Brain-to-Brain, Body-to-Body: A Sensorimotor Psychotherapy Perspective on the Treatment of Children and Adolescents[1]

Pat Ogden, PhD, Bonnie Goldstein PhD, Janina Fisher PhD

Children who are repeatedly frightened, violated, or neglected in their homes or communities generally endure prolonged dysregulated states with no one to turn to for help. Such experiences in infancy and early childhood strongly impact their sensitive, user-dependent brains and bodies. Affect regulatory mechanisms fail to develop optimally, social engagement and proximity-seeking behaviors are compromised, procedural learning adapts to a dangerous environment, and sensory processing may be adversely affected. A wide range of symptoms may develop, including poor functioning at school, difficulty in social situations, unusual distractibility, and avoidance of normal childhood activities such as play. Traumatic reminders trigger physiological reactivity, behavioral impulsivity or withdrawal, and emotions that range from unwarranted fearfulness, anger, or sadness to blunted affect and emotional numbing. Additional physical symptoms, such as eating problems, sleep disorders, headaches, or stomachaches, are all too common.

The non-verbal legacies of childhood trauma comprise three general areas of difficulty: dysregulated arousal, maladaptive procedural learning, and impaired sensory processing. Although they are mutually dependent and intertwined , we will address each separately for the purpose of clarity, with the functioning of each facilitated by the effective functioning of the others. Dysregulated arousal can be attributed to a compromised nervous system that cannot maintain arousal at a tolerable level, having lost or failed to develop the regulatory mechanisms to sustain states of calm, tolerate a wide range of physiological arousal, and/or bear strong emotions. Procedural learning is strongly influenced by traumatic experience, which shapes posture, gestures, and movements in ways designed to adapt to a threatening environment. Some children, driven by tense bodies that are hyperactive and hyperaroused, feel out of control, anxious, or aggressive. Others have collapsed or frozen bodies that fuel helpless and powerless feelings. Adaptive action becomes impulsive or destructive in the former case, difficult or impossible in the latter. Sensory processing is problematic for traumatized children who develop a hyper- or hypo- sensitivity to tactile, auditory, olfactory, gustatory, and visual stimulation. Such children may avoid or crave rough-and-tumble activities, complain of sounds that are too loud or not loud enough, or react to lights that are too bright or too dim. Gustatory sensitivity may severely restrict the type of food they will ingest, and poor proprioception (trouble sensing where their bodies are in space) may contribute to clumsy and uncoordinated movements.

Therapists can sometimes help children find the words for their traumatic experience and explicitly change maladaptive meaning (Tronick, 2009). In fact, many psychotherapy models depend almost entirely upon the child's verbal narrative as the entry point into the therapeutic process. However, relying exclusively upon language is less than optimal for a myriad of reasons. Words are not available for traumatized infants and young children because the language centers of the brains have not yet developed. Even after these centers develop, shame and fear, as well as beliefs such as, "I'll get in trouble if I tell," cause many children to silence themselves or deny what happened, sometimes even when asked. They typically experience what happened as their own fault, lacking the sophisticated cognitive ability to hold

[1] This article is published in: Ogden, P., Goldstein, B. & Fisher, J. (2012). Brain-to-brain, body-to-body: a sensorimotor perspective on the treatment of children and adolescents. In Longo, R. E. et al (Eds.) Current perspectives and applications in neurobiology: working with young people who are victims and perpetrators of sexual abuse. Holyoke, MA: Neari Press.

multiple working models in mind (Lyons-Ruth, Bronfman & Parsons, 2006). Language may also be inaccessible because the hippocampus (involved in verbal memory and the consolidation of memory) and the prefrontal cortex (the "executive brain" responsible for clear thinking) are inhibited during traumatic events, thus these events may not be encoded verbally. Moreover, when traumatic memories cannot be discussed and integrated, they are often dissociated (split off from conscious awareness) and stored as sensory perceptions, dysregulated arousal, and behavioral re-enactments that drive many of the symptoms described above.

Fortunately, a body-oriented approach does not rely on language for its efficacy and can directly target the non-verbal legacy of childhood trauma. Underscoring the role of unresolved trauma on affect regulation, procedural learning, and sensory processing, this chapter focuses on the centrality of these phenomena in the treatment of children and adolescents. We propose that a bottom-up approach that targets the body, in addition to the verbal narrative when available, can produce changes that will influence resolution of symptoms and increase the capacity for relatedness and adaptive behavior (Bakal, 1999; Fisher, Murray, & Bundy, 1992; Ogden & Minton 2000; Ogden, Minton, & Pain, 2006). We will prioritize the non-verbal "somatic narrative" that is beyond words and cannot be articulated but continuously anticipates the future and powerfully determines behavior. The cases described illustrate ways to alter the somatic narrative, highlighting bottom-up interventions that directly address the sensorimotor legacy of trauma.

The Experience-Dependent Brain

The human brain is use dependent. From the millions of possible synaptic connections available at birth, the synapses that are used repeatedly are strengthened, and the synapses that are used infrequently are pruned. Neuroplasticity (the ability of the brain to change according to experience) enables rapid development and organization of the brain in its environmental context. As Perry (2009) asserts, the brain develops in response to "the unique demands of a given environment to express from its broad genetic potential those characteristics that best fit the child's world; different genes can be expressed, and different neural networks can be organized from the child's potential to best fit that family, culture, and environment" (p. 245). Thus neuroplasticity allows the brain to adapt itself to its environment and become increasingly efficient within that particular context.

At birth there are very few connections between the cortex and the lower brain, as these descending pathways do not begin to myelinate until late infancy (Sunderland, 2008). Thus, the immature brain of an infant or young child is extremely vulnerable to environmental conditions and attachment relationships to develop the pathways required to regulate lower brain impulses and emotions. When an infant is repeatedly left for long periods of time in a dysregulated state, "his brain may not develop the pathways to enable him to manage stressful situations effectively. The legacy in later life is that he will not develop the higher human capacity for concern, or the ability to reflect on his feelings in a self-aware way" (Sunderland, 2006, p. 24-25). Traumatized children who have been deprived of the opportunity to adequately develop such pathways present significant challenges to the therapists who treat them.

The activation of the subcortical reptilian and limbic brains in response to the infant's distress and needs is designed to elicit the ministrations of attachment figures to regulate the infant and assure his or her survival. The primitive reptilian brain, fully on line at birth, is first to develop from an evolutionary perspective. The reptilian brain is the seat of "... basic instinctual action tendencies and habits related to primitive survival issues" (Panksepp, 1998, p. 43). The "paleomammalian" or "limbic" brain, surrounds the reptilian brain and is concerned with emotion, memory, some

social behavior, and learning (Cozolino, 2002). It is the seat of "... subjective feelings and emotional responses" (Panksepp, 1998, p. 43). The amygdala, the "alarm system" housed within the limbic brain, is fully on line at birth and is easily aroused by loud sounds, bright lights, being left alone, extreme temperature, and other risk-related stimuli for infants and young children. When an infant's distress is not tended to in a timely manner, the pathways between higher brain and these lower brain structures fail to develop, and the amygdala may be chronically overactive causing the child to be chronically hyperaroused.

The neocortex, last to develop phylogenetically and immature at birth, is the area of the brain on which attachment figures have the most impact. It is responsible for cognitive processing such as self-awareness and conscious thought. Key areas of the cortex help to regulate reptilian and limbic brains, and require emotionally responsive early interactions in order to develop adequately. Especially significant is the right orbitofrontal cortex, which helps to manage strong emotions and inhibit lower brain impulses (Schore, 1994; Siegel, 1999). Other areas that require emotionally responsive early parenting for optimum development are the dorsolateral prefrontal cortex (which helps us think, plan, reflect, and pay attention to the here and now), the ventromedial prefrontal cortex (which governs internal awareness and exerts a down-regulating effect that calms the lower brains) and the anterior cingulate (which regulates autonomic changes, attention, and helps to integrate cognitive and emotional experience). Infants and young children, lacking the capacity to regulate the functions of the subcortical brain, depend upon their attachment figures to be an "auxiliary cortex," (Diamond, Balvin & Diamond, 1963) or "interactive psychobiological regulator" (Schore, 1994) to help them modulate extreme arousal states.

Parallel to the differentiated levels of the brain, the two lateralized right- and left-brain systems also fulfill specific functions and pertain to different memory organization, emotions, and states of consciousness. The left hemisphere is primary for cognitive processing, verbal, elaboration, reasoning, linguistic behaviors, and meaning-making. It represents a conscious, explicit self-system (Schore, in press a). The right hemisphere is primary for emotional & body processing, intersubjectivity, unconscious affect regulation, and responses to threat cues, It represents an implicit self-system (Schore. in press a). The left hemisphere develops over time in the first years of life; whereas, the right hemisphere is functional at birth. While we might view behavior as well thought out and logical, Schore (in press b) asserts that the right hemisphere is dominant in governing human behavior, underscoring the powerful influence of implicit and body processing in human existence. The early socioemotional context directly influences the prefrontal areas of the right brain that are "dominant for the unconscious processing of socioemotional information, the regulation of bodily states, the capacity to cope with emotional stress, and the corporeal and emotional self" (Schore, 2001). If interactions between attachment figure and infant are sufficiently synchronized, "the organization of the infant's right brain shows increased coherence, as the flow of energy between the hierarchically organized higher right cortical and lower right subcortical components increase their connectivity, allowing the right brain to act as a self-regulating integrated whole, and therefore capable of increasing complexity" (Schore 2001, p. 24).

The malleability of the brain decreases as the child gets older, thus the timing of deprivation, attachment failure, and trauma is a critical element in the development of the brain. If infants are treated harshly, the release of certain "feel

good" chemicals is blocked: oxytocin, secreted by the pituitary gland at birth and during feeding, as well as the endogenous opioids, or endorphins, that are produced when the child is touched, played with, or held gently. Without adequate supplies of these neurochemicals that facilitate social engagement and recovery from distress, neglected and traumatized children are left with fewer resources for self-regulation. Additionally, the failure to develop the needed connections among regulatory and arousal brain structures may have long-term consequences that may prove difficult to remediate later in life (Schore 1994). Perry (2009) clarifies: "A child deprived of consistent, attentive, and attuned nurturing for the first 2 years of life who is then adopted and begins to receive attention love, and nurturing may not be capable of benefitting from these experiences with the same malleability as an infant" (pp. 244-245). Thus, the adaptive interdependent functioning of the three levels of the brain—neocortex, limbic, and reptilian – depends upon those early months and years. Moreover, later occurring trauma may compromise existing regulatory capacities of the brain with similar debilitating effects, causing emotions to escalate, behavior to spiral out of control, and environmental cues to be misinterpreted as threatening.

Siegel (1999) describes the brain as an "anticipation machine." As the brain develops in the use-dependent manner described above, the well-traveled neural networks begin to enable the brain to predict the future and anticipate experience. The past is "remembered as a series of *unconscious expectations*" [italics added] (Cortina & Liotti, 2007, p. 205). Sub-cortical and right brain processes play powerful roles in these expectations, which are all the more potent and influential precisely because the memories that shaped them are not available for reflection and revision (functions of the cortex and left brain). Brewin (2001) clarifies that, instead of being "verbally accessible," implicit memories are "situationally accessible," activated in the child's present life by both internal and external stimuli reminiscent of the past. These implicit memories contain "information that has been obtained from more extensive, lower level perceptual processing … (e.g. visuospatial information that has received little conscious processing) and of the person's bodily (e.g. autonomic, motor) response to it" (Brewin, 2001, p. 375). Subcortical and right brain implicit processing provides the child with unconscious general knowledge of how to be in the world, how to interact with others, what to express, what to hold back, what behavior is effective in producing desired results in the other—or in a traumatogenic environment, at least capable of minimizing abuse.

We propose that treatment that seeks to amend the profound effects of early trauma, neglect, and attachment failure on the final wiring and function of the brain may be enhanced by interventions other than top-down "talking about." Bottom-up interventions that work directly with movement, sensation, regulatory and sensory systems might address problems that originate in the reptilian and limbic systems, rather than the cortex. As Perry (1999) states "… the idea is to start with the lowest (in the brain) undeveloped/abnormally functioning set of problems and move sequentially up the brain as improvements are seen. This may involve initially focusing on a poorly organized brainstem/diencephalon and the related self-regulation, attention, arousal, and impulsivity by using any variety of patterned, repetitive somatosensory activities (which provide these brain areas with the patterned neural activation necessary for reorganization) …" (p 252). The following sections elucidate three kinds of bottom-up processes—affect regulation, procedural lerning, and sensory processing—and illustrate treating difficulties frequently encountered in each area.

Affect Regulation

Trauma impairs a child's ability to accurately appraise the environment at a neural level. Porges (2004; 2011) coined the term "neuroception" to highlight a neural process that can discriminate degrees of environmental safety, danger and life threat. According to Porges (2011), "the nervous system evaluates risk in the environment and regulates the expression of adaptive behavior to match the neuroception …" (p. 17). The neuroception of safety requires the myelinated branch of the vagus nerve, the branch of the parasympathetic nervous system, called the ventral vagal complex or "social engagement system". When arousal is regulated, this system is on line to provide a great degree of flexibility in communication and to govern areas of the body that are utilized in social and environmental interaction. Porges (2005) clarifies:

> The social engagement system has a control component in the cortex (i.e., upper motor neurons) that regulates brainstem nuclei (i.e., lower motor neurons) to control eyelid opening (e.g., looking) facial muscles (e.g., emotional expression), middle ear muscles (e.g., extracting human voice from background noise), muscle of mastication (e.g., ingestion), laryngeal and pharyngeal muscles (e.g., prosody), and head tilting and turning muscles (e.g., social gesture and orientation) (p. 35).

Available to the full term infant, the social engagement system is evident as the baby vocalizes, cries, grimaces, smiles, gazes, or coos—all actions that promote interactions with the caregiver (Porges, 2004; 2005). This neural regulation of facial muscles and voice serves to increase proximity with caregivers and assure the survival of the infant. The social engagement system is further developed through in childhood through face-to-face, brain-to-brain, body-to-body nonverbal communications with attachment figures who effectively regulate the child's autonomic and emotional arousal.

When safety is neurocepted, levels of autonomic arousal fluctuate within a "window of tolerance" an arousal zone within which "various intensities of emotional and physiological arousal can be processed without disrupting the functioning of the system" (Siegel, 1999, p. 253). Traumatized children typically have a compromised social engagement system, and thus cannot accurately neurocept safety even in non-threatening environments (Sahar, Shalev & Porges, 2001), which causes arousal to exceed the window of tolerance. Many traumatized children have developed "faulty" neuroception, "an inability to detect accurately whether the environment is safe or another person is trustworthy" (Porges 2011, p. 17). When caregivers consistently fail to ensure a child's safety and protection, the social engagement system habitually shuts down. The child's ability to regulate arousal and communicate via eye contact, facial expression, and verbalization or to respond optimally to overtures from others to engage fails to develop. These capacities can be encouraged through a variety of bottom-up interventions that foster adaptive responses to social interaction.

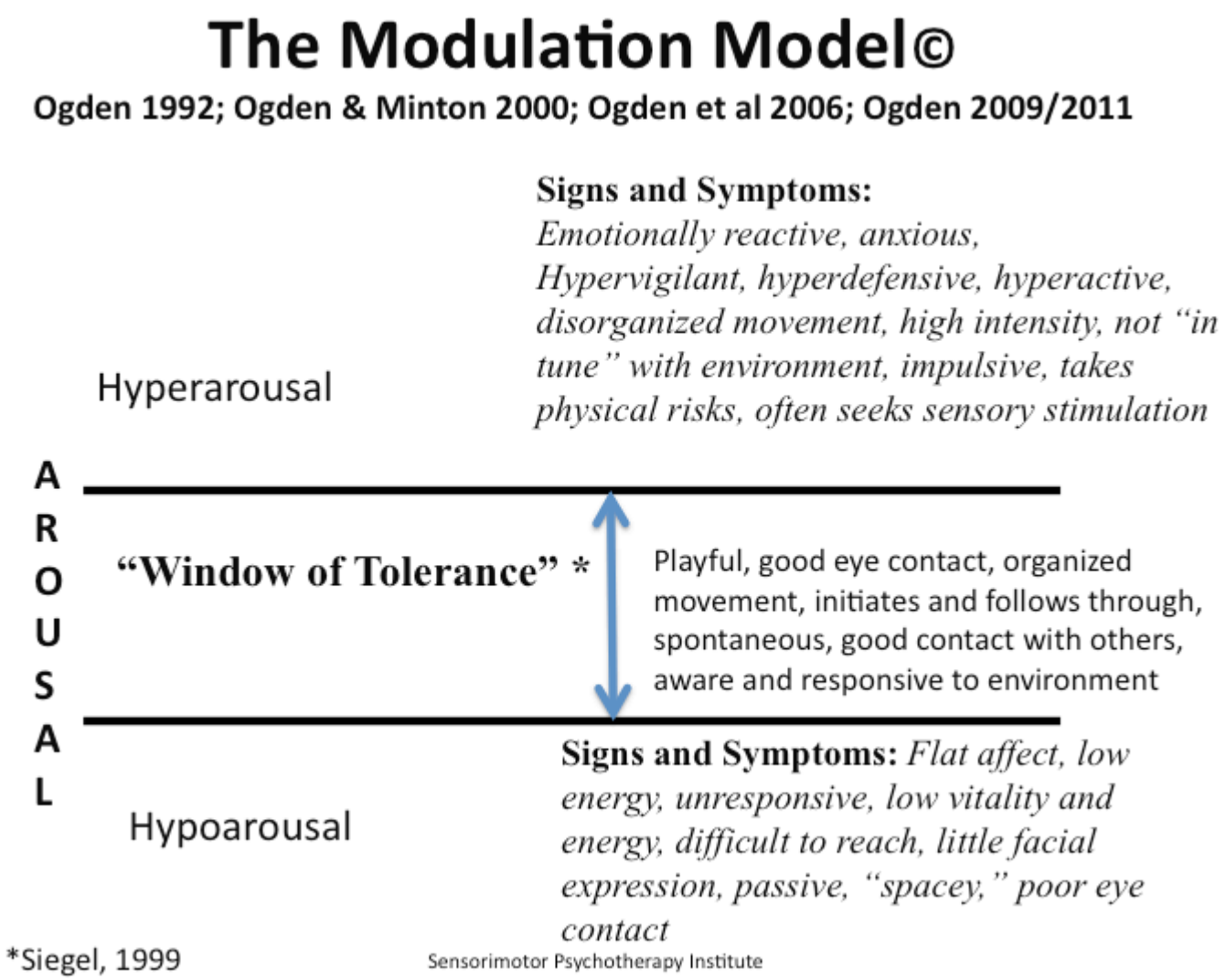
Casey, a five-year-old only child, suffered from social anxiety and hyperarousal. He had very little awareness of others and could not detect or respond appropriately to the cues that normally regulate social interaction. Casey's father abused drugs, and Casey reported that when his dad went on a binge, the whole house shook. Casey was afraid of his father's temper and would "disappear" to hide in his bed under blankets when his father came home. Eventually, Casey's mother obtained a restraining order, and the father was removed from the home. But despite his mother's reassurance of his current safety, Casey continued to fail to neurocept safety, as evidenced by his disruptive behavior and inability to adaptively engage with others. Casey's therapist suggested group therapy so that he could develop accurate neuroception in a social context, and learn to interact adaptively with his peers. A variety of group exercises were used accomplish these goals. Using a talking stick the six children took turns speaking, but Casey could not wait his turn and consistently demanded attention abrasively and in a loud voice, preventing the group acceptance he so

craved. During an attunement exercise using drums, in which one child was asked to tap out her rhythm and the others copy it, Casey would interrupt and start drumming before the other child was complete and he was unable to mimic the rhythm accurately. He became agitated and impatient when the others did not copy his own rhythm exactly the first time. Over several weeks, however, Casey gradually learned to quiet his arousal enough to listen to his peers, wait his turn for the talking stick, and correctly mimic the rhythms of the other children, and give the other children time to accurately drum out his own rhythm, all of which had the effect increasing his social engagement.

In another exercise designed to foster social engagement, the children were instructed by their group therapist to each place an index finger at opposite ends of a long dowel and then try to balance it together, a skill that requires attunement to each other. Casey at first took pleasure in making the other child drop his end of the stick, until his therapist invited him to try a new variation on this game: to follow his partner carefully and see how long they could keep the stick balanced. Casey's body and gaze visibly altered as he focused on how many seconds they could keep the stick balanced. He relaxed his body, tracked his partner, and his arousal spontaneously settled. Through bottom-up games like these, Casey learned slowly to listen, attune, and regulate his arousal and earn the acceptance of his peers that Casey so craved. While he is still has some difficulty in social settings, he is learning to calm his arousal, engage appropriately with other children, and his mother reports that he is less disruptive at school and in their relationship.

In the initial stage of threat, infants and young children neurocept danger and experience sympathetic arousal, accompanied by startle reactions, elevated heart rate, respiration and blood pressure, crying, and screaming. The neuroception of danger drives arousal out of the window of tolerance. This excessive sympathetic nervous system arousal fuels the attachment cry and other proximity-seeking behaviors, such as reaching, designed to elicit the help and protection of caregivers. When older children neurocept danger, fight/flight responses that require physical strength and capacity inaccessible to infants may also be stimulated by sympathetic arousal. When the perpetrator or nonprotective bystander is a primary caregiver, the failure of the attachment relationship to protect the child undermines his or her ability to recover and reorganize, feel soothed or even safe again, or to effectively utilize social engagement for care and protection. Chronic difficulties ensue, including pervasive difficulties in to modulating arousal, transitioning between calm and excited states, tolerating physiological arousal or affect, and navigating challenging situations without becoming hyper aroused.

One of the first steps in treatment from a sensorimotor perspective is helping children identify dysregulated arousal states, better regulate their hyperarousal, and develop accurate neuroception. In the therapy office, increased awareness of arousal can begin with the therapist creating a window of tolerance on a magnetic board, explaining to children in age-appropriate language and metaphor what the higher and lower arousal levels mean. Sensorimotor Psychotherapy's Modulation Model© and the window of tolerance is illustrated below; a simpler version that suits the age of the child is used in treatment.



Choosing from a set of brightly colored, appealing magnets, children are invited to place their magnets on the window of tolerance at the appropriate place to represent their own arousal. As arousal fluctuates throughout the session in response to different stimuli, the magnet can be moved accordingly, and children can be asked to show and describe how the level of arousal is reflected in their body. When one child was asked how he could tell his arousal was going up, he said, "Because I'm all excited in my tummy and my eyes are bugging out." Using these techniques, children can be helped to recognize the body cues that indicate fluctuations in arousal and then be invited to experiment with taking action to change arousal levels if they wish.

A variety of bottom-up games can provide a springboard for the development of affect regulation.

Brian, age 10, had suffered physical and sexual abuse for several years at the hands of his foster parents. In his group home placement, he was prone to emotional outbursts. Brian's favorite game to play was the Big and Little Game. Small groups of children were instructed to move about the room while making their bodies as small as they could, with the tiniest movements possible. Then they were encouraged to gradually make their bodies get bigger and bigger until they were as big and wide as they could be, taking up a lot of space and using gigantic movements of arms, hands, and legs. They were encouraged to experiment with making different kinds of big strong movements, such as slashing movements of the arms, stomping the legs, etc. First, they made huge movements with their upper bodies, then with their lower bodies, with instructions to show big energy. As they moved around the room as big as they could, without hurting

each other or getting in anyone's way, the children added sounds and noise. Then they were asked to do the same movements, showing little energy and little sounds. Some of the younger children enjoyed pretending they were animals---a great big gorilla and then a tiny little ant. They also experimented with fast and slow movements, and the transitions between them. Afterwards, they took turns demonstrating and describing their big experience in their bodies, using loud, big voices, then described the little experience with quiet little voices, and discussed when they wanted to be big or little in their homes and at school and what they thought other people's responses would be. Through these simple games targeted to high and low arousal, big and small movements, Brian and his peers began to transition through different arousal states with more ease and flexibility, to experience a sense of control and choice at a body level, and to begin to find words for their experience.

Talking about, or even thinking about, traumatic memories can be frightening and dysregulating. Children sometimes experience involuntary trembling and shaking when remembering the traumatic past or when hyperaroused in current situations. Using a technique called "sensorimotor sequencing," the therapist can help children learn to stay with these involuntary sensations and movements until they are discharged and settle by themselves (Ogden et al., 2006).

Jimmy, age four and severely abused, was an anxious child, with darting eyes and quick movements. His body seemed to vibrate, even though he was calmer after weeks of rhythm and movement exercises. When his therapist would ask him about his past abuse, he would sometimes shake uncontrollably. The therapist wanted to help Jimmy settle the arousal in his body so that his memories were no longer so frightening to recall and so that he could experience a somatic sense that it's over. Learning to slowly and mindfully track, detail by detail, the sequential involuntary physical movements and sensations as something interesting and curious rather than frightening can help accomplish these goals. Jimmy's therapist sought to teach him to be aware of his sensations (tingling, bussing, heaviness, temperature changes) and micro-movements (trembling and miniscule changes in muscular tension). She traced an outline of his body as he lay on butcher-block paper. After Jimmy had had time to cut out and color the outline of his body, his therapist taped it to the wall in her office. She then asked him to show where he noticed the feelings inside his body when he thought about his abuse and mark that place with a colored marker. Sometimes Jimmy could find words, sounds, or movements that went along with the sensation. Using a sensorimotor psychotherapy game called "Follow the Treasure" (Mackenzie Harris, personal communication Aug. 20, 2004), Jimmy placed his marker on the place in his body where he felt sensation and then followed the treasure as the sensation moved to another place in his body. Eventually, Jimmy could point to the parts of his own body where he felt sensation and follow these sensations as they fluctuated in texture, quality, and intensity through his body. When Jimmy's therapist asked him to mindfully follow the sequence of physical sensations and impulses as they progressed through the body, Jimmy learned to temporarily disregard emotions and thoughts and memories until his sensations and movements resolved to a point of rest and stabilization in the body.

While the sequencing is unfolds, the therapist gently and playfully encourages the child to just "follow the treasure" and allow these involuntary impulses to happen by themselves. This unique orientation focuses on the allowing the sensations and refraining from voluntarily directing them through conscious control.

As children witness and support the progression of sensations and impulses through the body without trying to control them, they begin to implicitly learn how to use their brain's capacity for mindfulness. When the original traumatic events were occurring, the child's awareness was embedded in the experience, and effective processing was overwhelmed and out of conscious control. In sensorimotor sequencing (e.g., follow the treasure), the child's attention

hovers over the experience, observing it and reporting it to the therapist. The slowness of this microprocessing and the maintenance of social engagement with the therapist keep the experience safe and manageable, challenging the habitual re-experiencing of implicit emotions, sensations, and motor activity. Children sometimes report that these movements seem to happen by themselves, without conscious intention or control, and—rather than continuing to be frightening—can generate feelings of well-being or calm when the movements come to completion.

When the nervous system is hyperaroused without resolution for long periods time, a quick shift to hypoarousal may occur. The body undergoes "…the sudden and rapid transition from an unsuccessful strategy of struggling requiring massive sympathetic activation to the metabolically conservative immobilized state mimicking death associated with the dorsal vagal complex" (Porges, 2001, p. 136). Sympathetic arousal quickly changes "from interactive regulatory modes into long enduring less complex [dorsal vagal] autoregulatory modes" (Schore, 2009a, p. 8). Parasympathetic nervous system activity via the dorsal vagal complex becomes the next and best instinctive line of defense when both the social engagement system and sympathetically mediated defensive responses of attachment cry, fight, and flight are unsuccessful or unavailable in assuring safety. The dorsal branch of the vagus nerve, the unmyelinated vagus, is the most primitive of these systems and is available at birth (Porges, 2011). The neuroception of life threat (as contrasted with the neuroception of danger) stimulates the dorsal vagal system to enable survival-related immobilization, such as feigning death, behavioral shutdown, and syncope. Many functions of the body begin to slow down, leading to " ... a relative decrease in heart rate and respiration and accompanied by a sense of 'numbness,' 'shutting down within the mind,' and separation from the sense of self" (Siegel, 1999, p. 254). When action is not feasible, extreme dorsal vagal arousal can result in fainting, vomiting, or loss of control of the rectal sphincter (Frijda, 1986). In these hypoaroused states, observed even in newborns (Bergman, Linley, & Fawcus, 2004), the infant or child is non-receptive to interactive regulation of caregivers (Schore, 2009a).

A variety of age-appropriate bottom-up interventions can be used to facilitate modulating a child's hypoarousal. Younger children can be taught the Choo Choo Train or Engine game (Bundy & Murray, 2002).

Tami came to therapy at age four because she was prone to shutting down, unable to talk or engage socially. She disappeared in the context of her chaotic family. Her parents had recently divorced, and Tami had lost the security of her house, her neighborhood friends, her preschool, and her cohesive family unit. Living in a very small apartment with only one bedroom she shared with her two older brothers, Tami put up no resistance when her siblings forced her to sleep on the floor. With no parental limits, her brothers bossed her and fought constantly—pushing, hitting, pulling hair—while Tami sat quietly in a corner and watched. Tami was speech-delayed, diagnosed with aphasia, and given special education services in school. Tami often fell silent, and was unable to stand up for herself in social situations or talk about her experience. Body-oriented interventions, however, did not require the use of words. In a context of play, Tami's therapist taught her the Choo Choo Train game. First Tami and her therapist revved up their bodies to be trains that were going very fast and then slowed down until their trains were barely moving. Tami's therapist helped her tune into her body to experience a somatic sense of fluctuations in her arousal, and to find words for the difference in her body sensations and movements between the slow Choo Choo and the fast Choo Choo. Tami enjoyed this game, and played it over and over, becoming increasingly expressive. The Choo Choo game taught her to transition from one arousal state to another, find the words for her experience, and develop implicit skill at modulating her hypoarousal. Slowly, Tami's arousal states shifted from immobility and passivity thought to reflect high dorsal vagal tone, to states of

pleasurable action and assertion, usually associated with increased ventral vagal tone and sympathetic arousal. Soon, Tami's father reported that she was more alive and no longer disappeared so completely in the family.

As those who work with children frequently encounter, it can be challenging to help youngsters develop the abilities to engage with others or take assertive action when their bodies are shut down and hypoaroused. A first step typically involves the therapist helping children to discover actions—rather than words—that help them feel safe. Once safety is established, social engagement can be fostered more effectively.

Abandoned by her mother in infancy and raised by her abusive and neglectful father who took her with him to pool halls night after night until he was sent to prison for sexually abusing her, Marie, age nine, had a very difficult time regulating her hypoarousal, engaging socially, and taking action in her foster home placement. She was teased by the other children for not talking and for sitting alone during playtime at school. In therapy, Marie was taught her to mark her own space by placing a rope around her at a distance of her choosing while she sat on the floor. This was "Marie's space," and no one could come inside her rope circle without her permission. Marie doubled up the rope as she placed it around the back of her body and confided to her therapist that she thought people might sneak up on her and surprise her from the back. As she sat in her circle, with the reassurance that no one would enter her circle unless she said they could, Marie felt safer, and almost immediately became more talkative and forthcoming. To help Marie learn to assert herself, her therapist rolled a large ball toward her as she sat in her rope circle, and she and Marie talked about how Marie felt in her body when the ball started to come into her space. The therapist suggested that Marie push or kick the ball out as it crossed her rope circle. This simple game playfully stimulated the sympathetic arousal necessary for action instead of her usual passivity. Eventually, her therapist took a pillow and began to move it into the little girl's circle again playfully instructing Marie to push it out of her space. Marie became very excited when the pillow approached from the back and, as she turned and pushed it out of her circle, her face lit up and she growled, then laughed. Marie wanted to repeat this experiment every session for weeks. After pushing the pillow away, Marie triumphantly exclaimed several times, "I fought it off! I fought it off!" In a safe environment, using action rather than words, Marie experienced what it was like to have the control over her boundaries she could not have as a small child with her father, and to take assertive action rather than become passively immobilized as she was forced to do during her abuse. Slowly, she was also able to translate her newly found assertion into more responsive action with her peers.

The therapeutic use of rhythmic sound and movement are effective interventions that promote adaptive neuroception and self-regulation.

Nina, an exceptionally intelligent seven your old, was a year and a half old when she was left alone for several days with an unfamiliar nanny when her brother was born. From birth, her brother had profound medical problems that absorbed the majority of the parents' attention and concern. Nina's mother reports that Nina had always been temperamentally withdrawn, shy,and slow to warm up. She struggled with peer interactions and had difficulty regulating her behavior at home and at school. She was easily hyperaroused, but would shift quickly into a collapsed hypoaroused state, particularly in social situations or during transitions, e.g., as she changed environments from home to school. In challenging school situations, she would collapse, unable to speak, and when she played with more than one friend, she often dissolved into tears and withdrew to her room. She became increasing isolated at school, as her school environment was not equipped to help her with her social difficulties, nor meet the academic needs of a gifted child. Nina's self-esteem plummeted further when every school she attempted to transfer into rejected her, and she was forced

to remain in a school in which she was extremely unhappy. Nina's distress was palpable as they entered a prospective school: she was unable to leave her mother's side, clinging, hiding behind mother's skirt, refusing to meet other children, and refusing to speak.

At the beginning of therapy, Nina bounced on the couch, flitted around the room, babbled incoherently, and could not settle down or interact with her therapist until 20-30 minutes into the hour. The therapist asked Nina to use a drum to demonstrate the emotions that she felt, particularly when she thought about the process that she had to undergo while visiting new schools. Nina beat rhythms on the drum that corresponded with various situations—walking from the car to the new school, interviewing with school personnel, meeting new children and visiting classrooms—and was eventually able to identify emotions such as anxiety, fear, boredom (her term for hypoarousal), terror, and anger. Use of the drum helped Nina find the words for a range of emotions and also served as a tool for regulation. As she beat out the rhythm that mirrored her emotional response to challenging situations, and then beat out a more regulated rhythm that enabled her to calm down, Nina learned to transition from high anxiety to more peaceful states. As she began to regulate arousal more smoothly, Nina's clinging, withdrawn behavior also changed into more comfortable interactions with new children and school personnel.

The hierarchical relationships between ventral vagal (social engagement), sympathetic, and dorsal vagal systems are established early in life, resulting in enduring arousal tendencies, reactions under stress, and even vulnerability to psychiatric disorders (Cozolino, 2002; Lyons-Ruth et al., 1999; Schore, 2001, p. 209; Sroufe, 1997; van Ijzendoorn, Schuengel, & Bakermans-Kranenburg, 1999). Prolonged negative affective and physiological states associated with early relational trauma "generate immature and inefficient orbitofrontal systems, thereby precluding higher complex forms of affect regulation" (Schore, 2009a, p. 8) in later years. The child is left with a compromised social engagement system and tendencies toward hypo- and/or hyperarousal states. However, through bottom-up neural exercises as described above, adaptive neuroception can be fostered and self-regulation can be developed, increasing the child's sense of agency and mastery.

Procedural Learning

Trauma-related hyper and hypoarousal go hand in hand with dysregulated animal defenses, the telltale signs of foiled attempts to protect and defend oneself from inescapable trauma. Past experience is reflected in procedural learning—physical action sequences or tendencies that echo implicit expectations of impending danger. As Beebe (2006) asserts, "Early interaction patterns are represented pre-symbolically, through the procedural organization of action sequences. Predictability and expectancy are key organizing principles of the infant's brain. Infants form expectancies of how these interactions go, whether they are positive or negative, and these expectancies set a trajectory for development…" (p. 160). Implicit predictions are conveyed by the child's procedural learning—i.e., the incremental learning of processes or habits through deliberate or unconscious repetition (e.g., looking down instead of making eye contact) of particular actions. Exposure to events that represent a real or perceived threat to safety elicit subcortical mammalian, or animal, defenses that are not mediated by the cortex; in fact, they actually *disable* cortical activity when engaged. These animal defensive strategies are adaptive at the moment of immediate threat, but tend to become default behaviors and inflexible action sequences in children with PTSD.

Animal defenses can be loosely categorized as the attachment cry that seeks the protection of someone older and wiser, mobilizing defenses that drive overt action (i.e., fight, flight), and immobilizing defenses that inhibit physical

action. These defenses are instinctively generated by the brain and nervous system through neuroception, which occurs via "unconscious subcortical systems that functionally trigger … adaptive neural circuits" (Porges, 2011, p. 228). Overactive defensive responses and faulty neuroception biased by traumatic experience are at the root of many symptoms and difficulties observed in traumatized children. As Porges states, "invalid neuroception of safety or danger might contribute to maladaptive physiological reactivity and the expression of the defensive behaviors" (Porges, 2011, p. 274). By definition, traumatized individuals have experienced a failure of their defensive responses to ensure safety. Clinically, we have observed that children tend to repeat a defense that was evoked at the time of the original trauma even though it may have been unsuccessful or only partially successful in conferring safety. Children are driven via bottom-up hijacking to reenact those same defensive responses long after they have survival value. In treatment, work with defensive responses through somatic interventions can reinstate the adaptive and flexible functioning of animal defenses.

The attachment cry defensive response is designed to elicit the help and protection of someone stronger and is distinguished from attachment behavior designed to secure and maintain enduring attachment relationships in the context of the neuroception of safety. Successful attachment cry responses require the availability of attuned or protective caregivers. But when attachment figures do not respond to a child's plea for help, he or she may eventually cease reaching out, avoid eye contact, and come to depend more upon auto regulation and withdrawal than on seeking help from others. Children may develop an implicit prediction that no one will respond to proximity-seeking behavior, and thus literally abandon integrated, purposeful proximity-seeking actions. In therapy, helping children to become more aware of their procedural tendencies and practicing new actions can address these types of issues. In addition to the practice of reaching out, exploring a variety of other arm movements can be vehicles for change (cf, Ogden, 2009/2010; Ogden, Minton, & Pain, 2006). Grasping, beckoning or pulling motions, expressive movements of opening the arms widely in gestures of anticipatory embrace or expansion are all significant avenues for exploration. Because the manner in which they are executed reflects the implicit self, changes in relational procedural actions are also reflected in changes in implicit self-experience.

While reaching out, grasping, and pulling movements can be a challenge for many children with poor social engagement, they can be strengthened through practice.

As a result of an abusive and isolated early childhood, Danny, seemed younger than his 12 years, had few social skills, and kept to himself during playtime at school. His arms hung limply by his side, and he avoided eye contact. Targeting his symptoms of social withdrawal, his therapist playfully invited Danny to mirror her gestures and explore what his arms could do, encouraging him to reach, push, hold, grasp, swing, relax, tighten, make sharp and soft movements, close his chest, and hug himself. As she engaged in this exploration with him, she instructed him to be aware of his fingers, hands, wrists, elbows, and what each could do. Modeling curiosity and excitement, she asked him to notice which of the gestures felt new, and which ones were most familiar. Playfully, they explored what happened when Danny reached out to take a favorite toy offered by the therapist, or reached back when his therapist reached out to him. They played a game in which Danny would close his eyes, and reach out with an open palm. His therapist would then place a surprise in his hand—a favorite toy, an orange, or a small piece of candy. Danny learned to communicate with his arms, letting them talk, noticing what happened emotionally as his arms talked. His therapist cued him, "Maybe you're enjoying it—or maybe you'd rather hide—maybe your arms are inviting me to come closer—maybe you want to

use your arms to keep others away because you need space alone—maybe your arms are scared, or maybe they are angry." Danny and his therapist worked to strengthen the arm muscles that pull in, connected with the psychological capacities of grasping and pulling in nourishment. Pulling motions were explored using a rope that each held, and Danny and his therapist took turns pull with different degrees of strength, sometimes arm over arm to decrease the distance between them. Unlike his early caregivers, the therapist was attuned to his affect and body language, allowing Danny to control the process and experience pleasure in the relational give-and-take of these games.

The sympathetic nervous system-mediated mobilizing defenses of fight or flight require increased blood flow to large muscle groups to prepare the body to take strong overt action. When escape seems possible, flight is the instinctive defense of choice (Fanselow & Lester 1988; Nijenhuis & Van der Hart, 1999; Nijenhuis, Vanderlinden, & Spinhoven,1998) and can be conceptualized as both running away from danger and running toward safety. When aggression appears likely to be effective, or when the individual feels trapped, the fight response is typically provoked. These sympathetically-mediated defenses, when over-utilized as under conditions of threat, can become inflexible and rigid, chaotic or hypoactive, or both. Some children with dysregulated flight responses exhibit fleeing behaviors, such as precipitously leaving the classroom or social situations, as well as more subtle flight-related actions: turning away, twisting, ducking imaginary objects, or backing away. Because of their physical dependence upon adults, most children are trapped in their families and do not have the resources or help to leave an abusive environment. In therapy, children have the safety to explore flight movements, experimenting with locomotion and moving away from unwanted stimuli.

Four-year-old Lisa was scared of spiders, and she and her therapist played the game of "run from the spider" over and over. Her therapist would pull out a plastic spider from its hiding place in a box, and Lisa would run first with fear but eventually with delight to her "safe spot" in the room, at the opposite end of the office. Then the spider would crawl back into its box. Through repeated iterations of this game, Lisa experienced an effective flight response, and a sense of control over her environment and its stimuli.

Kate was kept in a small basement where she could not move freely, and suffered such horrific extremes of abuse and neglect that she could not walk when she was adopted at five years old. Her dedicated adoptive parents painstakingly taught her to walk and brought Kate to group treatment when she was seven because the school system would not permit her to attend school due to her disruptive behavior. Kate refused to move during class, would not follow instructions, ran into the street at play time, and was violent to other children, frightening them into doing things for her. In her therapist's office, Kate loved sitting and playing with the chair-on-wheels. Understanding this child's history of being literally trapped like an animal in a small space and consequent need to complete a truncated instinctual flight response, Kate's therapist encouraged her to use the chair as a vehicle for effective flight by taking it into the hallway and pushing it down the hall. Kate lay face down on the chair, protecting her viscera, and pushed with her feet and legs. After weeks of this play, Kate's need to flee seemed satiated and her behavior improved.

Porges (2011) asserts that, "playing nice" comes naturally when neuroception detects safety and promotes physiological states that support social behavior. However, prosocial behavior will not occur when our neuroception misreads the environmental cues as unsafe and triggers physiological states that support defensive strategies (p. 12). Faulty neuroception is especially obvious in children with a tendency to overactive fight responses, i.e., who are overly aggressive and categorized as oppositional-defiant.

Jake, age 7, the youngest boy in a family of seven, slept in the living room with his three brothers. Jake was constantly picked on in his family and could not even complete his bowel movements privately without being taunted by his siblings. Extremely hostile, restless, and disruptive, with hunched, tight shoulders, Jake often aggressively said to other children, "I want to KILL you." In group therapy, these issues were addressed by asking Jake to make a boundary around himself with rope. He was encouraged to keep everyone out of his "bubble," his term for the circle of rope he created, and to use his voice and his arms to give the "get out" message. Jake experimented with telling others to come into his bubble, and then telling them to leave. Group members were instructed to do as he said and to get out of his boundary space when asked. With repeated iterations, Jake's procedural patterns visibly changed: his spine lengthened, his head came up, his eyes softened and his shoulders relaxed. These physical actions supported engagement with others, while his tense shoulders, squinting eyes, head down, and compressed spine supported disconnection and aggression. Jake finally had control over his own boundary, something he never had in his family, and his aggressive outbursts lessened.

When mobilizing defenses are ill advised, such as when a child's fight response might provoke more violence from the perpetrator or when the perpetrator and attachment figure are one and the same, passive avoidance or immobilizing defenses are the only survival strategies remaining (Allen, 2001; Misslin, 2003; Nijenhuis, Vanderlinden, & Spinhoven,1998; Nijenhuis & Van der Hart, 1999; Rivers, 1920; Schore, 2007). We have identified two types of immobilizing defenses: (a) the sympathetically mediated freeze response (alert immobility), and (b) the parasympathetically mediated feigned death response or floppy immobility (Ogden, 2009; Ogden, Minton & Pain, 2006). The freeze and feigned death responses are markedly different in presentation, although these two immobilizing responses are often conflated in the literature. The feigned death response, powered by the parasympathetically mediated dorsal branch of the vagus nerve, is characterized by limp musculature, behavioral shutdown, slowed heart rate, and/or fainting (Lewis, Kelly, & Allen, 2004; Nijenhuis & Van der Hart, 1999; Nijenhuis, Vanderlinden, & Spinhoven,1998; Porges 2001, 2004, 2005; Scaer, 2001; Schore, 2007). The freeze response is characterized by a highly engaged sympathetic nervous system, possibly combined with arousal of the parasympathetic (dorsal vagal) system (Siegel, 1999), stiff or tense muscles, increased heart rate, and a feeling of paralysis coupled with hyper-alertness.

Though adaptive for children in environments where escape is impossible and resistance might exacerbate the trauma, an immobilizing defense can become a default behavior that predominates over other, more adaptive, assertive actions.

Sixteen-year-old Sally, described as pre-psychotic, dissociative, and extremely at risk, was referred to group therapy by her psychiatrist. Sally had been adopted by a couple who subsequently separated, following which her custodial parent, her father, tragically died in an accident. Sally was then sent to live with her mother, who had custody of an older brother who was abusive not only to Sally, but also to his mother and their pets. Sally's mother was passive and helpless in the face of her son's violence. Sally seemed to live in a state of freeze—a "chronic state of hypervigilance, a tendency to startle, and occasionally panic (Krystal, 1988, p. 161)," as well as increased muscular tension. Though Sally was frozen and immobile when abused by her brother, she would later repeatedly punch holes in her bedroom wall, which she would then cover with a poster. In group therapy, she was given a ball to throw to one of the other girls. Her throw was at first weak, but buoyed by the encouragement of group members, she eventually tried throwing the ball hard, to the cheers of the other girls. Immediately she experienced a sense of satisfaction and joy. The

group then transitioned to an exercise that involved pushing against a pillow held by one of the girls, an action Sally eventually was able to execute with gusto. The group utilized a couch as a safety zone upon which the girls holding the pillow could fall, thereby allowing the person pushing against the pillow to complete the action. This therapeutic exercise mitigates freezing by facilitating both the execution of fight responses and social engagement via the support of the group.

With younger children, using a therapy ball to stimulate defensive responses can also be effective. The therapist instructs the child to imagine that "this ball is something you don't feel comfortable about, and it's slowly coming towards you. Show me what you want to do with the ball, and when you want to do it." Many children have to be told that they are allowed to take an action, or they are encouraged to pretend they are bulls with horns on their heads and can butt the ball away, big lions who can swipe the ball away, or strong gorillas who can push it away. The exercise can be done playfully and imaginatively, with the goal of exchanging the procedural learning of immobility for adaptive mobility and defense.

The above exercises also are equally effective for freeze responses and feigned death or floppy immobility (Lewis et al., 2004), With profound inhibition of motor activity (Misslin, 2003), coupled with little or no sympathetic arousal, this hypoaroused condition is an energy-conserving shutdown state that reduces engagement with the environment and may be accompanied by anesthesia, analgesia, and muscular/skeletal retardation (Krystal 1988; Nijenhuis & Van der Hart, 1999). When children suffer ongoing abuse, they often become overly compliant with the "aim to prevent or interrupt aggressive reactions" (Misslin, 2003, p. 59). Cues that indicate this passive defensive response include avoiding eye contact or lowering the eyes, crouching, and bowing the back in automatic obedience. Such behavior is often apparent in mechanistic compliance or "robotization" (Krystal, 1978) and usually involves a lack of protest against abuse (Herman, 1992). Children with habitual dorsal vagal responses tend to become easily hypoaroused, often accompanied by flaccidity in the musculature, slumped posture, and other submissive physical tendencies described above. When compliance is the best option, children's bodies instinctively respond with resignation, submission, and acquiescence to a threat cue, and they lose the ability to say "no."

Children can be helped to establish or reestablish a physically felt sense of saying "no" and saying "yes" with their bodies. The child can be instructed to say "NO" with his or her body, rather than in words, and given a variety of suggestions: "Maybe you could stamp your foot, or make your body really, really tight. Let's see what happens when you walk around the room saying 'NO' out loud and with your body. Then, say 'YES' with your body, and walk around the room saying 'YES'." After the children have had positive experiences with a strong no and yes response, they can be encouraged to make up stories about when they want to say "Yes" and when they want to say "No," again increasing the sense of choice and control at a body level.

Integrated actions are abandoned or distorted when they are persistently ineffective in producing the desired outcome. If children's boundaries are not respected, they either learn to stop asserting themselves, or they learn to assert themselves automatically and aggressively. If no one is there to reach back, children learn either to stop reaching out or to reach out compulsively in a clingy, apparently regressive manner. If children's feelings or vulnerability become a pretext for parental ridicule, they learn to avoid attachment figures when they feel distressed or needy. If eye contact or standing upright with their heads held high elicits more abuse, children will develop tendencies to slump and to keep their heads down.

Kate, the child who could not walk at age five, was in therapy for over a year before she finally felt safe enough and sufficiently comfortable with action to begin to explore various postures. Kate and her therapist tried out different postures to see how they felt. The therapist would ask, "What happens if we stand slumped with our heads down? How does that feel? How is that different from standing tall with our heads up?" As Kate learned to identify which postures helped her feel strong, she and her therapist explored walking around the grounds of the group home. In that larger open space with other children nearby, Kate instinctively reverted back to her furtive, tight walk, with eyes that darted around. She noticed, though, that the boys had a macho walk and that no one bothered them. Intrigued by that discovery, made possible by her increased ability to regulate arousal and to orient to her surroundings, Kate began to develop a new way of walking herself, first in the safety of her therapist's office and in the hallways of the therapy wing, and then finally on the grounds with her therapist beside her. Kate would initially try the walk outside for a few minutes, and then come back into the therapy office, scared by these previously forbidden actions. Over time, with repetition of the same actions over and over again, Kate learned how to change her procedural tendencies so that she could hold herself and move in a way that felt more empowering for her.

For Kate, this new way of walking was with her head up, shoulders open, and arms swinging by her side. But, for each child, what feels empowering may be different. In Sensorimotor Psychotherapy, the therapist is attuned to the importance of helping each child develop a way of moving in space that feels good and empowering to him or her. For some children, walking with head down might feel safer initially, and more expansive movements might develop over time. However the process of somatic and cognitive change unfolds, the therapist helps the child discover from the inside what feels right and to find the words for the right feeling. The discovery and elaboration of what feels right or good at a body level exchanges old procedurally learned responses that were adaptive in past traumatogenic environments for new empowering actions adaptive to current situations.

Sensory Processing[2]

The effective processing of sensory stimulation is critical to both affect regulation and procedural learning. The infant's and young child's adaptive responses to sensory stimulation provide the foundation for increasingly complex sensory processing and action sequences through the course of childhood. The ability to manage incoming sensory information is an automatic bottom-up process that develops somewhat predictably through exposure to a wide variety of sensory experiences. This process continues from infancy through about age 8 to 10 when the basic sensory-processing functions have matured, though these continue to be refined throughout the life span. An environment that offers enriching and challenging sensory experiences appropriate for the child's level of development is essential for a child to acquire sensory processing competency.

Selecting and orienting towards stimuli is one of the functions of sensory processing. From birth, infants instinctively select and orient toward sensory stimuli that are compelling or interesting at any given moment. When an external stimulus is found engaging or demands attention, an infant will orient to—or direct his or her sensory radar toward—this stimulus. Orienting involves visible physical actions of attuning the sensory organs, particularly the eyes, and often the head and body, in the direction of a stimulus. Orienting is highly automatic and is generated reflexively in

[2] The authors wish to thank Aubrey Lande, MS, OTR, for her input for the section on Sensory Processing

response to either an unexpected or novel stimulus (Fisher et al., 1991; Levine, 2004; Sereno, 2005) or a stimulus that meets survival needs. Orienting remains largely independent of conscious awareness even after the cortex has matured.

Pierre Janet pointed out a century ago that the sensory information available at any given moment far exceeds one's capacity for awareness. The child instinctively retracts or narrows his or her field of consciousness by selecting and orienting toward certain sensory stimuli and excluding others from awareness. What is selected from the enormous variety of available sensory stimulation is determined by the intensity and repetition of a signal, its novelty or familiarity, the child's internal state and needs at the moment, and of course his or her personal history. The term "field" of consciousness refers to the quantity of sensory input selected (Janet, 1907; Steele, Dorahy, Van der Hart, & Nijenhuis, submitted; Van der Hart, Nijenhuis, Steele, & Brown, 2004). The extent of this field of consciousness varies naturally depending on the environment and the needs of the child.

Narrowing the field of consciousness by selecting relevant cues is fundamental to organizing goal-directed behavior. The sheer amount of available sensory stimulation available at any given moment can easily overwhelm children who are unable to filter out irrelevant or insignificant information. If children cannot select effectively, they may fail to attend to relevant stimuli or may flit from one stimulus to another without being able to concentrate attention. In the context of neglect and abuse, the field of consciousness is strongly affected by adaptive priorities, e.g., some children may learn to selectively attend to adults' body language (visual stimuli) while screening out verbal language, and others may develop auditory hypervigilance but fail to orient to visual-spatial information. Many traumatized children present with symptoms reflecting sensory processing issues.

Megan, age seven, had great difficulty processing sensory stimuli that activated implicit memories of witnessing her mother's being abused in the context of ongoing domestic violence, and her school reported that her behavior was extremely problematic. Upon analysis of the flow of her school activities, her therapist discovered that Megan's behavior was most dysregulated in gym class, even though she loved gym class. She was excited to go to gym because she knew she would have fun, but as her male teacher explained the activities for the class, seven Megan would consistently have a tantrum. Triggered by a male authority figure, Megan appeared to be unable to differentiate the sensory input of his voice and body language from her mother's abuser, which led to a chaotic, disorganized expression of alarm through her tantrum. Once the origin of the tantrums was clear, Megan's therapist could intervene with activities that stimulated her proprioceptive system, gave her something to move against, and helped her feel more contained and organized, calming her nervous system. They began with a variety of activities to do in anticipation of her trouble in this class. Fifteen minutes before gym class, Megan engaged in several activities. She put a compression belt around her waist and used thick rubber bands at the ends of her fingers that provided resistance as she spread her fingers. She also power sucked her favorite drink through a long straw and ate half a cup of yogurt. Note that these activities were undertaken as purely bottom-up, sensory and neuroregulatory interventions as traditionally used by occupational therapists in sensory integration work.

Because child trauma treatment requires a bottom-up focus or components to address the autonomic and physiological sequelae, interventions originating in the occupational therapy world are increasingly being integrated into psychotherapy (Ayres, 1898; Fisher et al., 1991; Koomar, 2009). In Megan's case, interventions targeted at sensory processing with no verbal discussion of her behavior or trauma provided her with an opportunity to engage in organized, purposeful movement. This example illustrates the importance of reviewing patterns throughout the child's day to

discern what elements seem to overwhelm the child's processing capacities, noting transitions, triggers, or cumulative stress that might cause difficulty. Sensory activities can be built into the child's day in anticipation of mitigating stressful triggers that are designed to strengthen his or her threshold.

Traumatized children often have trouble sorting out relevant, significant cues from inconsequential ones (McFarlane, Weber, & Clark, 1993; van der Kolk, Van der Hart, & Marmar, 1996, p. 14). Their selection process may be biased by hypoarousal states and a corresponding dulling of the senses that interferes with the ability to select and orient to relevant cues. Children may also compulsively focus on a certain stimulus or filter out pertinent stimuli, failing to respond to important information. A felt sense of danger and the accompanying hyperarousal may cause trauma-related stimuli to become the dominant objects of orientation and new information about the environment to be screened out.

Aaron, age nine, experienced persistent hyperarousal that was exacerbated when faced with domineering peers, who presumably reminded him implicitly of the abuse he suffered at the hands of his older brother. He was unsupported by his parents who had grown to dislike their younger child, experiencing him as difficult to manage. Not surprisingly, Aaron suffered from nightmares, developed social anxiety around children who were dominant, and would obsessively collect data to support his perception of being mistreated. He became particularly triggered if he perceived that other children were receiving more attention than he was and automatically screened out any information to the contrary. Aaron could not express himself with words and, in social situations, became so hyperaroused, rageful, and out of control that he frightened other children. His therapist began with simple sensory activities that Aaron and his parents could integrate into his daily life to help him be in contact with his body and bring his arousal into a window of tolerance. He used a vibrating toothbrush in the morning and a foot-long thin straw to drink from. A soft, fragrant pillow would exude a pleasant scent of fresh pine essential oil when Aaron squeezed it hard. His bed was placed in a corner to provide a sense of protection, and he slept with a weighted blanket at night to provide a feeling of containment. His parents were instructed to have soft lighting in his room and to play gentle, rhythmic music when Aaron had to do chores, get dressed, or get ready for bed, in order to help him organize his own movement into a steady, modulated rhythm. These activities helped Aaron increase his ability to process sensory information, calm his nervous system, and eventually find the words to talk about his feelings rather than have tantrums. His relationships with his parents and his peers improved naturally as he implemented these simple sensory tools that helped stimulate his sensory system in ways that were regulating.

Sensory processing involves abilities for receiving, modulating, integrating and organizing sensory stimuli so that adaptive action can be taken. (Fisher et al., 1991). Once sensory input is received through the thalamus, the brain must select, enhance, inhibit, compare, and associate the sensory information in a flexible, constantly changing pattern (Ayres, 1989, p. 11). This complex process involves modulating and organizing sensory information in a way that "makes it possible to use the body effectively [to initiate, implement, and complete action] within the environment..." (Ayres, 1989, p. 11). Dysregulated arousal and over-active animal defensive responses disrupt and interfere with children's ability to effectively process sensory information and to complete adaptive actions.

Children with a wide window of tolerance can cope with greater extremes of arousal and thus process complex and stimulating information more effectively. Children with a narrow window of tolerance experience the same extremes as unmanageable and dysregulating, and are more susceptible to becoming dysregulated by normal fluctuations in arousal (Taylor, Koch, & McNally, 1992). The width of a window of tolerance is directly related to how much stimulation is

required to elicit a threshold of response; hyper- and hypoarousal coexist with extreme thresholds for sensory stimulation. When the threshold is low, the child's nervous system is aroused with very little input; when the threshold is high, more input is required. Traumatized children typically experience unusually high or low thresholds, or both. Children with a low threshold may become upset or aggressive with very little provocation or may become withdrawn to avoid activities or encounters that they find overstimulating. Children with a high threshold sometimes seek extreme stimulation but have difficulty assimilating the accompanying arousal. Some have a high threshold because of the buffering effects of hypoarousal, which lowers their responsiveness to the environment. For optimal functioning, the threshold should be "high enough that [children] can tolerate the complexity and stimulation inherent in the environment, yet low enough that [children] can perceive subtle changes and novelty in the environment" (Williamson & Anzalone , 2001, p. 28). Thresholds vary from child to child and are influenced by several factors: how long the effect of the stimulus lasts (the rate of recovery), the child's initial arousal level, previous experience (Williamson & Anzalone, 2001), and temperament (Siegel, 1999). Thresholds also vary with the type of stimulation. Some children have a high threshold for touch stimulation, such as cuddling and physical contact activities, but a low threshold for emotional stimulation, or vice versa. Some are more sensitive to visual input while others are more sensitive to auditory input. While one child might have little response to unusually loud noises in his immediate vicinity, another might be terrified and overwhelmed by the sound of a car in the distance. When arousal is too low and the threshold too high, a child may be hypo-responsive or sluggish, demonstrate a delayed response to physical stimuli, appear to have dulled senses, and fail to notice or orient to appropriate stimuli. Failure to respond appropriately in a timely manner can affect the child's attention, learning, social interactions, and performance.

Bobby, whose older brother was in prison, witnessed his mother's murder by her boyfriend. A spindly eight year old, with a high general threshold, Bobby was taken to emergency social service. He was passive, silent, and withdrawn for long periods of time. However, occasionally, his voice would become very high, and his eyes would dart around the room. His caretakers learned to recognize these signs as indicative of an impending shutdown in which Bobby would become completely non-responsive, often taking an hour to resolve. He seemed particularly triggered by loud, unexpected noises made by other children, sirens, and so on. To facilitate sensory processing, his therapist attempted to discover what sensory input Bobby enjoyed. He discovered that Bobby liked the smell of popcorn, so he began every session with microwaving a bag of popcorn. Bobby was encouraged to choose a small fidget toy from a selection in his therapist's office, and he chose a soft, squishy frog that he liked to squeeze. Every time Bobby heard the pop of a corn popping, he would squeeze his frog. Bobby became strongly attached to his frog, which he kept in his pocket. The therapist encouraged him squeeze his frog, which he kept in his pocket. Bobby also learned other simple tools to help him process sensory stimulation and regulate his nervous system. His therapist gave him little weights to tie to his shoelaces so he felt more grounded and taught him massage his fingers, which he liked and found regulating.

When arousal is too high, hypervigilance and hyper-orienting may result, leaving the child with a very low threshold for sensory stimulation. When aroual is too low, a child may fail to orient to the environment and may not notice significant stimuli. In either case, arousal is outside the window of tolerance, and the child's ability to discriminate the stimuli that are important from the ones that are not, as well as the ability to organize and integrate sensory input from more than one sensory system, will be hampered. Children may have difficulty learning when they cannot maintain

sufficient arousal to be attentive or when they become easily over stimulated by sensory information. In turn, the failure to process sensory stimulation effectively further dysregulates arousal, and a vicious cycle ensues.

Sensory processing requires that sensory information from all the senses is registered accurately, organized, modified, and responded to in an adaptive fashion. Sensory processing difficulties can involve any of the senses: touch, vestibular system (involving balance, the pull of gravity, and the position of the head and the sense of movement), proprioception (the movement and position of the muscles and joints and of the body as a whole), sound, sight, smell, or taste. Traumatized children may experience difficulty processing sensory stimulation when faced with reminders of the trauma, which is different from the sensory processing difficulties of children with sensory modulation disorder. Koomar (2009) clarifies:

> "…a child with a trauma background may be triggered by specific smells associated with past abuse, sounds associated with impending abuse or neglect, or physical touch but not from touching inanimate items. A child with sensory modulation disorder, on the other hand, may be moved into a states of overarousal by specific categories of sensation, such as pungent odors or lumpy textures, light touch, or sounds of a certain frequency level, regardless of the object or person who produces the sound" (p.2).

Whether the underlying cause is traumatic experience or sensory modulation disorder, the symptoms of sensory processing difficulties may look very similar. In either case, the child may fail to select, orient toward, and correctly interpret sensory input, triggering negative responses. In traumatized children, abuse-related faulty neuroception coupled with sensory processing deficits cause habitual propensity for flight, fight, freeze, and feigned death responses.

Becky, age six, came from a secure and loving family. But, following a van accident in which one person died in front of her and her mother had to be intubated while Becky watched, she was afraid to go to sleep at night and would wake several times during the night frightened and agitated. Becky began being insensitive and rough with her younger sister in their play together, and started wrestling with the family dog in a way that appeared to be mean and hostile. Rather than viewing these seemingly aggressive actions as violent or abusive, her therapist recognized that Becky was seeking a level of sensory intensity that could help her calm herself down. Her therapist explained to the concerned parents that Becky was probably trying to use proprioceptive stimulation to soothe and organize her nervous system and body. Her parents, at the therapist's suggestion, purchased a fleece blanket, filled it with ankle weights that would provide pressure, a vibrating pillo,w and a cheap CD player. Becky would lie on the floor with the vibrating, weighted fleece blanket on top of her and listen to the CD player while it played her favorite Disney CD. Following Becky's instructions, her parent applied pressure on her back until Becky felt calm and sleepy. Becky's sleep then improved, and she resumed her previous gentle play with her sister and the family dog.

Children may experience difficulty in any of the seven sensory systems (Fisher et al., 1991). Problems integrating tactile stimulation may manifest as unusual sensitivity to certain fabrics, seams and tags in clothing (even socks); resistance to bathing or messy activities; or even difficulty tolerating snuggling and light touch. Other children with tactile processing difficulties may be hyposensitive instead of hypersensitive to touch, which can manifest in touch seeking instead of avoiding, rough play with other children, and imperviousness to pain. Some children become picky eaters and gag easily while others may crave oral stimulation and frequently chew on pens and other objects. A child with auditory problems may be easily startled by noise, distracted by or fearful of ordinary sounds such as hairdryers, or, conversely, may be noisy and loud, unresponsive to verbal or auditory cues, confused about the direction from which

sounds originate. Hypersensitivity to smells such as perfume, bathroom, and even cooking contrasts with the hyposensitive of children who barely notice smells. Some children are triggered by sunlight, avoid eye contact, and are easily distracted by visual input. In the school arena, overhead lighting, buzzing of florescent lights, chaotic or overcrowded classrooms contribute to children's challenges when they are predisposed to hypersensitivities. Proprioceptive difficulties manifest in extremes of aggression, constantly roughhousing, crashing, and hugging too tightly, or, by contrast, in movements that are clumsy, uncoordinated, awkward, and stiff.

One young sexual abuse victim was very seductive and provocative and sought tactile stimulation through inappropriate physical contact. She took off her underwear and hung upside down from the jungle gym on the playground. She was helped by being encouraged to push big therapy balls against the wall, play tug of war with her therapist, and find appropriate tactile activities that she enjoyed (like finding a fleece cuddly toy to hug, and an old fur coat to pet).

A child who has acoustic sensitivity may benefit from earplugs, a thick headband covering their ears, or headphones to dull environmental noise. A child sensitive to visual stimulation chose a pair of sunglasses with very dark lenses that he put on whenever he felt he needed them.

One child who developed a hypersensitivity to smells after repeated surgeries carried peppermint tea bags in her pocket because she enjoyed the smell. She also carried a packet of Lifesaver candies, calling them her "smellies." The Lifesavers provided an alternative incoming smell and gave her something to suck, which provided organizing stimulation orally.

Eve, a very anxious and self-injuring adolescent who would cut her body frequently, benefitted from the smell of vanilla. She sought out the vanilla candle that her therapist occasionally lit during the winter months, and as therapy progressed, Eve reported that her mother, who had died of cancer a few years before, loved to bake, hence prior to her illness the smell of vanilla permeated the kitchen. She carried vanilla hand cream in her school backpack to ameliorate anxiety, and reported that the aroma soothed her and that her self-injurious behavior diminished.

Eight-year-old Lisa barely survived her premature birth, and then was neglected throughout her childhood, resulting in difficulties across several sensory systems. She could not tolerate the seams in her socks and agreed to wear only two of her many outfits because she found the other clothing too irritating to her sensitive skin. She gagged easily, reducing her food intake to macaroni and cheese, pudding, and a few other smooth foods because she found textured foods, such as meat, vegetables, and salad, irritating to her mouth. She sat alone in the classroom during playtime because the noise on the playground was too much for her, and she was hypervigilant about being bumped into. She was so sensitive to smells that she could not tolerate public outings with her family. Her world had become smaller and smaller, and her parents became increasingly frustrated with her limitations. In a sensory-oriented therapy, in a playful atmosphere, Lisa learned a series of sensory-processing skills that gave her more mastery over these difficulties. Her therapist showed her how to desensitize her mouth by dipping her thumb in pudding and then pressing on the roof of her mouth and inside her jaw, instructing her to give five deep pressures per location and then move the pressure to a different place in her mouth. Her gag response diminished, and she could begin to eat textured foods such as a turkey burger. Lisa's therapist also taught her several enjoyable sensory activities she could do for herself: in the shower, Lisa brushed her body with surgical scrub brush for 20 seconds and follow it up with squeezing herself to provide organizing proprioceptive stimulation and calm her nervous system. She learned which songs were regulating to her and put them

on her iPod. Lisa was happy to engage in these activities on her own, and experienced a sense of agency and empowerment in doing so. Slowly, her relationship with her family improved, she was able to make eye contact with her family, she felt more capable and had tools to use to soothe herself and help her process sensory stimulation.

In the case of all of these children, the ability to verbally process the events that shaped brain and body was limited by their ages. In addition, their symptoms were driven by body-based sensory processing issues. Through bottom-up sensory interventions, they were able to bring these symptoms under control and to develop new tools and patterns that improved relationships both at home and at school.

Conclusions: Changing the Brain and Body

A child's brain and body organizes itself for survival and adaptation under the unique circumstances of a particular biological heritage and family environment. Patterns of response that may be adaptive at a particular age or in a particular family context may no longer be adaptive later in childhood. The bottom-up approaches illustrated in this chapter help to capitalize on neuroplasticity and promote more adaptive behavior after traumatizing experiences. According to Schwartz and Begley (2002), neuroplasticity is "induced by changes in the amount [and kind] of sensory stimulation reaching the brain" (p. 16). In other words, repetition of habitual thoughts, emotions, body sensations, and movements will not change the brain, but it reinforces established neural networks and thus habitual ways of thinking, feeling, and acting. To change the brain, we must interrupt and inhibit rigid patterns and experiment with new amounts and kinds of sensory stimulation. The patterns of regulation, movement and sensory processing stemming from past trauma are evidence of the brain's neuroplasticity in adapting in traumatizing contexts, but these habitual reactions cannot help children capitalize on the brain's capacity for neuroplasticity in the present.

Changing the brain requires focused attention and direction (Siegel, 2006). It necessitates the conscious inhibition of old responses coupled with intentional repetition of new, more adaptive responses. In a sensorimotor psychotherapy approach, therapists help children to notice and describe what happens when they try something new, like pushing away, lengthening the spine, using a weighted blanket, and so on. Children learn to selectively direct their attention to practice a new physical posture or skill rather than repeating the old automatic response. In so doing, we hope to encourage the harnessing of neuroplasticity through inhibition of old responses and repetition of new ones.

When children suffer unresolved neglect and trauma, they are left at the mercy of non-verbal phenomena (affect dysregulation, maladaptive procedural tendencies, problems with neuroception and sensory processing) that can best be addressed by bottom-up psychotherapeutic approach. As Perry (2009) clarifies:

> "When symptoms related to the persisting 'fear' response (common in maltreated children) are addressed… remembering that these first arise in the brainstem and then move through the brain up to the cortex, the first step in therapeutic work is brainstem regulation. The child may also have a host of cortically mediated symptoms such as self-esteem problems, guilt, and shame. The most effective intervention process would be to first address and improve self-regulation, anxiety, and impulsivity before these cognitive problems becomes the focus of therapy" (p. 252).

From a sensorimotor psychotherapy perspective, the bottom-up difficulties of affect dysregulation, maladaptive procedural tendencies, and problems with sensory processing are often at the root of cognitive problems as well. Self-esteem problems, shame, and guilt have their somatic correlates that both initiate and sustain these difficulties. As Damasio (1999) reminds us, bottom-up processes will affect upper-level processes. A constricted body, rounded

shoulders, slumped posture, and downward turn of the head go along with low self-esteem, which is difficult to fully resolve without changing the physical tendencies that sustain it. Sympathetic alarm responses and dorsal vagal immobilizing responses are both associated with cortical inhibition, interfering with clear thinking, learning, and memory. When children cannot regulate affect, cannot move freely because their bodies are collapsed or frozen, and cannot process sensory information effectively, then their ability to experience a sense of safety and mastery will be compromised, and self-esteem will suffer. They may feel chronically ashamed, incompetent, frightened, angry, anxious, or inadequate. A sense of self develops in the context of cognitive schemas such as "There is something wrong with me" or "I am a bad child," schemas that are sustained by particular physical tendencies. Once the bottom-up difficulties are remedied, these upper-level processes and cognitive distortions often change accordingly, often without the need for attention to them directly through talk therapy.

Given that young children have more limited verbal and cognitive ability than adults, an approach that capitalizes on non-verbal communication and learning is particularly helpful and appropriate. Each child's body is different, and the right intervention and activity for each child is discovered through the child's felt sense and experience. If we as therapists apply the findings of the attachment and neuroplasticity research to psychotherapy with children, a somatically attuned relationship combined with focused attention to in the moment experience can potentially activate the neural circuits related to established patterns. Engaging new activities, postures, movements, and actions can facilitate the encoding of new neural circuits. In the context of a bottom-up approach to treatment, we help children to re-establish lost or unavailable somatic attunement, re-engage and complete truncated or dysregulated responses, and cultivate the physical and emotional satisfaction of success and competence as an antidote to early experiences of fear and humiliation. As the organization of the body changes in terms of its movement, posture, arousal level, and sensory processing ability, a different, more positive, sense of self emerges, supported by these physical changes. The child's body becomes his or her ally rather than an enemy whose dysregulated arousal, sensory processing difficulties, and maladaptive procedural action sequences cause social and emotional distress and prevent nourishing relationships.

References

Allen, J. (2001). *Traumatic relationships and serious mental* disorders. Chichester, **UK**: John Wiley & Sons.

Ayres, A. (1989). *Sensory Integration and the child*. Los Angeles, CA: Western Psychological Services.

Bakal, D. (1999). *Minding the body: Clinical uses of somatic awareness*. New York: The Guilford Press.

Beebe, B. (2006) Co-constructing mother-infant distress in face-to-face interactions: Contributions of microanalysis. *Infant Observation,* August 2006; 9(2): 151-164

Bergman, N.J., Linley, L.L., & Fawcus, S.R. (2004). Randomized controlled trial of skin-to-skin contact from birth versus conventional incubator for physiological stabilization in 1200 to 2199 gram newborns. *Acta Paediatrica, 93*, 779-785.

Brewin, C. R. (2001). A cognitive neuroscience account of posttraumatic stress disorder and its treatment. *Behaviour Research and Therapy, 39,* 373-393.

Bundy. A. C., & Murray, E. A. (2002). Sensory integration: A. Jean Ayres' theory revisited. In A. C. Bundy, S. J. Lane, & E. A. Murray (Eds.), Sensory integration theory and practice (pp. 3–34). Philadelphia: F. A. Davis.

Cortina, M., & Liotti, G. (2007). New approaches to understanding unconscious processes: Implicit and explicit memory systems. *International Forum of Psychoanalysis*, 16, 204-212.

Cozolino, L. (2002). *The Neuroscience of Psychotherapy: building and rebuilding the human brain*. New York: Norton and Company.

Damasio, A. (1999). *The feeling of what happens*. New York: Harcourt, Brace, and Company.

Diamond, S., Balvin, R. & Diamond, F. (1963). Inhibition and choice. New York: Harper and Row.

Fisher, A., Murray, E., & Bundy, A. (1991). *Sensory integration: Theory and practice*. Philadelphia: Davis.

Frijda, N. (1986). *The emotions*. Cambridge, UK: Cambridge University Press.

Herman, J. (1992). *Trauma and recovery*. New York: Basic Books.

Janet, P. (1907). *The major symptoms of hysteria*. London & New York: Macmillan.

Janet, P. (1909). *Les névroses*. Paris: E. Flammarion.

Koomar, J. A. (2009) Trauma-and Attachment-Informed Sensory Integration Assessment and integration. In Special Interest Section Quarterly: Sensory Integration. Vol. 32/4 Dec 2009. Retrieved on line at http://www.attachmentcoalition.org/SIandAtt.pdf February 11, 2911.

Krystal, H. (1978). Trauma and affects. *Psychoanal.Study Child, 33,* 81-116. Retrieved Feb. 20, 2011 http://www.attachmentcoalition.org/SIandAtt.pdf

Krystal, H. (1988). *Integration and self-healing: Affect, trauma, alexithymia*. Hillsdale, NJ: Analytic Press.

LeDoux, J. (2002). *Synaptic self: How our brains become who we are.* New York: Viking.

Levine, P. (2004). Panic, biology & reason: Giving the body its due. In I. MacNaughton (Ed.), *Body, breath, & consciousness*. Berkeley, CA: North Atlantic Books.

Lewis, L., Kelly, K., & Allen, J. (2004). *Restoring hope and trust: An illustrated guide to mastering trauma*. Baltimore, MD: Sidran Institute Press.

Lyons-Ruth, K., Bronfman, E., & Parsons, E. (1999). Atypical attachment in infancy and early childhood among children at developmental risk. IV. Maternal frightened, frightening, or atypical behaviour and disorganized infant attachment patterns. *Monographs of the Society for Research in Child Development*, 64(3), 67–96.

McFarlane, A. C., Weber, D. L., & Clark, C. R. (1993). Abnormal stimulus processing in posttraumatic stress disorder. *Biological Psychiatry, 34,* 311-320.

Misslin, R. (2003). The defense system of fear: behavior and neurocircuitry. *Clinical neurophysiology,* 33(2), 55-66.

Nijenhuis, E. & Van der Hart, O. (1999). Somatoform Dissociative Phenomena: A Janetian Perspective. In J.Goodwin & R. Attias (Eds.), *Splintered reflections: Images of the body in trauma*. Basic Books.

Nijenhuis, E. R., Vanderlinden, J., & Spinhoven, P. (1998). Animal defensive reactions as a model for trauma-induced dissociative reactions. *Journal of Traumatic Stress, 11,* 243-260.

Ogden, P. (2009) Emotion, mindfulness and movement: Expanding the regulatory boundaries of the window of tolerance. In *The Healing Power of Emotion: Perspectives from Affective Neuroscience and Clinical Practice*, edited by D. Fosha, D. Siegel, and M. Solomon. New York: W. W. Norton.

Ogden, P. & Minton, K. (2000). Sensorimotor psychotherapy: One method for processing traumatic memory. *Traumatology*, Vol VI, 3 (3), 1-20.

Ogden, P., Minton, K., & Pain, C. (2006). *Trauma and the body: A sensorimotor approach to psychotherapy.* New York: Norton.

Panksepp, J. (1998). *Affective neuroscience: The foundations of human and animal emotions*. New York: Oxford University Press.

Perry, B. D, (2009) Examining child maltreatment through a neurodevelopmental lens: Clinical applications of the neurosequential model of therapeutics. Journal of Loss and Trauma, 14:240–255, 2009 Copyright # Taylor & Francis Group, LLC ISSN: 1532-5024 print=1532-5032 online DOI: 10.1080/15325020903004350. Retrieved Jan. 14, 2011.

Porges, S.W. (2001). The polyvagal theory: Phylogenetic substrates of a social nervous system. *International Journal of Psychophysiology, 42*, 123-146.

Porges, S. W. (2004). Neuroception: A Subconscious System for Detecting Threats and Safety. *Zero to Three.* Retrieved August 8, 2005, from http://bbc.psych.uic.edu/pdf/Neuroception.pdf

Porges, S. W. (2005). The Role of Social Engagement in Attachment and Bonding A Phylogenetic Perspective. In C.Carter, L. Aknert, K. Grossman, S. Hirdy, M. Lamb, S. W. Porges, & N. Sachser (Eds.), *From the 92nd Dahlem Workshop Report: Attachment and Bonding: A New Synthesis*. MIT Press.

Porges, S. W. (2011) *The polyvagal theory*: *Neurophysiological foundations of emotions, attachment, communication, and self-regulation.* New York: W. W. Norton.

Rivers, W. (1920). *Instinct and the unconscious: A contribution to a biological theory of the psycho-neuroses*. Cambridge: Cambridge University Press.

Sahar, T., Shalev, A. Y., & Porges, S. W. (2001). Vagal modulation of responses to mental challenge in posttraumatic stress disorder. *Biological Psychiatry, 49,* 637-643.

Scaer, R. C. (2001). The neurophysiology of dissociation and chronic disease. *Applied Psychophysiology and Biofeedback, 26(1),* 73-91.

Schore, A. (1994). *Affect regulation and the origin of the self: The neurobiology of emotional development*. Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Schore, A. (2001). The effects of early relational trauma on right brain development, affect regulation, and infant mental health. *Infant Mental Health Journal, 22,* 201-269.

Schore, J. & Schore A. N. (2007). "Modern attachment theory: The central role of affect regulation in development and treatment." *Clin Soc Work.*

Schore, A. (2009a). Attachment trauma and the developing right brain: Origins of pathological dissociation. In P. Dell & J. O'Neil (Ed.), *Dissociation and the dissociative disorders: DSM-V and Beyond*. New York: Routledge.

Schore, A. (in press a) The right brain implicit self lies at the core of psychoanalysis. *Psychoanalytic dialogues*

Schore, A. (in press b) The right brain implicit self: A central mechanism of the psychotherapy change process in *Knowing, not-knowing and sort-of-knowing: Paychoanalysis and the experience of uncertainty*. Jean Pertucelli Ed. American Psychological Association division of Psychoanalysis (39).

Schwartz, J. M., & Begley, S. (2002). *The mind & the brain: Neuroplasticity and the power of mental force*. New York: Harper Collins

Sereno, A. (2005). Neural substrates of attention and orienting. The University of Texas. Retrieved May 8, 2005, http://research.uth.tmc.edu/nih/Sereno2.htm

Siegel, D. (1999). *The developing mind*. New York: Guilford.

Siegel, D. J. (2007). *The mindful brain: Reflection and attunement in the cultivation of well-being.* New York: W. W. Norton.

Sroufe, L. A. (1997). Psychopathology as an outcome of development. *Development and Psychopathology, 9,* 251-268.

Steele, K., Dorahy, M., Van der Hart, O., & Nijenhuis, E. (submitted). *Dissociation versus alterations in consciousness: Related but different concepts*.

Sunderland, M. (2006). The science of parenting: How today's brain research can help you raise happy, emotionally balanced, children. New York: DK Press.

Taylor, S., Koch, K., & McNally, R. (1992). How does anxiety sensitivity vary across the anxiety disorders? *Journal of Anxiety Disorders, 6,* 249-259.

Tronick, E. Z. (2009). "Multilevel meaning making and dyadic expansion of consciousness theory: The emotional and the polymorphic and polysemic flow of meaning" In D. Fosha, D. Siegel, & M. Solomon (Eds.), *The healing power of emotion: Affective neuroscience, development and clinical practice.* New York: W.W. Norton.

Van der Hart, O., Nijenhuis, E., Steele, K., & Brown, D. (2004). Trauma-related dissociation: conceptual clarity lost and found. *The Australian and New Zealand Journal of Psychiatry, 38,* 906-914.

Van der Kolk, B., van der Hart, O., & Marmar, C. (1996). Dissociation and information processing in posttraumatic stress disorder. In B. van der Kolk, A. McFarlane, & L. Weisaeth (Eds.), *Traumatic stress: The effects of overwhelming experience on mind, body and society* (pp. 303–327). New York: Guilford.

Van Ijzendoorn, M., Schuengel, C., & Bakermans-Kranenburg, M. (1999). Disorganized attachment in early childhood:Meta-analysis of precursors, concomitants and sequelae. *Development and Psychopathology, 11,* 225-249.

Williamson, G. & Anzalone, M. (2001). *Sensory integration and self-regulation in infants and toddlers: Helping young children to interact with their environments*. Washington, DC: Zero to Three.