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Posttraumatic Therapy in the Age of Neuroscience

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When people develop PTSD in the wake of exposure to a traumatic event, the imprint of that trauma comes to dominate how they organize their way in the world. Verbalizing, making meaning, and putting the event in contezt may provide a means of feeling understood, rejoining the human race, and gaining perspective on the experience, but it may do little to reorganize the person to feel safe and focused on fulfilling the demands of the present. Given the subcortical nature of trauma imprints, effective therapy needs to help survivors tolerate the sensory reminders of the trauma, and *physically* experience efficacy and purpose in response to stimuli that once triggered feelings of helplessness and dependence.

RESEARCH ON THE IMPACT OF TRAUMA ON A VARIETY OF DIFFERENT victim populations has shown that the vast majority of people who are not immediately and personally affected by a horrible tragedy sustain no lasting damage. Most people who witness terrible events are able to find ways of going on with their lives with little change in their capacity to love, trust, and plan for a hopeful future. Those who are most directly exposed to the sensory realities of the traumatic events are at highest risk for developing psychological problems: those who are physically immobile and helpless while trying to escape from a disaster, those with first-hand experiences of the sounds, smells, and images of a calamity; those who directly witness the death and dismemberment of human beings; and those whose lives have been permanently altered by the death or injury of a loved one.

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For most Americans trauma begins at home. The most common source of trauma for children and women is violence perpetrated by family members and intimate partners. Yet public disasters receive much more public concern than private traumas. Initially, communal tragedies tend to attract an enormous amount of attention and financial aid. Outpourings of social support, public acknowledgment, and practical help to restore functioning all have profound effects on helping victims recover. In contrast, lack of validation and public acknowledgment, such as usually occurs after an attack by acquaintances, tends to lead to shame, helplessness, secrecy and preoccupation with maintaining one's emotional connections and financial security.

PTSD as a Diagnosis

When people fail to establish a new homeostasis in the wake of a traumatic event, they are likely to develop the symptom picture described in the DSM-IV (American Psychiatric Association, 1980) diagnosis of post-traumatic stress disorder (PTSD). At the core of PTSD lies the concept that the imprint of the traumatic event comes to dominate the total organism and how victims organize their lives—people with PTSD perceive most subsequent stressful life events in the light of their prior trauma. This focus on the past is likely to gradually rob their current lives of a sense of meaning and pleasure (van der Kolk and van der Hart, 1991).

In contrast to PTSD, which is characterized by intrusive sensory recollections of traumatic life experiences, ordinary events generally are not relived as images, smells, physical sensations, or sounds associated with that event. Ordinarily, the remembered aspects of experience coalesce into a story that captures the essence of what has happened. As people remember and tell others about an event, the *narrative* gradually changes with time and telling.

Since the last decades of the 19th century it has been understood that extreme fear, terror, and helplessness during a traumatic event can overwhelm people's biological and psychological adaptive mechanisms. This breakdown makes them unable to assimilate the experience, that is, to integrate it as a personal event belonging to

their past (Janet, 1889). Instead, memories of the trauma are "dissociated" and not only return as narrative memories of what has happened, but are replayed in the form of intense emotional reactions, nightmares, images, aggressive behavior, physical pain, and bodily states that can all be understood as the return of elements of the mental imprints of the trauma.

Thus, the core pathology of PTSD is that certain sensations or emotions related to traumatic experiences are dissociated, keep returning in unbidden ways, and do not fade with time. That does not mean that the *stories* that traumatized people tell to *explain* what is going on do not change: narratives are a function of the interaction between speaker and listener. The problem with PTSD is that the images, sensations, and emotions related to the trauma do not change. Studies have shown that the traumatic imprints start changing, as well, as people recover from their PTSD (Foa, Molnar, and Cashman, 1995; van der Kolk, Hopper, and Osterman, 2001).

Traumatized people often do not realize that their intense feelings and reactions are based on past experience. In fact, the traumatic experience itself may be largely forgotten. People have an infinite capacity to rationalize their feelings and blame their current surroundings for the way they feel. This capacity protects them from having to confront the helplessness and horror of their past. The mind has many different ways to hide its truths from its owners.

Freud (1926) wrote: "If a person does not remember, he is likely to act out: he reproduces it not as a memory but as an action; he repeats it, without knowing, of course, that he is repeating, and in the end, we understand that *this is his way of remembering*" (p. 150). Most psychiatrists have come to accept that basic notion, and as a result emphasize the need for traumatized people to verbalize and "own" their experiences. There is widespread agreement that, without being able to put what happened into words, traumatized persons have a tendency to react to subsequent stress as if the trauma were still going on. If the problem with PTSD is *dissociation*, treatment should consist of *association*. As Freud (1914) put it, "while the patient lives it through as something real and contemporary, we have to do our therapeutic work on it, which consists in large measure in tracing it back to the past" (p. 152). As a result, in psychotherapy there always has been a major emphasis on trying to help patients give a full account of their trauma, in words, pictures, or other symbolic presentations.

The Neurobiology of Trauma

Numerous studies (see van der Kolk, Mcfarlane, and Weisaeth, 1996) have shown that people with PTSD, when confronted with elements of the original trauma, have psychophysiological reactions and neuroendocrine responses that reflect their having developed a conditioned response to certain reminders of the trauma. When confronted with a sufficient number of sensory elements that match the imprints at the time of the original trauma (such as being touched in a particular way, being exposed to certain smells, or seeing visual reminders of the earlier event), patients with PTSD activate biological systems that make them react as if they were traumatized all over again: with fight or flight responses.

Studies during the past two decades have shown that people with PTSD develop abnormalities in the neurotransmitters that regulate arousal and attention. Normally, stress activates both principal stress hormones: catecholamines and cortisol. One of the most important findings in PTSD research has been that people with PTSD have low levels of cortisol. The effect of increased secretion of norepinephrine, combined with decreased cortisol, renders people with PTSD more reactive to arousing stimuli (Yehuda, 2002). The simultaneous activation of norepinephrine and cortisol stimulates active coping behaviors. Increased arousal in the presence of low cortisol levels, such as occurs in people with PTSD, provokes indiscriminate fight or flight reactions. In addition, because of a phenomenon called *state-dependent memory retrieval*, people in a state of high physiological arousal tend preferentially to access emotional memories that are related to memories that were laid down while they were in a state of high arousal, thus precipitating flashbacks and nightmares.

Recent advances in the neurosciences and the emerging ability to take images of the brain while a person is exposed to different challenges (e.g., Ledoux, 1996; Rauch et al., 1996) have made it possible to locate those areas of the brain that are involved in the processing of different experiences. Under ordinary conditions, the brain structures involved in interpreting what is going on outside the organism function in harmony. The subcortical areas of the brain, the evolutionarily more primitive parts that are not under conscious control and possess no language, have a different way of representing past experience than do the more recently evolved structures of the

brain, located in the prefrontal cortex. These higher cortical structures allow people to use language and symbols to communicate about their personal past. However, when people are frightened or aroused, the frontal areas of the brain, which are responsible for the analysis of experience and associating it with other areas of knowledge, are deactivated (Arnsten, 1998). Deactivation of the dorsolateral prefrontal cortex (which is responsible for executive function) in patients with PTSD interferes with their being able to formulate a measured response to threat. In addition, high levels of arousal also interfere with the adequate functioning of the brain region necessary to put one's feelings into words: Broca's area (Rauch et. al., 1996). Thus, traumatized people are ill equipped to talk about their traumas in rational or analytical fashion.

Under conditions of intense arousal, the more primitive areas of the brain, the limbic system and brain stem, may generate sensations and emotions that contradict one's conscious attitudes and beliefs, thus causing traumatized persons to behave "irrationally" in response to stimuli that are objectively neutral, or merely stressful. One of the limbic structures that is centrally involved in traumatic reexperiencing is the amygdala, which serves as the "smoke detector" that interprets whether incoming sensory information is a threat. It creates "emotional memories" in response to particular sensations, sounds, images, and so forth that are associated with threat to life and limb. When one is exposed to stimuli that represent danger, signals are passed to the rest of the organism to protect itself. These emotional interpretations are thought to be "indelible" (LeDoux, 1996): once the amygdala is "set" to remember particular sounds, smells, bodily sensations, and the like as dangerous, the person is likely to respond to these stimuli as a trigger for a fight or flight reaction.

The Subcortical Nature of Self-Experience

The world of human infants initially is defined by their bodily sensations. As part of their becoming members of the human race, they come to interpret these sensations in the context of their physical interactions with their mothers. At that time, the only tool that a mother has to modulate emotional states of a baby is directly to change the infant's physical sensations by rocking, feeding, stroking, as well

as by making soothing noises and engaging in other comforting physical interactions. The infant is a "subcortical creature . . . [who] lacks the means for modulation of behavior which is made possible by the development of cortical control" (Schore, 1994, p. 30). This is strikingly similar to the experience of traumatized people, who also appear to be at the mercy of their sensations, physical reactions, and emotions.

Once people are traumatized and develop PTSD, their ability to sooth themselves is compromised. Instead, they tend to rely on actions, such as fight or flight, or on pathological self-soothing, such as self-mutilation, bingeing, starving, or the ingestion of alcohol and drugs, to regulate their internal balance. The degree to which these subcortical reactions can be inhibited depends, in part, on one's relative level of emotional arousal, which, in turn, depends both on the activation of brain stem arousal centers and on activation of the prefrontal cortex. Under ordinary conditions, people can suppress their anger or irritation, even while the appropriate physiological processes associated with these states, such as increased blood pressure and contraction of stomach muscles, continue. This inhibition is called "top-down processing" (LeDoux, 1996, p. 272): higher (neocortical) levels of processing can, and often do, override, steer, or interrupt the lower levels, elaborating on, or interfering with, emotional and sensorimotor processing. As Damasio (1999) claims:

> We use our minds not to discover facts but to hide them. One of the things the screen hides most effectively is the body, our own body, by which I mean, the ins and outs of it, its interiors. Like a veil thrown over the skin to secure its modesty, the screen partially removes from the mind the inner states of the body, those that constitute the flow of life as it wanders in the journey of each day. . . . But this has a cost. It tends to prevent us from sensing the possible origin and nature of what we call self [p. 28].

The usual regulatory system of adults uses top-down processing that is based on cognition and is operated by the neocortex. This process enables high-level executive functioning by observing, monitoring, integrating, and planning. It can function effectively only if it succeeds in inhibiting the input from lower brain levels. Traditional psychotherapy relies on top-down techniques to manage disruptive emotions and sensations. These are approached as unwanted

disruptions of "normal" functioning that need to be harnessed by reason, rather than as reactivated unintegrated fragments of traumatic states. Top-down processing focuses on inhibiting rather than "processing" (integrating) unpleasant sensations and emotions.

The Tyranny of Language

In traditional, insight-oriented psychotherapy, people learn to *understand* that certain emotional or somatic reactions belong to the past and are irrelevant to their present lives. This understanding may help them *override* automatic physiological responses to traumatic reminders, but not *abolish* them. While providing a deeper understanding of why they feel the way they do, insight of this nature is unlikely to allow the reconfiguring of the alarm systems of the brain.

In a neuroimaging study employing PET scans, Rauch et al. (1996) showed that, when people relive their traumatic experiences, there is decreased activation of Broca's area and increased activation of the limbic system in the right hemisphere of the brain. This finding suggests that, when people with PTSD relive their trauma, they have great difficulty putting that experience into words. Our finding of a relatively increased activation of the right hemisphere, compared with the left, implies that, when people relive their trauma, they are imbedded in the experience: they are *having* the experience but cannot analyze what is going on in space and time. This explains why so many traumatized people attempt to avoid becoming aroused and losing control by facing what has happened to them. Instead, they tend to talk "around" the trauma rather than facing it.

The Therapeutic Challenge

Experience shows that many traumatized people, when attempting to put their trauma into words, respond physically, as if they were traumatized all over again, rather than gaining relief. Reliving the trauma without being firmly anchored in the present often leaves people with PTSD more traumatized than they were before. Recalling the trauma can be so painful that many people with PTSD choose not to expose themselves to situations in which they are asked to do so.

Hence, when one is treating PTSD, a central challenge is how to help people process and integrate their traumatic experiences without making them feel traumatized all over again, or, in the language of neuroscience: how to process trauma so that it is quenched, rather than kindled.

Until the advent of modern psychological treatment methods many societies made use of theater and ritual to deal with communal traumas. The Greek tragedies, as well as the rewriting of the tragedy of Vietnam in Hollywood movies, are good examples of this. In my own experience I have been astounded by the similarity between the communal healing rituals in various non- Western societies, from Kwa Zulu Natal to Laos. Over the past few years our Trauma Center in Boston has collaborated with theater groups that work with traumatized inner city children in the northeastern United States. Dramatic enactment is a way of dealing with, narrating, and transforming their traumatic experiences, by allowing the children both to share their personal experiences and to find action-oriented ways of coming to an alternative resolution to the once-inevitable outcome of the original traumatic event. This work is predicated on the idea that, to overcome a traumatic experience, people require physical experiences that directly contradict the helplessness and the inevitability of defeat associated with the trauma.

In helping traumatized people process their traumatic memories, it is critical that they gain enough distance from their sensory imprints and trauma-related emotions that they can observe these sensations and emotions without losing their ability to keep their wits about them, or engaging in avoidance maneuvers. The serotonin reuptake blockers (SSRIs) often can facilitate that process. Studies in our laboratory have shown that SSRIs can be extremely helpful for PTSD patients to gain emotional distance from traumatic stimuli and stay calm enough to make sense of their traumatic intrusions (van der Kolk et al., 1994).

After alleviating the most distressing symptoms, it is important to help people with PTSD find a language by which they can come to understand and communicate their experiences. In order to put the event(s) in perspective, the victim needs to relive it without feeling helpless. Traditionally, following Freud's notion that words can substitute for action to resolve a trauma (Breuer and Freud, 1893), this has been done by helping people talk about the entire traumatic experience (Herman, 1992; Resick and Schnicke, 1992; Foa et al., 1999). Victims are asked to articulate what happened and what led up to it; their own contributions to what happened, their thoughts

and fantasies during the event, what was the worst part of it, and their reactions to the event in detail, including how it has affected their perceptions of themselves and others. Such exposure therapy is thought to promote symptom reduction by allowing patients to realize that remembering the trauma is not equivalent to experiencing it again; that the experience had a beginning, a middle, and an end, and that the event now belongs to one's personal history. If people can stick with exposure treatment and relive the trauma in words and feelings in a safe therapeutic context, there is a substantial likelihood that they will overcome their PTSD. However, these forms of treatment also have high dropout rates (Ford and Kidd, 1998), probably because patients feel too overstimulated reexperiencing the trauma without immediate relief.

Most traditional therapies have paid little attention to posttraumatic changes related to bodily experience: the sensate dimension of life. This neglect ignores the fact that the origin of one's emotional states is the state of the body's chemical profile, the state of one's viscera, and the contraction of the striated muscles of the face, throat, trunk, and limbs (Damasio, 1999). Applying these lessons from modern neuroscience has made us realize that effective treatment of PTSD needs to involve promoting awareness, rather than avoidance of internal somatic states. Promoting awareness of the "felt sense" (Gendlin, 1988) allows feelings to be known, rather than to be sensed as harbingers of threats that need to be avoided. Mindfulness, awareness of one's inner experience, a "felt sense" is necessary if one is to respond according to the current requirements for managing one's life, rather than reacting to certain somatic sensations as a return of the traumatic past. Such awareness allows people to introduce new options to solve problems and not merely to react reflexively. As Damasio (1999) writes: "Consciousness establishes a link between the world of automatic regulation and the world of imagination—the world in which images of different modalities (thoughts, feelings, and sensations) can be combined to produce novel images of situations that have not yet happened" (p. 258).

Imagining new possibilities, not merely the repeatedly retelling of the tragic past, is the essence of post-traumatic therapy. In recent years a variety of new techniques have been developed that have the potential for desensitizing patients with PTSD without fully engaging them in a verbal reliving of the traumatic experience. In this regard a relatively new and still somewhat controversial treatment for PTSD,

Eye Movement and Desensitization and Reprocessing (EMDR) (Chemtob et al., 2000), is of particular interest. This treatment consists of having people remember (but not necessarily verbalize) their feelings, thoughts, and somatic sensations related to a traumatic event, while undergoing bilateral stimulation, usually by following the therapist's hand as it moves from side to side in front of the patient. In the vast majority of traumatized patients this maneuver produces rapid mental associations to seemingly unrelated prior life events and a gradual diminution of the emotional intensity of the memories of the trauma itself (van der Kolk, 2002). Aside from its remarkable therapeutic efficacy, this novel treatment challenges our most fundamental paradigms about how therapy changes psychological programs. Providing bilateral stimulation obviously does not directly affect consciousness; it is likely to work by means of its actions on subcortical processes that have little or nothing to do with insight and understanding.

Conclusions

The formulation of PTSD as the way the human mind responds to overwhelming trauma is only about 20 years old. Since then there has been an explosion of knowledge about how experience shapes the central nervous system and the formation of the self. Developments in the neurosciences have started to make significant contributions to our understanding of how the brain is shaped by experience and how life itself continues to transform the ways biology is organized. The study of trauma has probably been the single most fertile area within the disciplines of psychiatry and psychology in helping to develop a deeper understanding of the interrelationship between emotional, cognitive, social, and biological forces that shape human development.

Research in these areas has opened up entirely new insights into how extreme experiences throughout the life cycle can have profound effects on memory, affect regulation, biological stress modulation, and interpersonal relatedness. It promises to shed light on the fundamental question of how the mind comes to integrate experience in such a way that one is prepared for future threat, while being able to make a distinction between what belongs to the present and what belongs to

the past. These findings, together with the development of a range of new therapy approaches, are beginning to open up entirely new perspectives on how traumatized persons can be helped to overcome their past.

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