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

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Children with histories of neglect and trauma typically exhibit a wide range of symptoms, ranging from unwarranted fearfulness, anger or sadness, to blunted emotions, poor functioning at school or in social situations, unusual distractibility and avoidance of normal childhood activities. They may develop eating problems and sleep disorders or complain of physical pain such as headaches or stomachaches. Traumatic reminders often trigger physiological reactivity, behavioral impulsivity, or social and emotional withdrawal. Children frequently feel helpless and powerless, reflected in and sustained by collapsed or frozen body postures, or out of control, anxious, or aggressive, driven by bodies that are hyperactive and hyperaroused. Adaptive action becomes impossible or difficult in the former case, impulsive or destructive in the latter. In addition, affect regulation is often compromised by a nervous system that cannot maintain arousal at a tolerable level, having lost or failed to develop the ability to sustain states of calm, to tolerate a wide range of physiological arousal, and/or to bear strong emotions without becoming overwhelmed. Trauma and early attachment failure leave their imprint on the body's procedural memory system as well, shaping the child's posture, gestures, and movements in ways geared to adapt to a threatening environment. Dysregulated affect/arousal and maladaptive procedural action sequences can be exacerbated by difficulty processing sensory stimulation. Traumatized children may appear clumsy, having trouble with sensing their own movements and where their bodies are in space, and/or develop a hyper- or hypo- sensitivity to tactile, auditory, olfactory, gustatory, and visual stimulation. They may either 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.

These disruptive non-verbal legacies of childhood trauma—dysregulated arousal, maladaptive procedural tendencies, and sensory processing problems – shape what Schore calls the right brain dominant "implicit self." (Schore & Schore, 2007; Schore, in press a & b; Schore, 2009b). The experience-dependent implicit self develops through right-brain-to-right-brain affect-laden interactions with attachment figures that begin at birth. In negligent or abusive home environments, a child may be left in prolonged dysregulated states with little or no interactive repair or may be frightened, violated, and/or neglected by his attachment figure. In these cases, affect regulatory mechanisms fail to develop optimally, social engagement and proximity-seeking behaviors are compromised, procedural learning adapts to the failure of safety, sensory processing may be adversely affected, and non-verbal cues may be unclear or contradictory. In most psychotherapy models, the verbal narrative serves as the entry point into the therapeutic process. Though less adept at verbal and conceptual meaning-making, obviously children do use language

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to make sense of their worlds and themselves, and helping them find words for their experience and/or change maladaptive explicit meanings clearly can have a positive effect (Tronick, 2009). However, the language to describe traumatic experience so that it can be assimilated within an autobiographical narrative is not always available to children, for a myriad of reasons. Typically, lacking the cognitive ability to hold multiple working models in mind (Lyons-Ruth et al, 2006), children tend to experience what happened as their own fault, and the shame, fears, and beliefs such as, "I'll get in trouble if I tell," cause them to silence themselves or deny what happened, sometimes even when asked. In addition, during traumatic events, certain brain areas are inhibited, preventing the traumatic experience from being encoded into an explicit and cohesive narrative: the hippocampus, involved in verbal memory and in the consolidation of memory, and the prefrontal cortex, the "executive brain" responsible for clear thinking and decision-making. Additionally, in young children, the language centers of the brain may not be sufficiently developed, limiting the child's ability to explain what happened. Moreover, when traumatic memories cannot be integrated, they may be 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. A child 'recalls' what happened through non-verbal reliving of the historical traumatic event through traumatic play (Terr, 1989), relational interactions, reactions to triggers, and through mysterious physical symptoms that seem to have no organic basis.

Highlighting the role of unresolved trauma on affect dysregulation, procedural action sequences, and sensory processing, this chapter focuses on the centrality of these non-verbal phenomena in the treatment of children and adolescents. We propose that a bottom-up approach that directly impacts the non-verbal narrative can produce changes in the traumatized child's body that will influence positive resolution of symptoms and increase the capacity for relatedness and adaptive behavior (Bakal, 1999; Ogden & Minton 2000; Ogden, Minton & Pain, 2006; Fisher et al, 1992). This chapter prioritizes the "somatic narrative" that is beyond words and cannot be articulated but continuously anticipates the future and powerfully determines behavior. The cases described in this paper illustrate ways to alter the somatic narrative, highlighting bottom-up interventions that directly address the sensorimotor legacy of trauma. As the organization of the body changes in terms of its movement, posture, arousal level, and sensory processing ability, so 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.

The Experience-Dependent Brain

The human brain is use-dependent. From the millions of possible synaptic connections available at birth, the ones activated repeatedly are strengthened, and the less utilized weaker synapses are pruned. Neuroplasticity, the ability of the brain to change according to experience, enables this process and allows the brain to adapt itself to its environment and become increasingly efficient within that particular environment. Neuroplasticity permits rapid development and organization of the brain in response to the "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 (Perry, 2009, p. 245)."

The immature brain of an infant or young child is extremely vulnerable to environmental conditions. The connectivity and communication between cortical and subcortical areas increases rapidly in early life, developing the pathways necessary to regulate the infant's lower brain impulses and emotions. The neocortex, responsible for cognitive processing such as self-awareness and conscious thought, is the last to develop phylogenetically. Key areas of the cortex help to regulate lower brain structures and require emotionally responsive early interactions to develop adequate pathways to lower brain structures. Especially significant is the right orbitofrontal cortex, which helps to manage strong emotions and inhibit lower brain impulses. Early attachment experiences stimulate the child's immature brain in ways that "prune" the neurons of the right orbitoprefrontal cortex, a structure that is especially important because of its ability to regulate emotional and autonomic arousal (Schore, 1994; Siegel, 1999), and which is dependent upon interactive regulation in infancy for its development. Additionally, 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, thus calming the reptilian brain) and the anterior cingulate (which regulates autonomic changes, attention, and helps to integrate cognitive and emotional experience) all require emotionally responsive early parenting for optimum development. 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," or "interactive psychobiological regulator" that helps them modulate extreme arousal states. Descending brain pathways from the cortex to the lower brain do not begin to myelinate until late infancy and continue to develop throughout the course of childhood.

The "paleomammalian" or "limbic" brain, is concerned with emotion, memory, some social behavior, and learning (Cozolino, 2002) and is the seat of "affective knowledge . . . subjective feelings and emotional responses (Panksepp, 1998, p. 43)." The amygdala, a structure within the limbic brain, is fully on line at birth. It is the "alarm system" of the brain and is easily aroused by loud sounds, bright lights, being left alone, extreme temperature, and other risk-related stimuli for infants and young children. Activation of the limbic system in response to failures in attachment behavior (proximity, responsiveness, interactive regulation) is an evolutionary advantage in early childhood. The reptilian brain, the first to develop from an evolutionary perspective, is fully on line at birth and governs arousal and homeostasis of the organism. The reptilian brain produces "innate behavioral knowledge . . . basic instinctual action tendencies and habits related to primitive survival issues (Panksepp, 1998, p. 43)." When an infant is not "given enough help with his intense lower brain feelings and primitive impulses, 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)." Children who have not had the opportunity to adequately develop these pathways present significant challenges to the therapists who treat them.

Good-enough primary caregivers adapt to the infant's ongoing development by responding to the "maturation of the nervous system, accompanied by increasing differentiation of skills, [driving] infants to reorganize their control systems(Brazelton, 1989, p. 105)." At each stage of development, , the attachment figure must readjust responsiveness to the child's changing physical and emotional needs, ensuring an environment that is both safe and secure and yet sufficiently enriching and challenging to stimulate the child within his or her developmental capacity and to provide experiences of both enjoyment and mastery (Bradley, 2000; Emde, 1989).

Because the malleability of the brain decreases as the child gets older, the timing of deprivation, attachment failure, and trauma is a critical element in the development of the brain. When attachment relationships are insecure or disorganized, the connections among regulatory and arousal brain structures fail to develop adequately, and the infant suffers longer periods of, and lower thresholds for, dysregulation (Schore 1994). Perry (2009, pl 244-245) 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." Moreover, later occurring trauma may compromise existing regulatory capacities with similar effects, causing emotions to escalate, behavior to become out of control, and environmental cues to be misinterpreted. For example, a traumatized child whose heart rate escalates when asked a question by her third grade teacher experiences a somatic sense of wanting to run. Her accelerated heart rate and the tension in her legs and feet fuel trauma-related emotions of fear and dread, reactions that sabotage her ability to accurately appraise current reality. She may be unable to respond to the question, although she knows the answer and tells herself she should speak. Additionally, if children are treated harshly, the release of certain "feel good" chemicals is blocked: oxytocin, secreted by the pituitary gland at birth and during feeding, and the edogenous opioids, or endorphins, that are produced when the child is touched, played with, or held gently. Without adequate supplies of the neurochemicals that facilitate recovery from distress and social engagement, neglected and traumatized children with inadequate interactive regulation are left with fewer resources for auto-regulation.

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, conscious elaboration, reasoning, linguistic behaviors, and meaning making and represents a conscious, explicit self-system (Schore in press a). The left hemisphere develops over time in the first years of life, but the right hemisphere is functional at birth. For securely attached infants, interactions with their attachment figures "[facilitate] right brain development, promote efficient affect regulation, and [foster] adaptive infant mental health (Schore, 2001, p. 204)." The right hemisphere is primary for emotional & body processing, implicit communication,

intersubjectivity, unconscious affect regulation and responses to threat cues. 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)." While we might view behavior as well thought out and logical, Schore asserts, "…it is the emotion processing right hemisphere and its implicit homeostatic-survival and communication functions that is truly dominant in human existence (Schore, in press b)." As Schore states, "The right brain implicit self represents the biological substrate of the human unconscious mind and is intimately involved in the processing of bodily based affective information associated with various motivational states (2009, p. 114)."

As the brain develops in this use-dependent manner,, the infant's neural pathways are constructed. The well-traveled neural networks begin to enable the brain to predict the future and anticipate experience. Siegel (1999) describes the brain as an "anticipation machine." Sub-cortical and right brain processes play powerful roles in anticipating the future, the primary function of the brain. The past is "remembered as a series of *unconscious expectations*" (italics mine) (Cortina and Liotti, 2007, p. 205). These expectations are all the more potent and influential precisely because the memories that shaped them are not available for reflection and revision. 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. Taking shape long before the more rational and linguistic left-brain and neocortex are fully developed, the implicit self is far reaching and enduring.

Early trauma, neglect and attachment failure profoundly influence the final wiring and functional outcome of the brain (Schore, 1994; Perry, 2009), and treatment to change this wiring may be enhanced by interventions other than top-down "talking about." Bottom-up interventions work directly with movement, sensation, arousal and sensory systems in the hope of developing new capacities for regulating arousal, processing sensory stimulation and taking adaptive action. Such interventions are thought to be effective to 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 poorly organize 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 describe three kinds of bottom-up processes and give examples of treating difficulties frequently encountered in each area: Affect regulation, procedural action sequences, and sensory processing.

The Modulation of Arousal

The difficulties with affect, energy, and arousal observed in traumatized children all pertain to the functioning of the autonomic nervous system. Porges (1995; 2001; 2001a; 2004; 2005; in press) has elucidated the complex interplay between the parasympathetic and sympathetic nervous systems in his "polyvagal theory." One branch of the parasympathetic nervous system, the ventral vagal complex, involving the ventral branch of the vagus nerve, the myelinated vagus, reflects levels of autonomic arousal fluctuating within a "window of tolerance" (Siegel, 1999), i.e., a state of autonomic and emotional arousal that is optimal for well-being, effective functioning. Falling between the extremes of hyper- and hypoarousal, this is a zone within which "various intensities of emotional and physiological arousal can be processed without disrupting the functioning of the system (Siegel, 1999, p. 253)." Porges calls this system the "social engagement system" because it provides a great degree of flexibility in communication and regulates areas of the body that are utilized in social and environmental interaction.

> 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). (Porges, 2005)

Available to the full term infant, the social engagement system is evident as the baby vocalizes, cries, and grimaces to signal distress, or smiles, gazes, or coos to interact socially with the caregiver (Porges, 2004; Porges, 2005). These kinds of behaviors serve to increase proximity between infant and caregiver and assure the survival of the child. This "eural regulation of [facial] muscles that provide important elements of social cueing are available to facilitate the social interaction with the caregiver and function collectively as an integrated social engagement system (Porges, 2005, p. 36)." The social engagement system is further developed through attuned interactions, initially built upon a series of face-to-face, brain-to-brain, body-to-body nonverbal interactions with attachment figures who regulate the child's autonomic and emotional arousal. Porges (in press) coined the term " "neuroception" to "emphasize a neural process, distinct from perception, that is capable of distinguishing environmental (and visceral) features that are safe, dangerous, or life-threatening" (p. 58). .According to Porges (in press) "the nervous system evaluates risk in the environment and regulates the expression of adaptive behavior to match the neuroception of an environment that is safe, dangerous, or life- threatening (p. 17)." In order for

a child to socially engage, he or she must neurocept safety.

The dominance of the social engagement system is overridden under conditions of stress, including hunger, cold, isolation, and, of course, trauma. Under these conditions, infants and young children neurocept danger, and depend upon sympathetic nervous system arousal to fuel the "attachment cry" and other proximity-seeking physical behaviors, such as reaching, designed to elicit the help and protection of attachment figures. In childhood, successful attachment cry responses require the availability of attuned or protective caregivers, while successful fight/flight responses require physical strength and independence not available to infants and young children. If both the social engagement system and sympathetically-mediated defensive responses of attachment cry, fight, and flight are unsuccessful or unavailable in assuring safety, another line of defense is required. For many children, parasympathetic nervous system activity via the dorsal vagal complex becomes the next and best line of defense. The dorsal branch of the vagus nerve, the unmyelinated vagus, is the most primitive of these systems and is available at birth. The dorsal vagal branch enables 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). The neuroceptionof life threat stimulates dorsal vagal tone. The hierarchical relationships between social engagement, sympathetic, and dorsal vagal parasympathetic systems are established early in life, resulting in enduring arousal tendencies, reactions under stress, and even vulnerability to psychiatric disorders (Cozolinno, 2002; Lyons-Ruth et al., 1999; Schore, 2001, p. 209; Sroufe, 1997; van Ijzendoorn et al., 1999).

When caregivers are "frightened or frightening," the child's social engagement system is superseded by sympathetically-mediated hyperarousal states or parasympathetically-mediated dorsal vagal hypoarousal states (Lyons-Ruth et al, 2006). Disorganized/disoriented attachment in children has been associated with elevated heart rates, intense alarm reactions, and higher cortisol levels, as well as with behavior indicative of increased dorsal vagal tone, such as stilling, going into trance, unresponsiveness, and shutting down (Schore, 2001). In the initial stage of threat, infants and young childrenneurocept danger and demonstrate sympathetic activation, accompanied by startle reactions, elevated heart rate, respiration and blood pressure, usually accompanied by crying and screaming (Schore, 2009a). However, when sympathetic arousal cannot be regulated, 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)."

Persistent dysregulated affect and arousal are primary symptoms observed in traumatized children. In these instances, the nervous system has lost its ability to tolerate arousal, to transition between calm and excited states, to tolerate a wide range of physiological arousal or affect, and to navigate challenging situations without becoming hyper or hypo aroused. One of the first steps in treatment from a sensorimotor perspective is helping children identify arousal states

and better regulate their arousal. 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. Decreased shame and defensiveness give way to curiosity when a child's troubling symptoms or behaviors are explained as manifestations of arousal. Alternatively, the therapist could also draw a thermometer on the magnetic board, or even an oven dial image, with high temperatures representing high arousal. Choosing from a set of interesting magnets, children are invited to place their magnets on the window of tolerance or the thermometer 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. Using these techniques, children can be helped to recognize the body cues that indicate fluctuations in arousal and then invited to experiment with taking action to change arousal levels if they wish.

A variety of bottom-up interventions can be used to facilitate modulating a child's autonomic dysregulation. Young children can be taught to modulate their arousal levels through games like the Choo Choo train or Engine game ((Bundy & Murray, 2002, p. 29). Tami came to therapy at age four because she was prone to shutting down, unable to talk or engage socially, causing her to "disappear" in the context of her chaotic family. Her parents had recently divorced, and Tami had lost her house, her neighborhood friends, her preschool, and her family unit. Living in a very small apartment with only one bedroom shared by all the siblings, she put up no resistance when she was forced her to sleep on the floor by her older brothers. With no parental limits, her brothers fought constantly—pushing, bullying each other, 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. Because she did not speak, she was also unable to stand up for herself in social situations. Using body-oriented interventions, however, did not require the use of words. Establishing a playful atmosphere, her therapist taught her the Choo Choo train game, which allowed Tami to experience a somatic sense of control as she first sped up her Choo Choo until it was going very fast and then, at her therapist's instruction, made her train go very slowly. Tami learned to tune into her body and find words for the difference in her body sensations and movements between the slow Choo Choo and the fast Choo Choo. On her own, Tami decided to draw her "heart pumping" after her Choo Choo went fast and her "slow feet" after her Choo Choo went slowly. Playing the "big and little" game, Tami made her body as big as she could, describing what it felt like in a loud voice, and then made her body as little as possible, using a very "little" voice. Tami enjoyed these games, and played them over and over, becoming increasingly expressive. These games taught her to transition from one arousal state to another, find the words for her experience, and develop skill at modulating her hypoarousal, and, soon, Tami's father reported that she was more "alive" in the family. Slowly, Tami's arousal states shifted from immobility and passivity, presumably reflecting high dorsal vagal tone, to states of pleasurable action and assertion, usually associated with increased sympathetic arousal.

Bottom-up interventions can provide a springboard for the development of improved affect regulation for chlldren in group settings as well. 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 at first prone to wide swings in arousal but learned to modulate his arousal through a variety of games. 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 slowly encouraged to 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 big movements of arms, hands, and legs. 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. 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." Then they were asked to do the same movements, showing "little energy." Some of the younger children enjoyed pretending they were animals---a great big gorilla and then a tiny little ant. Through these simple games targeted to high and low arousal, big and small movements, children 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 also to increase social engagement.

Regulating arousal in social situations is difficult for children who have themselves not received the "interactive psychobiological regulation" (Schore, 1994) necessary for the development of affect regulatory brain structures. Early relational trauma not only impedes brain development and threatens physical and psychological integrity, but also results in failure of the social engagement system, which required a neuroception of safety. Because the social engagement system comes 'online' in reciprocal mirroring by caregiver and infant, it depends upon "good enough" attachment. If the perpetrator or nonprotective bystander is a primary caregiver, abuse inevitably includes a failure of the attachment relationship, undermining the child's ability to recover and reorganize, to feel soothed or even safe again. The child's opportunity to effectively utilize social engagement for care and protection is over-ridden, and he or she experiences overwhelming arousal without the availability of attachment-mediated comfort or repair. When caregivers chronically fail to ensure a child's safety and protection, as is the case in chronic childhood trauma, the social engagement system habitually shuts down. The child's ability to communicate via eye contact, facial expression, verbalization, or turning and tilting of the head fails to develop, as well as the ability to respond optimally to social engagement behavior in others. Unchecked by the "brakes" of the social engagement system, the sympathetic or the dorsal vagal nervous systems remain highly activated, causing dysregulated arousal. Sympathetic arousal can quickly change "from interactive regulatory modes into long-enduring less complex [dorsal vagal] autoregulatory modes (Schore, 2009a, p. 8)." In these hypoaroused states,, observed even in newborns (Bergman, Linley, & Fawcus, 2004), the infant or child is non-receptive to interactive regulation (Schore, 2009a). When the interactive regulation of caregivers during the child's early years is dysregulating, this non-receptivity is adaptive. Unfortunately, the 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. Since the these orbitofrontal systems are

dependent upon interactive regulation for optimal development of auto-regulatory ability, the child is left with a compromised social engagement system, procedural tendencies toward hypo- and/or hyperarousal states, and decreased ability for self regulation.

As those who work with children frequently encounter, it can be challenging to help children whose bodies and arousal are shut down to develop the abilities to engage with others or take assertive action. 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 until he was sent to prison for sexually abusing her, Marie, age nine, had a very difficult time regulating her arousal, 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. Even though Marie shut down and would not speak or interact in social situations with her peers, she had spent many long hours during her first 9 years hanging around billiard halls with her father and could play pool exceptionally well. 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 had been attacked from the back. As she sat in her circle, Marie almost immediately became more talkative and forthcoming. Her therapist took a large ball, and she and Marie talked about how Marie felt in her body when the ball started to come into her space. Marie was told to try to 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. Next, her therapist took a pillow and began to move it into the little girl's circle. 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 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 regulate arousal within the window of tolerance and to have the control over her boundaries she could not have as a small child with her father. She was also able to practice taking the adaptive actions necessary for an increased sense of safety and ease with her peers. Many children must be encouraged to exchange a procedurally-learned submissive, passive stance that appears to indicate high dorsal vagal tone for assertive action, especially when such action would have made the original trauma worse. The interventions above can also be done with big balls rolled towards the child or held by the therapist to provide resistance against which the child can push. Jeanie (5 years old) took no action at all as the ball came towards her. Her body remained frozen and immobile. At her therapist's playful suggestion, she and Jeanie began to trade roles: Jeanie pushed the ball toward the therapist while the therapist modeled pushing it away. Then they practiced becoming big strong lions (Jeanie's choice of animal) who could push the ball away. Jeanie brought the ball close to her therapist several times, closely watching how her therapist pushed it away. The therapist tracked Jeanie carefully, noticing her apprehension and maintaining a playful atmosphere. Jeanie needed a sense of plenty of time to

transition from her state of immobility to taking action, but eventually she was willing to push the ball away, tentatively at first, then gradually with more vigor and energy and pleasure.

Traumatized children have difficulty with appraisal. Porges describes faulty neuroception as "an inability to detect accurately whether the environment is safe or another person is trustworthy (Porges in press p. 17)." Many traumatized children have developed faulty neuroception and despite adults "talking about" or reassuring them of safety, their nervous systems still perceive danger in response to non-threatening trauma-related stimuli. Group therapy that focuses on bottom-up interventions to promote modulation of arousal offers opportunities for children to develop accurate neuroception and to learn interactive regulatory skills within a social context of peers. Casey, a five and a half year old boy, did not have difficulty taking action. In fact, his behavior was bullying and aggressive to other children. With 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. An only child, Casey would "disappear" when his father was home, afraid of his temper, and his mother reported that he often hid in his bedunder blankets. Eventually, Casey's mother obtained a restraining order, and the father was removed from the home. Casey's therapist suggested group therapy so that Casey could learn to regulate himself in a social context. A variety of exercises were used in the group. The six children were asked to take turns talking, using a talking stick, but initially 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 could not perceive the rhythm accurately, and he would interrupt and start drumming before the other child was complete. 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 mimic the rhythms of the other children, which had the effect of both regulating his own arousal and increasing his social engagement.

In another exercise designed to foster attunement and 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." He was asked 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 long" 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. 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.

Traumatogenic environments that produce disorganized attachment in children typically include both neglect and abuse: In context of neglect, children are often at the mercy of abusive and/or non-protective adults, and abusive environments are usually characterized by concurrent neglect. Whereas physical, emotional, and sexual abuse typically produces either chronically

heightened autonomic arousal or biphasic alternations between hyper- to hypoarousal states, neglect typically leads to a flattening of affect (Gaensbaur & Hiatt, 1984), decreased arousal, and a tendency toward chronic increase in dorsal vagal tone a more negative effect on children than abuse alone (Ciccetti & Toth, 1995). Overstimulation and inadequate repair are inevitable outcomes of trauma, but inadequate stimulation, insufficient mirroring, and a lack of responsiveness by the caregiver accompany neglect.

When affect regulation is hampered by both abuse and neglect, the therapeutic use of rhythmic sound and movement can facilitate increased ability to regulate. Nina, a very bright seven-year old girl, struggled not only with peer interactions but also difficulties regulating her behavior at home and at school. Nina was a year and a half when her brother was born with medical problems, and she was left for six days with an unfamiliar nanny. Her mother reports that, from birth, she was a temperamentally withdrawn, shy, slow to warm up child and that her behavior tended to quickly vacillate from dysregulation to collapse. When she came to therapy, Nina was easily hyperaroused, but her body 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, presumably reflecting increased dorsal vagal tone in response to trauma-related stimuli or overstimulation or both. When she played with more than one friend, or when a few, similar-aged cousins came together, she often disintegrated into tears, unable to modulate the increased arousal, resulting in increased social isolation both in the home and school arena. Her self-esteem was also adversely affected when she was not offered a spot in any of the schools she attempted to transfer into and was forced to remain in a school environment that was not meeting academic or social needs, fueling her ever-present feelings of rejection. When she came to therapy, the primary tasks were to help Nina learn to develop greater self-awareness and ability to regulate her arousal so that she could modulate her behavior in school, increase her ability to play with other children, and tolerate conflict or overstimulation.

At the beginning of therapy, Nina bounced on the couch, flitted around the room, babbled incoherently, and could not settle down to start interacting with her therapist until 20-30 minutes into the hour. Initially, sessions focused on helping Nina to notice correlations between her thoughts, her feelings, and how she held her body, both her posture and resulting gestures. Nina laughed as her mother described her daughter's body posture as slouching back or disappearing into the couch, withdrawing rather than engaging with the kids or school staff. Role playing with the therapist, in which each mimicked the body postures and gestures of the other, allowed her to deepen her awareness of how she "lived in her body," and viewing videos taken of these sessions together allowed Nina to join her therapist in becoming more aware of her body, concomitantly identifying feelings, thoughts and emotions.

Subsequently, once Nina had words for her emotional states, the therapist asked her to use a drum to demonstrate some of the emotions that she felt, particularly when she thought about the process that she had to undergo while visiting new schools—from meeting with school personnel to meeting new children and visiting new classrooms. Her distress was palpable from the moment that she and her mother started to drive to the school, and she was unable to leave her

mother's side, clinging, hiding behind mother's skirt, refusing to meet other children, and refusing to speak. These emotions were identified using the drum, as Nina beat out feelings such as anxiety, fear, boredom (her term for hypoarousal), terror, etc. Use of the drum aided in identification of the range of emotions and also served as a tool for regulation, enabling Nina to better navigate the challenging situation of transitioning to a new school. Nina learned through drumming to move from more peaceful states to high anxiety as she imagined challenging situations at school, and then to beat out a more regulated rhythm that enabled her to re-regulate again. As she learned to regulate arousal more smoothly, Nina's clinging, withdrawn behavior also changed into comfortable interactions with new children and school personnel.

Directly addressing traumatic memory can be dysregulating for both adults and children. Exposure to trauma-related cues, even if deliberate as in narrative or play therapy, also evokes implicit memories, including autonomic arousal and animal defense responses. Depending on the child and traumatic environment, explicit and implicit memory typically provokes hypo- arousal and immobilizing defenses or the intense sympathetic arousal that mobilizes vigorous defensive actions. Each of these defensive patterns represents a truncated response, a survival defense that could not be successfully completed. Aggressive behavior may be an expression of incompleted, hyperactive fight/flght responses, while passive, collapsed, and numb states might reflect the failure of active defenses. When a child starts to become dysregulated by the narrative, the play, or some other trauma-related cue, bottom-up therapeutic interventions can be initiated that facilitate completion of the vigorous actions not possible at the time of the abuse. For example, the therapist might help children become aware of the impulses to push or kick and then guide them to forcefully push or kick a large therapy ball until they experience feelings of satisfaction, strength, or regulated arousal.

In the context of therapeutic work or when inadvertently exposed to trauma-related stimuli, children may also experience involuntary trembling and shaking, which often indicates a discharge of "the tremendous energy generated by our survival preparations (Levine, 2005)." 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. Jimmy, age 4, was severely abused in his foster home. He 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 encourage him to talk about the traumatic events, he would sometimes shake uncontrollably. The therapist wanted to help Jimmy settle the arousal in his body so that the memories were no longer so frightening to recall and so that he could experience a somatic sense of "it's over." To help children regulate such intense arousal states requires them to be able to slowly and mindfully track, detail by detail, the sequential involuntary physical movements and sensations as something interesting and curious rather than frightening. The first step in teaching Jimmy awareness of his sensations (tingling, bussing, heaviness, temperature changes) and micro-movements (trembling and miniscule changes in muscular tension) was to trace 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. Jimmy was asked to show his therapist where he noticed the feelings inside his body and mark that place with a colored marker. Sometimes Jimmy could find words, sounds, or movements that went along with the sensation. Using a therapeutic game called "Follow the Treasure" (Mackenzie Harris, personal communication Aug. 20, 2004), Jimmy placed his marker on one area where he felt sensation and then "followed the treasure" as his sensation moved to another place in his body. Eventually, Jimmy did not need the mark or tracing but 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. As Jimmy's therapist asked him to mindfully track or "notice" the sequence of physical sensations and impulses (sensorimotor processing) as they progressed through the body, he learned to use cognitive processing 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 unfolding, the therapist keeps playfully encouraging the child to just "follow the treasure" and allow these involuntary impulses to happen by themselves. This unique orientation focuses on the allowing the movements and refraining from voluntarily directing them through conscious control.

Through these exercises, as they witness and support the progression of sensations and impulses through the body without trying to control them, children begin to 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 information 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.

Procedural Learning

When a child's experience cannot be organized through language, it becomes organized on a more primitive and fundamental implicit level (Piaget, 1962). Rather than those experiences resulting in conscious expectations, implicit expectations develop as action sequences or tendencies. As Beebe (2006) asserts: "Early interaction patterns are represented pre-symbolically, through the procedural organization of action sequences. Predictability and expectancy is a key organizing principle 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)." These trajectories are evident in Tronick's (2007) Still Face experiments, in which mothers were asked first to socially engage with their infants, then to be "still" and unresponsive for several seconds. When the lack of response continues past a few moments, "the infants disengage, look away, become sad and engage in self-organized regulatory behaviors such as thumb sucking to maintain their coherence and complexity and to avoid dissipation of … their state of consciousness… there is meaning and certitude made by and expressed in his or her

posture, actions and affects… (Tronick, 2006, p. 16-17)." If such experiences recur often over time, as they would if the caregiver is depressed, preoccupied, or impaired by mental illness or substance abuse, the child's action sequences of postures, gestures, and affects become habitual and continue to be engaged long after environmental conditions have changed. For example, under these circumstances, the child might begin to implicitly predict that no one will respond to proximity-seeking behavior, so proximity-seeking behaviors might be abandoned in favor of auto-regulatory behaviors. Implicit predictions go hand in hand with the child's procedural learning – i.e., the incremental learning of processes or habits through deliberate (e.g., riding a bike) or unconscious repetition (e.g., looking down instead of making eye contact) of particular actions. Procedural learning includes many of childhood's developmental milestones: learning to drink from a cup, putting on clothes independently, tying shoes. Other types of procedurally learned action sequences can be adaptations to a particular environment, such as avoiding or making eye contact, distancing versus approaching adults, using movements to elicit attention or to be "seen and not heard." Once learned, these procedural behaviors become a part of the implicit self and its predictions and are activated and/or exacerbated when certain skills or interpersonal habits are required or when internal or external reminders of the past distress or threat occur. The implicit memories or action sequences connected to post-traumatic terror might manifest in the constriction or collapse of the body, the shaking of a dysregulated nervous system, tension in the larynx and tightness in the voice reflecting a loss of social engagement, or in the avoidance of or locking in of eye contact. Such action sequences both reflect and sustain predictions of the future, and helping children to change them is often necessary to resolve the trauma and promote adaptive behavior.

Alice, 14 years old, characteristically walked in a sluggish, plodding way with her head down, avoiding eye contact. Just attending school had been difficult since kindergarten, due to peer teasing, lack of friendships and social support, and being ostracized at lunchtime. Her parents, both politicians, lived in their own busy world, and Alice was raised by one nanny after another. It appeared that Alice had procedurally learned not to be talkative, and she typically replied "fine" to all inquiries about her state. Because her history had been encoded in these physical patterns and because language was not Alice's best avenue for communication, her therapist asked Alice to show what it looked like when she walked to school when she did not want to go. After some discussion of how Alice's body was telling them about how much her school experience affected her, her therapist wondered out loud what would happen if Alice and she together tried on a new walk, a tall, "above it all" posture. Almost immediately Alice's mood reflected the change in her body: "That feels better!" This simple change in procedural learning was the first therapeutic step toward increasing Alice's social engagement and self-esteem.

As a child's affective body language, facial expression, and vocalizations are responded to in a pleasure-enhancing manner by an attuned caregiver, the positive experience of non-verbal communication fosters his or her future relationship to somatic expression as a means of communication. In a secure attachment, infants learn to repeat the actions that catalyze the desired attuned response from their attachment figures and become increasingly effective at non-verbal signaling, engaging, and responding to others (Brazelton, 1989; Schore, 1994; Siegel, 1999; Stern,

1985; Tronick, 2007). Alice had had little such attunement from her absent parents and inconsistent care from her various nannies. She learned instead to avoid engagement through her down-turned head, lack of eye contact, plodding gait, and slumped posture.

When parents not only fail to attune but are "frightened or frightening," the child's resulting action sequences might appear confusing and contradictory but can be understood the result of simultaneous or alternating stimulation of two opposing psychobiological systems: attachment and defense (Liotti, 1999; Lyons-Ruth et al., 1999; Main et al., 1996; Ogawa, Sroufe, Weinfield, Carlson, & Egeland, 1997; van der Hart, Nijenhuis, Steele, & Brown, 2004). The instinctive attachment behavior of a child in distress is proximity-seeking to caregivers, , but if caregivers are "frightened or frightening," they dysregulate or cause further distress instead of providing comfort and safety, creating for the child an irresolvable paradox (Main et al., 1986) in which no option is satisfactory: the child cannot safely approach, flee, or re-orient to find another source of safety. These sequences occur repeatedly in the lives of abused and neglected children. When the attachment system is aroused, proximity-seeking behaviors are mobilized. But because the defensive system is also aroused, flight, fight, freeze or hypoarousal/feigned death responses are mobilized. For example, Jo, age 3, approached her day-care worker to take the toy he held out to her with hunched shoulders and a fearful expression. Unable to directly approach his favorite aunt, Ray, 5 years old, walked slowly backwards toward her, until his back was against her knee. In a residential treatment program, Jimmy, age 8, often became aggressive toward staff members just after moments of closeness, success, or praise. Children such as these with disorganized/disoriented attachment patterns experience the alternating or simultaneous stimulation of these two opposing psychobiological systems.

Trauma-related procedural learning is reflected not only in dysregulated autonomic arousal but also truncated or out-of-control animal defenses, the telltale signs of foiled attempts to protect and defend oneself from inescapable trauma. 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 both tend to become inflexible action sequences in children with PTSD. When triggered by reminders of past trauma, "bottom-up hijacking" (LeDoux, 2002) by the amygdala shuts down the frontal lobes, rendering the child at the mercy of subcortical appraisal, with no assessment or regulation from the higher levels of the thinking brain. In traumatized children, these animal defenses drive implicit processes and symptoms that can be loosely categorized as relational actions: seeking 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 a process of "neuroception," our perceptual system for evaluating risk and safety in the environment. Neuroception is not a conscious process; rather, it occurs via unconscious subcortical systems that functionally trigger … adaptive neural circuits (Porges, in press, p. 228). Neuroception is biased by traumatic experience. In traumatized children, hypervigilant awareness of trauma-related cues repeatedly stimulates action sequences associated with the dangerous past and activates the associated neural circuits. According to Porges (in

press), early trauma, especially repeated trauma, " functionally retunes neuroception to conservatively detect risk when there is no risk (p. 253)." Overactive defensive responses may be at the root of many symptoms and difficulties observed in traumatized children: aggressive behavior, inability to defend, clinging and distancing. As Porges states, "invalid neuroception of safety or danger might contribute to maladaptive physiological reactivity and the expression of the defensive behaviors (Porges, in press, p. 274)"

The "attachment cry" response is designed to elicit the help and protection of someone stronger. These actions are distinguished from attachment-related behavior designed to secure and maintain enduring attachment relationships in the context of the neuroception of safety. An infant's vocalization and body movement reflects the social engagement system from birth onward, and as children become mobile, later proximity-seeking actions include reaching towards, holding on, walking towards, eye contact, and so on. But when attachment figures are neglectful or do not respond to social engagement a child may cease reaching out, , avoid eye contact, and come to depend more upon auto regulation than interactive. Adaptive in that context, these procedural actions implicitly predict that no one will respond to proximity-seeking behavior, resulting in the literal abandonment of integrated, purposeful action of reaching out. In child therapy, helping children to become more aware of their procedural tendencies and practicing new action patterns 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, Minton & Pain, 2006, Ogden, 2009/2010). Grasping or beckoning motions, actions of pushing, hitting, or making circular motions that define one's personal boundary, expressive movements of opening the arms widely in gestures of anticipatory embrace or expansion, movements of self-touch, such as hugging oneself—all are significant avenues for exploration. Because the manner in which they are executed reflects the implicit self, changes in relational procedural learning 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 play time. His arms hung limply by his side, and he avoided eye contact. Targeting his symptoms of isolation and lack of social engagement, 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 gestures felt new, 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. With his eyes closed, the therapist asked him to reach out and then placed a "surprise" in his hand—a favorite toy, an orange, a small piece of candy. Danny learned to communicate with his arms, letting them talk, noticing what happened inside in his feelings 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." In another exercise, Danny and his therapist worked to strengthen the muscles that pull in, connected with the psychological capacities of grasping and pulling in nourishment and developing, the experience of give-and-take, Danny and his therapist explored pulling motions using a rope that each held. Danny was told to pull as hard as he wanted, as hard as it felt good to him. Unlike his early caregivers, the therapist was attuned to his affect and body language, allowing Danny to control the process and experience pleasure in give-and-take with another human being.

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 et al., 1998; Nijenhuis et al., 1999) and can be conceptualized as both running away from danger and running toward safety. When aggression appears likely to be effective, or when the victim 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 and hyperactive, or both. Faulty neuroception is also evident in children with a tendency to overactive "fight" responses, i.e., who are overly aggressive and categorized as "oppositional-defiant." As Porges clarifies, "playing nice" comes naturally when our neuroception detects safety and promotes physiological states that support social behavior. However, prosocial behavior will not occur when our neuroception procedurally misreads the environmental cues as unsafe and triggers physiological states that support defensive strategies (in press, p. 12). Jake, age 7, as 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 aggressive, 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 nomenclature for the circle of rope he created, and to use his voice and his arms to give the "get out" message. When another member put her toe inside his bubble, he yelled, "OUT." Jake played with telling them to come into his bubble, and then telling them to leave. His group members were instructed to do as he said and to get out of his boundary space when asked. With repeated iterations, Jake quieted down. His procedural patterns visibly changed: his spine lengthened, his head came up, and his shoulders relaxed. The therapist reflected back to him that he looked like a king on his throne, with a different kind of power from his aggressive defense. Jake finally had control over his own body and boundary, something he never had in his family.

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 if the environment is abusive. 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 could experience a sense of control over her environment and its stimuli. In another example, Kate suffered such extremes of abuse and neglect, left alone like an animal, that at five years old, she could not walk. Her dedicated adoptive parents 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 behavior. Kate refused to move in class, would not follow any 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 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 movement 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 was eventually satiated and she moved on to other activities.

When mobilizing defenses prove ineffective in dangerous situations, 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 immobilization behaviors are the only survival strategies remaining (Allen, 2001; Misslin, 2003; Nijenhuis et al., 1998; Nijenhuis et al., 1999b; 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, Minton & Pain 2006; Ogden 2009). The freeze and feigned death responses are markedly different in presentation, although these two immobilizing responses are often conflated in the literature. 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, tense muscles, increased heart rate and a feeling of paralysis coupled with hyper-attentiveness. This "alert immobility" (Misslin, 2003, p. 58) may appear as complete stillness except for eye movement and respiration.

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 lesbian couple who subsequently separated, following which her custodial parent tragically died in a car accident. Sally was then sent to live with her other mother, who had custody of an older brother who was abusive not only to Sally, but also to his mother and their pets. Sally gained weight rapidly, while her mother was passive and helpless in the face of her son's violence. Though Sally was 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 and listless, but with communal encouragement from the group members, buoyed by the support, she tried throwing the ball hard. Immediately

she experienced a sense of satisfaction and joy. Having completed this exercise, the group transitioned to an exercise that involved pushing against a pillow held by one of the other girls, which 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 simultaneously facilitates completion of fight responses and social engagement via the community support engendered by 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 're bulls with horns on their heads and can butt the ball away, or 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. As an additional exercise, or as a precursor to pushing something away, an empowering sensation of pushing can be experienced by modeling or encouraging children to position themselves as if preparing to do pushups, often viewing together a children's yoga card depicting the plank position where the body is parallel to the ground in a push up position. Playfully holding this position, perhaps using a timer, children report feeling powerful, becoming aware of the strength in their arms, and noticing shifts in breathing as their heart rate increases.

The ability to say "No" is a subset of the fight response and is often missing as procedural learning in abused or neglected children. In another exercise, 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.

The above exercises also are effective for "feigned death" or "floppy immobility" (Lewis et al 2004), responses powered by the parasympathetically-mediated dorsal branch of the vagus nerve. Characterized by limp musculature, behavioral shutdown, slowed heart rate, and/or fainting (Lewis et al, 2004; Porges 2001; Nijenhuis et al., 1998; Nijenhuis et al., 1999b; Porges, 2004; Porges, 2005; Scaer, 2001; Schore, 2007), this defense variant occurs as a "last resort" when all else has failed. 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 (Nijenhuis 1999; Krystal 1988).

When children suffer ongoing abuse, they might 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 to the demands of the aggressor. Such behavior is often apparent in mechanistic compliance or "robotization" (Krystal, 1978) and usually involves a lack of protest against abuse (Herman, 1992). Though adaptive for children in environments demanding automatic obedience, immobilizing defenses develop into inflexible patterns when engaged repeatedly, soon becoming default behaviors that predominate over other, more adaptive actions. A habitual freeze response typically includes a "chronic state of hypervigilance, a tendency to startle, and occasionally panic (Krystal, 1988, p. 161)," as well as increased muscular tension. Children with habitual dorsal vagal responses in the face of danger tend to become easily hypoaroused, develop a slumped or collapsed posture, flaccidity in the musculature, and may become helplessly submissive rather that actively defensive. When compliance is the best option, children's bodies instinctively respond with resignation, submission, and acquiescence to a threat cue.

Two weeks prior to therapy, a boy two years older pulled down 7 year old Anthony's pants, along with those of his best buddy, Aric, in the school bathroom, and touching Anthony's genitals while he stood immobilized. Anthony told no one, but refused to go to school. Despite Anthony's silence, Aric's reporting the incident to his parents resulted in Anthony and his mother being called into the headmaster, where Anthony shamefully heard the incident retold in front of them. The older boy confessed and was expelled, however, Anthony's fears grew. His post-traumatic responses interfered with his neuroception, making school and the bathroom feel dangerous and threatening. He missed five days of school and, upon his return, refused to go to the bathroom, or even near the bathroom, where the molestation took place. Prior to this incident, Anthony had also been bullied by Aric, his best buddy, who ordered him around or otherwise dominated Anthony. In his first session following the abuse, Anthony refused to talk about the trauma, so he was encouraged instead to use the drum to illustrate what happened. His therapist helped him notice his slumped posture, caved chest, tight arms, and shallow breath, with shortness of breath increasing as his mother told of the trauma. But rather than focusing on what happened, the therapist helped him to concentrate on the drumming and on his body. The focus on his breathing and then opening his chest by widening his arms helped to change Anthony's body tendencies: his head came up, shoulders back, creating a posture in which confidence felt more natural than fear. The next steps for Anthony involved addressing his tendencies toward compliance and submission. Anthony's treatment goals included integrating defensive movements of pushing away, using a pillow as described above, and then encouraging Anthony to begin adding words: : Stop! No! Go away! Leave me alone!" After practicing these assertive actions in his first therapy session, he was able to return to school.

In Anthony's second session, he reported that his friend had tried to bully him on the playground andthat he had "forgotten" to use his assertive actions and words. This session focused on Anthony developing a somatic sense of having boundaries. Sitting on the floor, he was invited to use a rope to create a "bubble" around him and then to push out what he didn't want and reach

or beckon for what he did want inside his boundary space. His older sister, who came to his second session, roleplayed invading his bubble, and Anthony discovered many ways to say "No:" "I'm in charge of me!" "You can't touch me unless I say!" "I get to decide." "I can be powerful, I am powerful!" His therapist helped him to find the movements that best corresponding to his saying NO. At first, he pushed his sister out of his bubble hesitantly and with little force, but, with practice, his push became more and more assertive and strong, as did his voice. His therapist then suggested that he fold a piece of cardboard over the roped-off boundary/bubble and write a message for the world. , The one he chose was, "Don't come in unless I say." He also wrote a message for himself on the inside fold of the cardboard: "I can say no." Anthony also wrote these same words on a paper that he kept in his pocket as a reminder that he could use them on the playground if he were teased or bullied. Anthony's mother reported that after these two Sensorimotor Psychotherapy sessions, "Anthony seems to have grown up, has more of a presence and confidence about him." Anthony reported that his relationship with Aric changed after the second session. Not only did Aric refrain from taking away Anthony's bat when they played, but he also allowed Anthony to have his turn without the usual bullying and interference.

For Kate, the child who could not walk at age five, it took a year of therapy before she finally felt safe enough and sufficiently comfortable with action to make a boundary by creating a rope circle around herself and to begin transforming impulsive, aggressive behavior into well-regulated integrated pushing motions and assertive words. The experience of a strong, comfortable act of pushing accompanied by words feels safer to children than fear-generated impulsive acts of aggression. She, like Anthony, created a sign with the words she wanted her boundary to say to others and to herself but specified that nobody could see what she wrote, not even her therapist. Whether we understand this choice as fear-driven or generated by feelings of greater control, she was able to tell her therapist how important it was to her that she could create the sign without even her therapist knowing what it said. Eventually, Kate and her therapist folded the paper up, taped it, and Kate put in a safe place in her therapist's file cabinet. Long after Kate left the group home, her therapist opened the paper to find that the little girl had written, "I'm scared." For a child like Kate, raised like a trapped animal, actions connected to self-expression, self-assertion and self-protection can be terrifying. Repeatedly executing new defensive movements and putting words to the experience can gradually enable children to overcome the procedurally-learned, fear-generated action sequences that lead to either passive or aggressive behavior.

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 gaze to gaze contact or standing upright with their heads held high elicits more abuse, children will develop tendencies to slump and to keep the head down. In traumatogenic environments, these tendencies are coupled with faulty neuroception. As Porges (in press) clarifies: "if

neuroception identifies a person as safe, then a neural circuit actively inhibits areas of the brain that organize the defensive strategies of fight, flight, and freeze." But evenslight changes in body language or movements that can shift neuroception from "safe" to "dangerous." When this shift continues to occur with non-threatening individuals and stimuli, the child's neural systems associated with prosocial behavior are disrupted, and the neural systems associated with defensive strategies are triggered and become hyperactive.

After Kate worked on the experience of having a boundary, was able to write, "I'm scared" on the paper, and then explored her feelings about what she wrote without even identifying the content, something shifted internally, allowing her to become more willing to work with her own vulnerability, but initially without words. First, Kate and her therapist tried out different postures to see how they felt. The therapist would ask: "What happens if you stand like slumped with your head down? How does that feel? How is that different from standing tall with your head 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 more 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, 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 learning so that she could 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 client 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. For children deprived of early experiences of attunement, exploration, and healthy willfulness, the discovery and elaboration of what feels "right" or "good" at a body level re-establishes an important developmental trajectory.

Sensory Processing[2]

The effective processing of sensory stimulation is critical to affect regulation, learning, and adaptive behavior. The infant 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-

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

up process that develops somewhat predictably through exposure to a wide variety of sensory experiences. This process continues from infancy to 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 response to either an unexpected or novel stimulus (Fisher, Murray, & Bundy, 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.

Moment by moment, a child must select what to attend to from the enormous variety of sensory input in the environment. 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 naturally retracts (narrow) his or her field of consciousness by selecting and orienting toward certain sensory stimuli and excluding others from awareness. What is selected 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 a child who is 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 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 day, seven-year old Megan would consistently start to have a tantrum. Triggered by a male authority figure, Megan

appeared to be unable to assimilate the sensory input of his voice and body language to differentiate him 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 the 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 on 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 ½ cup of yogurt. Note that these activities were undertaken as purely bottom-up, sensory and neuroregulatory interventions with no verbal discussion of her behavior or trauma and provided the opportunity for Megan to engaged in organized, purposeful movement. Eventually in therapy, Megan was able to discuss what had happened, but not before she felt empowered and safe in her own body. 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 cause difficulty for the child later in the day. 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, a foot-long thin straw to drink from, and a soft, fragrant pillow that would exude a pleasant scent of fresh pine essential oil when Aaron squeezed it hard. His bed was placed in a corner 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.

Before treatment, Aaron's sensory procedural learning prevented him from taking in a full range of sensory information that could allow him to regulate his arousal and take appropriate action. 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.

When arousal remains in the hyper- or hypoarousal zones, behavior tends to become less structured, and reflexive defensive tendencies occur that appear to be random and disorganized. 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." Traumatized children typically experience unusually low or unusually high thresholds, or both.

Hyper- and hypoarousal coexist with extreme thresholds for sensory stimulation. Many traumatized children have a narrow window of tolerance and are unable to withstand much stimulation (a low threshold). Others 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. 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. 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 et al., 2001, p. 28)." Thresholds vary from child to child and are influenced by several factors: the kind of sensory stimuli (some children are more sensitive to visual input while others are more sensitive to auditory input), how long the effect of the stimulus lasts (the rate of recovery), the child's initial arousal level, previous experience (Williamson et al., 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. 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, sluggish, have a delayed response to physical stimuli, dulled senses, fail to notice or orient to appropriate stimuli, and have a very high threshold of arousal. 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. Bobby, a spindly eight-year-old, with a very high threshold, was taken to emergency social service. He was passive, silent, and withdrawn. However, at times, 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 non-responsive, often taking an hour to resolve. He seemed particularly triggered by loud, unexpected noises made by other children, sirens, and so on. His therapist discovered that Bobby liked the smell of popcorn, so she 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, and his therapist encouraged him to talk to the frog. One skill Bobby learned was to squeeze his frog, which he kept in his pocket, each time he heard a loud noise. His therapist also taught him other simple tools to help him process sensory stimulation and regulate his nervous system. She gave him little weights to tie to his shoelaces so he felt more grounded; he also learned to massage his fingers, which he liked and found regulating.

When arousal is high, hypervigilance and hyper-orienting may be the result, leaving the child with a very low threshold for stimulation. If arousal is not in the window of tolerance, the child's ability to discriminate which stimuli are important and which 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 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 " (retrieved on line).

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 neuroception coupled with sensory processing deficits cause habitual proneness to flight, fight, freeze and feigned death responses. These overactive defensive responses may manifest as hpervigilance, isolated play, aggression, difficulty with social interactions, tantrums and unpredicted outbursts. 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 was seriously injured and had to be intubated, Becky was subsequently afraid to go to sleep at night and would wake several times during the night frightened and agitated. She began wrestling with the family dog in a way that appeared to be mean and rough, but actually Becky was seeking a level of sensory intensity that could help her calm her nervous system. She was also rough with her younger sister in their play together. Rather than viewing these seemingly aggressive actions as violent or abusive, her therapist explained to the concerned parents that Becky was probably trying to use proprioceptive stimulation to calm 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 pillow 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 gently play with her sister and her family dog.

Children may experience difficulty in any of the seven sensory systems (SI Book). Problems integrating tactile stimulation may manifest as unusual sensitivity to certain fabrics, seams and tags in clothing, even socks, or 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 hyposensitivy of children who barely notice smells. Some children are triggered by sunlight, avoid eye contact, and are easily distracted by visual input. Proprioceptive difficulties manifest in extremes of aggression, constantly rough-housing, crashing, hugging too tightly, or, by contrast, in movements that are clumsy, uncoordinated, awkward, and stiff,

A variety of activities can assist a child with sensory processing. 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. Children can also choose from different color options for the lenses, their choices informed by their experience when trying on the various colors. One very anxious adolescent claims that wearing dark purple lenses help him feel a sense of safety and anonymity. Other colors are experienced as soothing and relaxing or energizing and mobilizing.

One child who developed a hypersensitivity to smells after repeated surgeries carried peppermint tea bags in her pocket because she enjoyed that smell. She also carried a packet of life-saver candies, calling them her "smellies." The life-savers provided an alternative incoming smell and gave her something to suck, which provided organizing stimulation orally. Eve benefitted from the smell of vanilla. She had lost her mother to cancer when she was young, and was a very anxious and self-injuring adolescent who would cut her body frequently. Eve sought out the vanilla candle that her therapist occasionally lit during the winter months, and as therapy progressed, she reported that her mother loved to bake, hence prior to her illness the smell of vanilla permeated the kitchen. Identifying and processing the memories unleashed by this aroma became a lens to examine her somatic experience, previously unknown except when self-injuring, as she explained that "cutting was the only way I felt anything in my body". Eve carried vanilla hand cream in her school backpack to ameliorate anxiety, and reported that the aroma soothed her-- aiding her anxiety-- and that her self-injurious behavior diminished.

Eight-year-old Lisa barely survived her premature birth, 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 so irritating. 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 couldn't play on the playground because it was too noisy, 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. Her therapist instructed 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 information and calm her nervous system. She learned which songs were regulating to her and put them on her

i-Pod. 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, and, in addition, their symptoms were driven by body-based sensory processing issues. Only through bottom-up sensory interventions were they 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 young brain and body organizes itself for survival and adaptation under the unique circumstances of a particular biological heritage and family environment and develops procedurally-learned patterns of response that became automatic. Because of the phenomenon of neuroplasticity, procedural tendencies adaptive in one specific environment may cause lasting changes in brain organization and structure, affecting autonomic, affective, and sensory processing for years to come. Patterns of response adaptive at a particular age or in a particular family situation may no longer be adaptive later in childhood, leading to stubborn and frustrating symptoms and behavior often misunderstood as intentional or oppositional. A child's brain may wire itself in ways that became rigid and fixed, resistant to change, either because of automatic tendencies, faulty neuroception, difficulties with self-regulation, or sensory processing deficits that usurp more adaptive responses in non-traumatic contexts.

We believe that utilizing the bottom-up approaches illustrated in this paper help to capitalize on neuroplasticity to change these earlier procedural tendencies and promote more adaptive behavior. 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, feelings, body sensations, and movements connected to earlier patterns of symptom and memory will not change the brain. This repetition only reinforces established neural networks and thus habitual ways of thinking, feeling and acting. To change the brain and the body responses, we must interrupt and inhibit rigid patterns and experiment with new amounts and kinds of sensory stimulation, as illustrated in the bottom-up interventions described in the previous sections.

Neuroplasticity also requires focused attention and direction (Siegel, 2006), the opposite approach to that of free-floating attention or free association. Without direction, children typically engage well-established neural pathways determined by habits of orientation, affect and arousal. In bottom-up treatments, children are helped to first become more curious and aware of these habits and then to focus attention on trials of new actions and reactions. When they learn to select the object(s) of attention, several phenomena occur: habitual patterns are inhibited, allowing other brain areas to be stimulated, and children experience a sense of greater control and mastery. When heightened awareness and sustained attention to new stimuli or new actions is repeated, retention is also facilitated. Therapists can teach children how to selectively focus on stimuli to which they normally might not attend in order to take advantage of attention's role in

neuroplasticity. Kate paid attention to walking with a new, aligned posture; Megan learned to initiate new activities to organize her nervous system prior to gym class.

Neuroplastic change requires the conscious inhibition of old responses coupled with intentional repetition of new, more adaptive responses. The repeated patterns of regulation, movement and sensory processing stemming from past trauma are evidence of the brain's neuroplasticity in past environments, but these habitual reactions cannot help children capitalize on the brain's capacity for neuroplasticity in the present. 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 practicing a new physical posture or skill rather than repeating the old automatic response. In so doing, we also hope to encourage the harnessing of neuralplasticity through inhibition of old responses and repetition of new ones.

When children suffer unresolved neglect and trauma, they are left at the mercy of bottom-up phenomena (affect dysregulation, maladaptive movement patterns, problems with neuroception and sensory processing) that are not best treated by a top-down 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. As Damasio (1999) reminds us, bottom-up processes will affect upper level processes. In other words, a propensity for certain emotions and thoughts is created by bottom-up responses. Sympathetic alarm responses and dorsal vagal immobilizing responses are both associated with cortical inhibition, interfering with learning and memory. When children cannot regulate affect, cannotmove freely because their bodies are collapsed or frozen, and/or 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." Once the bottom-up difficulties are remedied, these upper level processes and cognitive distortions often change accordingly, without the need for attention to them directly.

An inherent assumption in Sensorimotor Psychotherapy is that since the body's answers do not come in the form of words, we can only discover the "right" answer through a process of mindful trials of new movements, postures, words, and orientation. 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, just as it is in normal development in the context of secure attachment. 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" and "moment to moment" experience can potentially activate the neural circuits related to established patterns, while 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.

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