, pursue a tightly focused goal, and, typically, have little funding and few or no full-time staff.

* * *

Although, as noted above, different types of peacebuilding actors tend to undertake different sorts of activities, one must not overgeneralize about who does what. In every intervention, a fluid combination of factors is present that shapes which actors get involved, why, and how. Political, economic, ideological, and security interests can encourage or discourage an actor's involvement, and available resources, expertise, and partners can determine what form that involvement takes, as can an actor's view of what constitutes the most effective type of intervention.

Some actors—not least, but not only and not always, governments and intergovernmental entities—believe that the power to stoke conflict or foster peace rests above all in formal state institutions and structures. Therefore, they look at peacebuilding as a primarily top-down activity that should center on the state and its institutions. They may seek to find ways to strengthen the state's ability to govern in a transparent and accountable fashion, to provide security, and to manage conflict. This could include a range of activities including reforming security-related institutions, adopting legislation designed to encourage economic investment, and holding elections. Oftentimes, this approach, which is generally centralized in the capital of the country in question, relies on outside experts who take the lead. Consultation with local actors is often limited and when done, is focused on a small group of professional elites in the capital of the country.

Other peacebuilding actors believe that the power for addressing violent conflict lies at a more community-based level and take a bottom-up approach. These actors focus more at the grassroots level, working with civil society organizations and communities. These activities are sometimes clustered around the capital, but often they are spread across the country, in regional and rural centers. In many countries, it is a fiction to assume that the central government has control over all its territory—or, indeed, that it

has ever enjoyed such control. In many countries, local and community-based structures operate to govern and resolve conflict, either traditionally and historically or because the state has collapsed amid conflict, leaving a vacuum for local structures to fill.

Still other peacebuilding actors favor a combination of top-down and bottom-up approaches. They seek to address the structural, political, and societal issues that drive violent conflict by working with formal institutions as well as with grassroots and local groups, often using ways to connect the two through dialogue and stressing the importance of inclusion as a way to peace.

Peacebuilding's Track Record

Despite the large cast of peacebuilding actors—and despite their expertise, commitment, and resources—peacebuilding efforts have often achieved less than policymakers and practitioners had hoped.

That is not to say all peacebuilding interventions have failed. If we define “success” to mean preventing or halting violent conflict while continuing to address its structural drivers in the search to transform society, then we can point to more than a few examples of success—albeit often partial—this century. For instance, success on a national scale was achieved via the 2016 peace agreement between the Colombian government and the FARC rebels, which was hailed as a landmark agreement that ended five decades of war. The peace process itself won praise for the high level of women’s participation. The agreement was applauded by the international community because it was seen as comprehensive in striving to address structural issues such as rural reform, provide redress for victims, address the problem of illicit drugs, and promote political participation. Yet, like many agreements, implementation is proving challenging, and it is far too early to tell if the initial gains achieved will be sustained.

Nepal, too, is a tale of success overall. A 2006 peace agreement brought an end to a ten-year-old civil war, and key provisions of the agreement have continued to be implemented, albeit often slowly and contentiously. Nepal still has work to do on implementing the provisions related to transitional justice and addressing the structural factors that helped contribute to the civil war such as the long-standing marginalization of many ethnic, religious, and caste groups. The peace process has experienced multiple setbacks, including periods of violence, yet each time Nepal has found mechanisms to put the peace process back on track. A number of peacebuilding endeavors have supported

implementation of the peace agreement. One was USIP's Justice and Security Dialogue (JSD), which started in 2007 and ran through 2014, and provided a forum for police, community, civil society, and political actors to open lines of communication, identify rule of law challenges, build trust, and solve problems related to justice, security and rule of law. It produced multiple successes, including opening communication channels between the public and police, and making the police accountable to the public.

Iraq has hardly been a beacon of peacebuilding accomplishment since the US-led invasion of 2003, but some local successes have nonetheless been won. For example, local-level facilitators have been able to stem cycles of violence and ensuing bloodshed between tribes.¹² And the JSD process developed in Nepal was customized to suit Iraqi conditions and has helped prevent violence between various groups in several provinces, while building trust between security forces and local communities.

These successes, however, cannot disguise the fact that many other peacebuilding interventions have had little or no positive impact. Libya, for instance, can be seen as a transition failure. After the overthrow of Muammar Gaddafi in 2011 by rebels who were assisted by air power from a NATO-led coalition, a number of efforts were initiated by international peacebuilders and organizations to work with the new government and civil society to address a number of transition issues, including transitional justice, constitution making, and conflict resolution dialogues. But early jubilation soon evaporated as political power fragmented, militias seized control of the streets, and the country spiraled down into civil war. Peace talks continue as of early 2021 but it is a long road ahead for Libya to transition to peace and stability. From Syria to Myanmar, numerous other cases of failure—some partial, others comprehensive—could be cited.

A mixed record for peacebuilding is hardly surprising, given the daunting complexity of the social, political, and economic problems peacebuilding is trying to address. Furthermore, despite claims that peacebuilders have failed to stem the tide of violent conflict and wars, the reality is peacebuilders are grossly underfunded. The amount of money spent on peace is a pittance compared with the funding lavished on war. Even if we add the resources invested by countries around the world in diplomacy and development to the amount spent on peacebuilding per se, the total is a tiny fraction of what is spent on waging wars. Some countries, it should be noted, do spend more on peacebuilding than on military intervention, but they are certainly in the minority. In short, in terms of financial resources, peacebuilders are massively outgunned by generals and warlords.

Even so, one might have expected to be able to point to more peacebuilding successes, not least because the field has grown significantly in the past twenty years and considerable time and effort have been focused on how to translate the recognized need for peacebuilding initiatives into practical accomplishments. Why has the peacebuilding record not been better overall?

Many peacebuilders would answer that question by pointing to one or more of four shortcomings of the current approach. One is a tendency—exacerbated by impatient donors—to look for a silver bullet, for quick fixes, for panaceas.¹³ A second explanation is that foreign actors often dominate peacebuilding, and many times locals and local knowledge are excluded and disrespected.¹⁴ A third shortcoming is the peacebuilders often take a highly technical approach, focused on metrics that translate poorly to ground reality and specialist expertise that is often narrowly focused. Peacebuilding actors all too often offer technical solutions to conflicts deeply rooted in human perceptions and patterns of thought and behavior.

The fourth problem is that peacebuilding is typically stove-piped with little contact between the different silos of peacebuilding activity. Some organizations are broken down into or organized around specialized or thematic units (e.g., “Youth,” “Gender,” “Rule of Law,” “Policing”) that do not always effectively share information or work together as an integrative whole on a problem set or a country conflict. This shortcoming is compounded by the lack of interplay between the thematic expertise and the country expertise within many organizations. Other organizations are primarily organized around country or regional bureaus, which lead peacebuilding efforts, but they sometimes fail to adequately integrate into their programs the thematic expertise and lessons from other regions. Peacebuilding is, or should be, a system—dynamic, interrelated, unpredictable, multidisciplinary, with local knowledge essential. In that system, neurobiological and psychosocial factors,¹⁵ actors, and dynamics are no less important—and may even be more important—than economic, political, and security dynamics. But this tends to go unrecognized. Many of us have come to realize that we have been underestimating the human dimension: perceptions, fears, trauma, identities, affinities, biases, decision-making processes, and so forth. Even when we do recognize the full impact of such factors, we typically do not know what to do about them.

Peacebuilders' Firsthand Experiences

This is not to say that we have been entirely blind to the human dimension. We have recognized that psychosocial factors such as stress, anxiety, fear, and trauma play an important role in how societies, groups, and individuals respond to efforts to foster peace and reconciliation. We have sometimes looked to the field of psychology for insights and guidance, which we have then used to help shape our efforts to provide psychosocial support and trauma relief.¹⁶ These efforts were often incorporated into a “transitional justice” framework designed to help societies acknowledge and address past human rights abuses and other forms of injustice—the idea being that, by addressing them, societies emerging from conflict would be less likely to fall back into conflict and future occurrences could be prevented.¹⁷

That being said, most of us paid little heed to neuroscience more broadly and generally lacked understanding of the depth, breadth, and power of the forces and factors rooted in neuroscience. Nor did we know what to do about them. In 2004, when USIP highlighted the link between trauma and divided societies, it was definitely ahead of the curve.¹⁸ Generally speaking, we did not have an adequate understanding of the forces rooted in our nervous systems and of their power to fuel emotions, perceptions, and decision making that, in turn, can provoke and sustain violent conflict or nurture trust and cooperation. Nor did we know what we might be able to do about those forces.

We might have known something about individual aspects of the brain's wiring—such as the fight-flight-freeze system—but our understanding was typically superficial and fragmentary, and thus we underestimated the potency of neural impulses. We did not understand that trauma, for example, can be rooted in the body itself through the nervous system. We were not oblivious to the trauma we encountered, but we were not equipped to understand its sources, the extent and nature of its impact, and how we might support individuals and societies, as well as ourselves, to deal with it. Let me recount a few episodes from my own experiences in the field, and from those of fellow peacebuilders, that illustrate this.

I began this article by describing my time in Bosnia, but what I experienced there was, as I went on to discover, by no means peculiar to that part of the world. A dozen or more years after I left Bosnia, I was working in Libya right after the fall of Muammar Gaddafi. I traveled around the major cities, seeking to support Libyan efforts to strengthen justice and security in the midst of the profound insecurity created by the death of the

tyrant and the demise of his brutal and repressive regime, which had ruled the country for forty years. The security vacuum was quickly filling with armed militias that had joined the fight against Gaddafi and were loath to give up their guns and power, together with the criminal gangs and organizations that smuggled and trafficked arms, drugs, and especially humans. Meeting with people from all walks of life—including engineers, militia members, former soldiers, human rights defenders, and students—I discovered that visions of creating a free and prosperous Libya were colliding with trauma, anger, and a desire for revenge—the legacies of living under a dictatorship that tortured and imprisoned its political opponents, stoked regional rivalries, and doled out resources to some sections of society while denying them to others. Experiences of the violence during the uprising had also left their mark.

I facilitated one workshop full of business leaders, engineers, lawyers, students, and professors who were first asked to identify the justice and security challenges facing Libya. That part went fairly smoothly. Then they were asked to think through options for addressing these challenges. We got stuck. I tried in various ways to explain the exercise and elicit ideas. One person, seeing my discomfort and trying to be helpful, mentioned a few ideas. But the rest remained quiet. Finally, in frustration, my host pulled me aside and told me that I have to tell them what they need to do. He said that many people in Libya have a little Gaddafi in them and that they will not respect me if I do not exert my power and tell them what they need to do. I wondered, was my host right? Do some people living in authoritarian regimes, when the despot is gone, continue to want to continue being told what to do? If so, what is it in a post-conflict scenario that prompts some people to look for someone to give them orders?

While in Libya, my colleague Vivienne O'Connor told me that she was working with a senior official who, before the uprising, had become a lawyer. During the uprising, he had joined the fight against Gaddafi's forces, and though he had no previous military experience, he had become a commander of one of the militias. After Gaddafi's ouster, he was seen as a hero and given a senior role in the new administration. His commitment to his job was remarkable. He had a vision for his country that included Libya building a strong foundation of rule of law. Realizing that dream, however, was another matter. Whenever my colleague interacted with him, he seemed to find it hard to concentrate, smoked incessantly, and his hands were always in motion and his feet tapping. Nonetheless, he was being asked to fix, almost singlehandedly, the Libyan justice system. Other Libyans she met in rule of law workshops testified to a similar predicament: they were being asked

by international officials and peacebuilders to fix their country, but they found it hard to focus because they were struggling with depression and anxiety arising out of the violent conflict that none of them had been prepared for. Meanwhile society as whole was grappling with the reality of a spike in domestic violence, alcohol abuse, and drug use. As my colleague said, clearly a lot of Libyans had been traumatized either during Gaddafi's rule or during the bloody revolution to oust him—and that degree of trauma was going to make it very hard for Libyans to achieve reconciliation and build a stable and just society.

My efforts to piece these experiences together and better understand the nature and impact of trauma were helped by conversations I had had at various times between 2005 and 2010 with Max Hernandez from Peru and Lord John Alderdice from Northern Ireland, both psychiatrists by trade, and both very active in their own countries' peace processes and later in advising other countries on theirs. One thing that they talked about that made a lasting impression on me is the concept that the past can be in the present, unless addressed. The concept resonated with my experiences in Bosnia, and I was reminded of it when I was in Libya. Indeed, in every postconflict country in which I have worked there has been a barrier like that, holding back efforts to move forward after war.

Many of my colleagues have also witnessed the enduring potency of historical grievances, existential fears, and “us-vs.-them” thinking. The following textboxes offer two, not untypical examples of what my colleagues have encountered when working in conflict-affected societies.

Existential Fears and Personal Anguish

By Mona Yacoubian

“I was observing a Track 2, intra-Kurdish dialogue. Dialogue participants came from inside Syria, Iraqi Kurdistan, and Europe. Many had close family members still inside Syria. Existential concerns permeated the dialogue. Often, participants referenced the Kurds' long-standing sense of threat and fear of genocide. Some participants had lost family members in Halabja, the Kurdish village that was the target of massive chemical weapons attack perpetrated by the Saddam Hussein regime. Many spoke of the Kurds' history, their deep sense of persecution, and their fears going forward as they contemplated future trajectories in Syria.

“Most disturbing, however, was the depth of anguish expressed by some participants whose family members were currently being targeted inside Syria. These participants had family members who were from the Kurdish canton of Afrin in north-west Syria. Earlier in the year, Turkish-backed armed groups had invaded and occupied the area. Participants from this region reported incidents of forced displace-

ment, torture, and other atrocities. At lunch, I sat with a Kurdish woman from Afrin who recounted the various crimes being committed against her family members. At one point, she pulled out her cell phone and showed me a video of her nephew being tortured, noting, 'This is happening now. I received this yesterday.'

"The urgency and depth of her concerns were painful to behold and powerful. How could she or others engage in dialogue, take risks, and offer compromises when, at that moment, loved ones were being violated and suffering. While the dialogue was among Kurds and the atrocities were reportedly being committed by Turkey and its Arab allies on the ground, the moment put into perspective the difficulties of dialogue and peacebuilding at a time when participants are suffering and their existential fears are rightly stirred."

Us. vs. Them Thinking

By Khitam Al-Khaykanee

"In spring 2011, we launched the first JSD dialogue in four provinces across Iraq, where we convened representatives of the local police and the local communities to discuss the security challenges hindering their safety and to map the potential collaborative solutions for local stability. Prior to the joint dialogue, we held series of preparatory meetings with each sector to understand the level of grievances felt by each sector and to understand how each sector perceived the 'other one.'

"At that time, the police sector was fragile and isolated from the community for various reasons, and there was a widespread lack of trust in local police and their ability to protect civilians. For their part, the police had lost many colleagues who had been lured into deadly traps by false reports from community members of suspicious behavior at specific locations; when the police arrived, terrorists would detonate explosives.

"Despite the many preparatory separate meetings with representatives of each sector, when we brought them together for the joint dialogue sessions, the participants' strong emotional reactions revealed their ingrained perception of "us vs. them." Both sectors held the 'other party' accountable for the casualties among family and colleagues killed in the ongoing wave of violence in their districts.

"The joint meetings brought everyone together. When each party's concerns and challenges were presented, the room felt so tense, and vibes of hatred filled the room in all directions. At the beginning of each session, we asked all participants to listen carefully and respectfully to the discussion, and we had to keep on reminding them to do so whenever a spark of accusation flew from one or other party. It was easier said than done."

In the 2010s, and especially in the second half of that decade, my awareness of what insights neuroscience can offer peacebuilders continued to grow. In part, this is the result of my personal experiences, including in 2018 completing an intensive three-year training and certificate program on the neurobiology and resolution of trauma through the Somatic Experiencing Trauma Institute. In part, too, I have benefited from increasing coverage in the mainstream media about neuroscientific discoveries about the sources of aggression and conflict and the prospects for countering or reworking them to prevent violence or rebuild fractured societies. Presumably, many neuroscientific advances were already known to those who read—and could understand—the relevant scientific literature, but most peacebuilders were not familiar with that sort of material. We were more likely to come across articles with titles such as “How Neuroscience Is Offering Hope for a More Peaceful World” in the *Washington Post*.¹⁹ Our awareness has also been enhanced by the appearance of similar articles in the peacebuilding literature.²⁰ There was also a small cadre of individuals and organizations who sought to link neuroscience and peacebuilding. One example is the pathbreaking work done by Beyond Conflict that conducts research at the intersection of cognitive and brain science with conflict prevention and resolution. Another example is the El-Hibri Foundation that partnered with the Alliance for Peacebuilding (AfP) to hold conferences bringing together peacebuilders and neuroscientists. And USIP provided funding to AfP for the “Rewiring the Brain” project and sponsored the Neuroscience and Peacebuilding Initiative that contributed to the development of “Neuroscience and Peacebuilding.”

As neuroscience has gradually become better known, I, like some of my colleagues, have come to the conclusion that neuroscience might offer clues as to why peacebuilding is not working in the way we think it should. We have had a mental model of how to fix things, but that model is flawed by our failure to adequately factor in, and to adequately understand, something as fundamental as the human brain and body—how they shape attitudes, emotions, behaviors, decisions, and actions.

There is also the reality that as peacebuilders, we are not somehow outside the room, shielded from what is happening inside the room. As peacebuilders, exposure to others’ trauma can result in what is called “secondary” or “vicarious” trauma.²¹ Further, we can risk being thrown into a trauma vortex through our own experiences of trauma that result from working in war zones. Peacebuilders need to understand the dynamic, recognize it when it is happening, and be equipped to address it.

Further, as peacebuilders, we need to understand how our own nervous system, thoughts, biases, and beliefs can have an impact on the environments in which we work and the people we work with. We need to understand that we become part of the system when we engage with it, and that we can either help or hinder the situation based on our understanding of the situation and our neuroscientific insights.

How Neuroscience Can Inform the Work of Peacebuilders

To be sure, we must not rush ahead of ourselves, thinking that neuroscience can solve all of peacebuilding's problems. Nonetheless, we would be denying ourselves a source of invaluable knowledge and insights if we were not to ask what sort of contribution neuroscience is making, or might make, to peacebuilding.

In general terms, one can answer that question in terms of how neuroscientific insights can complement peacebuilders' existing knowledge:

- *Neuroscience can help to confirm what we know and what we don't know*—offering scientific justification and support for what peacebuilders have intuitively understood they should do to be effective. This seems to be how peacebuilders are currently making use of neuroscience.
- *It can promote refinement of existing practices*—deepening our understanding of why people think and behave as they do, thus inspiring peacebuilders to do what they already do differently (e.g., more often or less often, in different sequences or combinations). Perhaps we are just beginning to get to this point.
- *It can inspire new approaches*—surprising peacebuilders with unexpected insights into how people think and behave, thereby encouraging peacebuilders to start doing things they have not done before. This is the most exciting possibility, but when might we get to this point, and what might we discover when we get there?

Another way of answering the question of what neuroscience can contribute is to identify specific peacebuilding tools and activities. Thus, in addition to enhancing peacebuilders' general understanding of how humans think and behave, neuroscientific research could inform activities such as the following:

- *Negotiation and mediation to bring the parties to a conflict together and reach a peace agreement.* This might also involve developing confidence-building measures and other techniques to improve the climate for negotiation and mediation, as well as refining techniques to make the actual process of negotiation and mediation more

successful. The sorts of contributions neuroscience might make in this area include “how mediation can trigger parties’ underlying traumas; how to recognize from parties’ body language what they are experiencing during mediation; neurobiological issues presented by face-to-face communication between parties during the opening session, and throughout the mediation; gender in mediation and neurobiological differences in reactions to conflict between men and women; the neuroscience of the relationship between impasse and insight.”²²

- *Facilitated dialogue, joint problem-solving, and other techniques to help build bridges between individuals and groups and to change or work with group dynamics.* In this area, neuroscience could, for instance, give peacebuilders valuable insights into how facilitators can manage dialogue between individuals and groups who may be highly emotional, angry, and full of animosity toward each other.
- *Reconciliation, transitional justice, and other techniques to address and begin to heal social, ethnic, political, and other divisions and build rule of law in the aftermath of violent conflict.* Questions such as “how do we break the cycle of violence when people have been hurt and continue to hurt others?” might be easier to answer with the help of neuroscience.
- *Trauma education, support, and other techniques designed to help individuals avoid, cope with, and/or gradually overcome trauma.* In this area, the kinds of questions with which peacebuilders need help include, for instance, “How can traumatic experience be a catalyst for empowerment and resilience and how can this knowledge be integrated into peacebuilding programming?”
- *Constitutional reform, security sector reform, law reform, government reform, and other techniques to build more accountable, transparent, democratic governments.* Governance involves issues of power and control, of forms of decision making, of in-group vs. out-group attitudes, of tradition vs. openness to change, and so forth.
- *Military and law enforcement interventions such as peacekeeping operations, policing, and other activities designed to impose or maintain physical security.* Insights into how populations, subgroups, and individuals respond to, say, different types of use of military and law enforcement power, or to the breakdown of trust between a local population and an unresponsive or abusive police force, could be valuable.

- *Media reform, education reform, hate speech regulation, and other techniques to control what is allowed to be said and how it is said.* Such measures could help shape how the public as a whole or sectors within (e.g., schoolchildren) think about themselves, other groups, and society as a whole, as well as about issues such as human rights and democratic norms.

As this illustrative list suggests—and as the articles in “Neuroscience and Peacebuilding” confirm—the scope for neuroscience to contribute is not only vast but also expanding as new research throws new light on why humans fight and how they can be encouraged to resolve their differences peacefully instead of violently. What we peacebuilders need is fourfold. First, we need to discover and understand what neuroscience can tell us about subjects such as dehumanization, aggression, and empathy; intergenerational trauma; radicalization and terrorism; group dynamics; the power of ritual; and the promise—and perils—of artificial intelligence. Second, we need to support further research into such areas. Third, we need to learn how to apply these neuroscientific insights in our practical peacebuilding work. And fourth, we need to launch an unending conversation with neuroscientists about what we both have learned and what we both would still like to discover. If we work together, we can accomplish remarkable things.

Notes

1. See <https://www.ushmm.org/confront-genocide/cases/bosnia-herzegovina>.
2. Global Partnership for Prevention of Armed Conflict (<https://www.gppac.net/who-we-are>).
3. Organization for Economic Co-operation and Development (OECD)
4. Dan Snodderly, ed., *Peace Terms: Glossary of Terms for Conflict Management and Peacebuilding* (Washington DC: United States Institute of Peace Press, 2018), 67.
5. Researchers founded institutes such as the Peace Research Institute Oslo (PRIO) in Norway, the Department of Peace and Conflict Research at Uppsala University in Sweden, and the Stockholm International Peace Research Institute (SIPRI), while colleges and universities established programs in peace studies. Today, there are hundreds of such programs around the world, including George Mason University’s Carter School of Peace and Conflict Resolution that was established over forty years ago and was the first university in North America to offer an MS in conflict analysis and resolution. Another well-known program, the Kroc Institute, was founded in 1986 at the University of Notre Dame and subsequently established another center at the University of San Diego. The Kroc Institute defines peace studies as “an interdisciplinary academic field that draws on political science, sociology, history, anthropology, theology, psychology, philosophy, and other fields to . . . understand the causes of armed conflict; . . . develop ways to prevent and resolve war, genocide, terrorism, gross violations of human rights; and . . . build peaceful and just systems and societies.” <https://kroc.nd.edu/about-us/what-is-peace-studies/>
6. Boutros Boutros-Ghali, *An Agenda for Peace* (New York: United Nations, 1992),

7. See Dan Snodderly, *Peace Terms* (Washington, DC: United States Institute of Peace Press, 2019).
8. See <https://www.un.org/sustainabledevelopment/sustainable-development-goals/>.
9. See <https://www.pathwaysforpeace.org>.
10. See <https://www.brookings.edu/wp-content/uploads/2019/03/Global-Development-Disrupted.pdf>, 14.
11. Broadly speaking, an NGO is a “private, self-governing, nonprofit organization.” NGOs are sometimes assumed to be synonymous with “civil society,” but that is inaccurate. NGOs are part of civil society, but by no means the entirety of it. Civil society “encompasses a wide array of nongovernmental groups including civic, educational, trade, labor, business, charitable, media, religious, recreational, cultural, and advocacy groups as well as informal associations and social movements.” Dan Snodderly, *Peace Terms* (Washington, DC: United States Institute of Peace Press, 2019), 22.
12. See <https://www.usip.org/publications/2015/07/shadow-massacre-peaceful-return-iraq-part-ii>.
13. See <https://www.idea.int/gsod/files/IDEA-GSOD-2017-RESOURCE-GUIDE-PEACEBUILDING.pdf>, 11.
14. See the discussion in <https://www.tandfonline.com/doi/pdf/10.1080/15423166.2016.1150692?needAccess=true>.
15. The term psychosocial “attempts to express the recognition that there is a close, ongoing circular interaction between an individual’s psychological state—the realm of the mind, cognition, and emotions—and his or her social environment, especially relationships with others in the family/community system.” (Bergh & Jareg, 1998, p.16) cited in https://www.interventionjournal.com/sites/default/files/Peacebuilding_and_psychosocial_intervention_the.4.pdf. Although there is no agreed-upon definition on psychosocial support or its scope, psychosocial interventions have generally covered “a range of different approaches: psychotherapy, rehabilitation and reintegration, community dialogue and reconciliation, development assistance and livelihoods support. (Hamber et al., 2014) cited in *ibid.*, 220.
16. See <https://www.usip.org/sites/default/files/sr135.pdf>.
17. USIP’s *Peace Terms* defines transitional justice thus: “A process that addresses large-scale human rights abuses in an effort to establish the truth of what happened and why, acknowledge the suffering of victims, hold perpetrators accountable, compensate for wrongs, prevent future abuses, and promote social healing. War crimes tribunals are perhaps the best-known example. Some mechanisms are judicial, such as tribunals. Others are not, such as trauma- healing programs, reconciliation projects, reparations, and monuments or war memorials.” Snodderly, *Peace Terms*.
18. See <https://www.usip.org/publications/2005/04/trauma-and-transitional-justice-divided-societies>.
19. See https://www.washingtonpost.com/news/inspired-life/wp/2015/03/04/how-neuroscience-is-offering-hope-for-a-more-peaceful-world/?utm_term=.7fb6a7690670.
20. See https://beyondconflictint.org/wp-content/uploads/2018/05/Neuroscience-and-Peacebuilding_v1.pdf.
21. See <https://www.usip.org/education-training/courses/understanding-trauma-how-do-we-strengthen-resilience>. See: <https://www.reuters.com/article/us-health-mental-aid-workers-idUSKCN0RU2ZY20150930>. See also <https://academic.oup.com/epirev/article/34/1/145/500710>.
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Suggestions for Further Reading and Resources

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in neurobiology at the ETHZ in 1998, associate professor in molecular cognition at UZH and ETHZ in 2005, and full professor in neuroepigenetics in 2013. Mansuy's research examines the epigenetic basis of complex brain functions in mammals and focuses on the mechanisms of epigenetic inheritance. The goal is to determine the processes underlying the influence of life experiences on mental and physical health across generations. Mansuy is a member of the Swiss Academy of Medical Science, and the European Academy of Sciences (EURASC), EMBO, and is elected Knight of the Legion of Honor and Knight in the Order of Merit in France. She is a member of multiple review boards, including the European Research Council and CNRS. She is chief coeditor of *BioMolecular Concepts* and a member of the editorial board of *Environmental Epigenetics*, *Hippocampus*, *Neurobiology of Diseases*, *Frontiers in Behavioral Neurosciences*, *Biology of Mood and Anxiety Disorders*, and *Frontiers in Epigenomics*. She has coauthored several reviews and books in the field of molecular cognition and neuroepigenetics. She has coauthored a book on epigenetics for the public in French (*Reprenez le contrôle de vos genes*, Larousse, 2019) and German (*Wir können unsere Gene steuern*, Berlin Verlag, 2020) and is regularly featured in the media and public press.

GLYNDIE NICKERSON

Glyndie Nickerson is a Somatic Experiencing Practitioner and a Somatic Experiencing Trauma Institute faculty member. She holds an MA and a PhD in clinical psychology, and she currently teaches in the United States and Ireland. She has a background as a bodyworker, yoga teacher, Brennan healing science practitioner, and long-time meditator. She specializes in nervous system dysregulation due to chronic stress and trauma, anxiety, depression, attachment ruptures, and chronic illness. As a meditator she also teaches about safely deepening contemplative practice with an embodied approach. She has worked in community mental health in the United States, and she has worked in other countries with tsunami victims, domestic abuse survivors, and torture survivors. Her work is informed by current neurophysiological research, object relations, attachment theory, and Jungian and relational psychoanalysis perspectives. She recognizes and includes awareness of cultural, historical, and systemic trauma as part of the healing process.

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