Journal of Aggression, Maltreatment & Trauma, 19:699–720, 2010

ISSN: 1092-6771 print/1545-083X online
DOI: 10.1080/10926771.2010.515162

TRAUMA TREATMENT

A Controlled Pilot-Outcome Study of Sensory Integration (SI) in the Treatment of Complex Adaptation to Traumatic Stress

ERIKA M. KAISER and CRAIG S. GILLETTE
Colorado Springs, Colorado, USA

JOSEPH SPINAZZOLA
The Trauma Center at JRI, Brookline, Massachusetts, USA

This study tested whether sensory integration (SI) treatment combined with psychotherapy would improve symptom outcome over psychotherapy alone in the treatment of complex posttraumatic stress, as measured by the Disorders of Extreme Stress Not Otherwise Specified (DESNOS) clinical construct in a group of 10 adult patients with histories of childhood abuse. DESNOS symptoms were assessed at three time periods (T1, baseline; T2, after experimental group SI treatment; and T3, after wait-list control group SI treatment) using the Structured Interview for Disorders of Extreme Stress (SIDES). The Sensory Learning Program™ (SLP), developed by the Sensory Learning Institute of Boulder, Colorado, was used as the SI treatment modality. Results indicated significant differential improvement for the group treated with SLP in SIDES Total Score (T1/T2 and T2/T3), Self Perception (T1/T2 and T2/T3), Affect Regulation (T2/T3), and Alterations in Meaning (T1/T2).

KEYWORDS “bottom up” approach to trauma processing, complex adaptation to traumatic stress, developmental trauma, dysregulation of the HPA system, experience-dependent maturation of the brain, sensory integration

Submitted 20 October 2008; revised 28 February 2009; accepted 30 June 2010.
Address correspondence to Erika M. Kaiser, 1410 Bellaire Dr., Colorado Springs, CO 80909. E-mail: erikakaiser1@msn.com

Results of more and more studies have indicated that early childhood trauma and neglect are risk factors for continuing psychological and behavioral problems in adulthood (Herman, 1992; McLean & Gallop, 2003; Spitzer, Chevalier, Gillner, Freyberger, & Barnow, 2006; van der Kolk & Fisler, 1994; van der Kolk et al., 1996). There has been a parallel interest in determining the mechanisms through which these early events shape emotions, thoughts, and behaviors many years later (Pynoos, Steinberg, & Goenjian, 1996; Teicher, 2002; Zlotnick et al., 1999). Fairly recent and rapid development in the neurosciences has produced increasingly sophisticated brain structure and function models that have added considerably to the understanding of these mechanisms (Bremner; 2005; Kandel, 2000; Mesulam, 1998; Nemeroff, 2004).

THE NEUROBIOLOGY AND NEUROPSYCHOLOGY OF TRAUMATIC EXPERIENCE

Evidence from a number of research studies, including those that have employed MRI and PET scans (Bremner et al., 2003), has converged on identifying several distinct brain systems that are negatively altered by childhood abuse and are associated with persisting difficulties with memory, dissociation, emotional regulation, and psychopathology in adulthood (Bremner, 2003, 2005; Bremner, Krystal, Charney, & Southwick, 1996; Nemeroff, 2004; van der Kolk, 1996a). In addition, dysfunction has been identified in basic neurohormone activity involving glucocorticoids, catecholamines, serotonin, and endogenous opioids (Heim et al., 2002). The hypothalamus–pituitary–adrenal (HPA) system is the system most directly linked to stress-regulatory systems. Dysregulation of the HPA system has been associated with early traumatic experiences. For example, increased HPA reactivity to psychosocial stress has been demonstrated in adult women with a history of childhood sexual or physical abuse (Heim et al., 2000).

Kandel (2000) outlined a model in which neural connections are created and altered by experience and mediated by sensory input. Although genes provide the basic capacity for sensory integration (SI), specific sensory stimulation prior to and after birth weakens synaptic connections in some circumstances and strengthens them in others. The brain develops in use-dependent fashion and organizes during development in response to experience (Perry, Pollard, Blakley, Baker, & Vigilante, 1995). Recent research has indicated that interpersonal interactions are an important source of sensory experience. Schore (2003) provided an excellent discussion of the self-organization of the developing brain as it occurs in the context of a relationship with another self. Research has proposed that early development through interaction with others occurs through visual, auditory, and tactile modalities (Trevarthen, 1993).

Because the brain's capacity for processing sensory input is more limited than the receptors' capacity to measure the environment, the central nervous system is designed to filter and organize bits of sensory information into an integrated experience (Siegel, 2001). Sensory input is organized in a manner that enables an individual to establish a sense of where the body is in time and space, to feel safe in one's own body, and to accurately perceive the body's relationship to the environment (Ayres, 1998). The early developing "true self" can therefore be seen as a bodily self that preserves a sense of the continuity of being (Winnicott, 1971). As children proceed through the sensory integrative process in a normal and healthy way, they become able to respond to sensations with adaptive responses that are increasingly more mature and complex (Ayres, 1988). Moderate exposure to stress early in life develops the capacity to modulate the stress response, which leads to more effective overall arousal regulation (Schore, 2003).

This development can be quite different for children who are exposed to overwhelming traumatic experiences or subjected to neglect or sensory impoverishment. Response patterns during trauma range from the potential to dissociate bits of experience to hyperaroused panic. If a child is consistently or repeatedly subjected to traumatic experiences, a persisting fear state could develop into the equivalent of an ongoing trait (Perry et al., 1995). Lack of sensory stimulation could result in failure to develop the sensory pathways relating to the ability to accept comfort, think positively, and have hope. If the range of sensory experience available to a child becomes limited, available responses to developmental challenges, such as formation of affective relationships with others, are also limited (Greenspan & Porges, 1984).

SENSORY INTEGRATION AND TRAUMATIC EXPERIENCES

The focus of this study is on SI; specifically how it might be restored after trauma has interfered with its development. To understand how poor SI results in dissociation, emotional regulation problems, and somatization, it is useful to understand the sequential and hierarchical development of the brain.

In the course of experience-dependent maturation, brain functions develop as they are needed in the maturation process. The brain stem area develops first, then emotional centers, and then cognitive centers (Meares, Stevenson, & Gordon, 1999). Development is associated with gaining autonomy from sensory control and the acquisition of cortical control over behavior that is organized at a lower level (Toates, 1998). Correspondingly, higher cortical brain areas can function effectively only if they are able to interrelate in a healthy way with lower brain levels (Rauch et al., 1996; van der Kolk, 2002).

In Schore's (2003) proposed model, upper cortical connections from prefrontal areas provide the capacity for emotional regulation. If dendrites in hypothalamic neurons that project to higher cortical areas are not utilized because of early experiential restriction, those dendrites are pruned in the normal pruning process. On the other hand, pathways to the subcortical systems responsible for dissociation are myelinated. Van der Kolk (1996b) studied individuals suffering from complex adaptation to traumatic stress who met criteria for the Disorders of Extreme Stress Not Otherwise Specified (DESNOS) clinical construct. He concluded that prefrontal areas were unable to assert inhibitory control over lower brain areas in these individuals. Meares et al. (1999) proposed that somatization could be the result of defective descending inhibitory mechanisms.

SENSORY INTEGRATION TREATMENT

The term *sensory integration treatment* has no standardized definition. According to practitioners, SI is a complex, evolving process that considers an individual's sensory needs, interaction style, occupational roles, and behavior (Schaaf & Anzalone, 2001). Researchers who conducted a meta-analysis on SI treatment provided an extremely broad operational definition, describing it as, "treatment that is aimed to enhance development of basic SI processes with activities that provide vestibular, proprioceptive, tactile, or other somatosensory inputs as modalities to elicit adaptive body responses" (Vargas & Camilli, 1998, p. 191).

Given the wide variety of treatment protocols, the efficacy of a sensory integrative approach has been difficult to measure (Spitzer & Roley, 2001). Most studies have focused on individuals with learning disabilities, but researchers have also conducted studies on the efficacy of SI for individuals with developmental disabilities and autism (Spitzer & Roley). Some professionals support and value sensory integrative approaches (Rimland & Edelson, 1994), but others have serious doubts as to its efficacy (Hoehn & Baumeister, 1994). Weak treatment fidelity is a serious shortcoming in assessing the validity of SI studies in general (Parham et al., 2007).

In the field of psychology, Porges (2003) conducted an experiment with autistic children where he utilized acoustic stimulation to improve the neural connections between upper cortical areas and the brain stem system that regulates the muscles of the head. The intervention resulted in noticeable improvements in social behavior and communication skills as well as improvements in parental interaction styles. SI has also been successfully used in the treatment of self-mutilation (Moro, 2007).

We found no studies specifically applying SI treatment to complex posttraumatic stress disorder (PTSD) symptoms. Yet, van der Kolk (2002) postulated that for therapy to be most effective for individuals with complex adaptation to trauma, it must provide for integration and processing of disruptive emotions and sensations and not merely cognitive inhibition of these arousal states. He contended that improved regulation of core physiological states would have broad positive impact on posttraumatic sequelae including cognitive attributions, and he proposed a “bottom-up” approach to trauma processing. This viewpoint has been supported by well-controlled treatment outcome research in which resolution of emotional dysregulation, dissociative symptoms, and interpersonal problems was found to be an important first step in sequential intervention for clients suffering from complex PTSD (Cloitre, Koenen, Cohen, & Han, 2002).

SENSORY LEARNING PROGRAM

In our study, SI treatment was provided using the Sensory Learning Program™ (SLP), a 30-day multimodal intervention developed by Mary Bolles of Boulder, Colorado. SLP utilizes a trochoidal motion table, computerized light instrument, and acoustic training suite (see Figure 1), incorporating three forms of SI intervention: visual, acoustic, and vestibular. Syntonics (Liberman, 1986; Spitler, 1941) provides the rationale for using colored light. Tomatis (1991) and Bérard (1993) conducted research that forms the basis for the acoustic stimulation portion of SLP. The work of Ayres (1998) forms the basis for the vestibular portion. The goal of SLP is to create interaction effects among the visual, auditory, and vestibular systems, resulting in overall improvement in SI. These systems are developmentally and physiologically linked. The canals and bulbs of the vestibular system are located in the inner ear and share the same endolymphatic fluid as

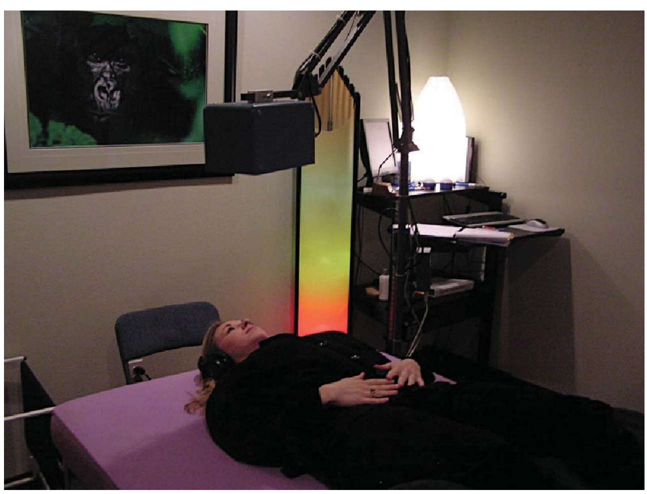

FIGURE 1 Sensory Learning Program equipment.

the cochlea (Uttal, 1973). Most eye movements are reflexive, and the vestibular system plays an important role in these reflexes (Castro, Merchut, Neafsey, & Wurster, 2002). According to SLP theory, systems are inhibited by trauma but retain the potential for being restored; therefore, the creation of an environment for the brain to "relearn" adaptive internal structure is possible.

During the SLP process, the participant lies on a trochoidal motion table that slowly rises and descends in a circular pattern, providing vestibular stimulation. At the same time, the participant's eyes follow a stationary light instrument that provides predetermined frequencies of colored light in accordance with syntonics theory. Gated music is introduced through headphones that are worn during the session.

Constant vestibular stimulation of the trochoidal table arouses the reticular system, which activates the nervous system, preparing the individual for SI. Stimulation of subcortical structures might, however, result in a fear response, immediately altering internal states and preparing individuals for attack, fight, flight, or other adaptive behaviors (Iverson, Kupfermann, & Kandel, 2000). To prevent the fear response, movement of the table entrains the cerebral spinal fluid flowing through the vesicles to a rhythm that is similar to the rate of flow of the cerebral spinal fluid when the body is resting. Because feedback from the body is required to sustain fear (LeDoux, 1998), helping the body to remain at an "at rest" state reduces the likelihood of activation of the dissociative or hyperarousal neural networks.

Retraining the vestibular system is a form of exercise across polarities. Movement of the table circulates fluid in the semicircular canals of the inner ear. The accelerative field resulting from table movement causes endolymphatic fluid to operate on the hair cell mechanoreceptors (Uttal, 1973). The hair cells bend back and forth, causing depolarization and hyperpolarization along the vestibular nerve to the brain (Castro et al., 2002). In sensory learning theory, the more the vestibular system is worked, the better connections it has to other brain structures.

Gated music introduced through headphones distracts the participant's cognitive processes, allowing integration work to progress unconsciously. Introduction of gated music is also intended to level out the participant's listening profile. According to Tomatis (1991), listening profile distortions result when an infant unconsciously cuts off a frequency band that is emotionally disturbing or the infant is hypersensitive to a frequency band; for example, perhaps the frequency of the mother's voice is shrill and uncomforting. In studies conducted by Tomatis, hyperacute hearing at certain frequencies can affect specific areas of the brain, triggering abnormal reactions. Bérard (1993) found that hyperaudition on specific frequencies resulted in the same identifiable problems. For example, the listening profile found to be typical of some suicidal patients was hypersensitive hearing in the left ear at

2,000 Hz, a progressive drop at 3,000, 4,000, and 6,000 Hz, and then an abrupt rise at 8,000 Hz.

Auditory retraining works on the principle of introducing sounds that are alternately stronger, softer, and of higher and lower frequency. This results in a broad range of movement of the stirrup bone in the inner ear. Retraining is thought to result in normalization of audition across the frequency spectrum. In SLP, the gated music is compiled by the Sensory Learning Institute and consists of a variety of full-spectrum vocal and instrumental pieces.

Use of colored light in the SLP procedure serves two purposes: (a) introduction of various frequencies of light along the energetic portion of the optic nerve pathway, affecting the firing pattern of the hypothalamus; and (b) exercise of the extrinsic eye muscles to broaden peripheral vision and allow more light to travel along the optic nerve. During the SLP program, differing light sequences are hypothesized to operate in such a manner as to stimulate the sensory systems from the "bottom up"—from the brain stem, to the emotional centers, to the cognitive centers.

To date, SLP has been used with children and adults to address problems associated with sensory disorders, including acquired brain injury, learning and behavioral problems, attention deficit disorder (ADD)/attention deficit with hyperactivity disorder (ADHD), developmental delays, autism, and birth trauma. Although the program's developers and some users have reported improvement in those who are treated with SLP, there are no controlled, empirically based studies to attest to its effectiveness.

HYPOTHESIS

In this study, we combined a "top-down" treatment modality (psychotherapy) with the "bottom-up" treatment modality provided by SLP. We hypothesized that participants with histories of childhood trauma who were treated with SLP in combination with regular psychotherapy would show improvement in traumatic stress symptoms beyond what similar individuals in regular psychotherapy alone accomplish.

METHOD

Participants

Participants were 10 adults recruited from Franciscan Community Counseling (FCC), a mental health clinic in Colorado Springs, Colorado. There were three men and seven women at the beginning of the study with an average age of 46.7 (range = 34–62, *SD* = 9.37). All reported a history of mental health treatment (see Table 1), most beginning in childhood and at least periodically as an adult; all were in therapy throughout the study. All but two

TABLE 1 Participant Demographics

#	Group	Type of trauma	Age at trauma	Diagnosis	Tx history
1	XPER	Sexual abuse Parental discord	Age 9–10 Infancy	296.25 MDD 309.81 PTSD 300.3 OCD 301.82 Avoidant	Age 9–10 Adolescence Past 6 months
2	XPER	Parental discord Emotional abuse	Early childhood Early childhood	309.81 PTSD 301.5 Histrionic 301.6 Dependent	Past 11.5 years
5	XPER	Physical abuse Emotional abuse	Entire childhood Entire childhood	300.21 Panic disorder 295.7 Schizoaffective	Since age 13
7	XPER	Emotional abuse Physical abuse	Entire childhood Entire childhood	294.9 Cog disorder NOS 300.3 OCD 296.32 MDD	Past 5 years
8	XPER	Physical abuse Sexual abuse Emotional abuse Neglect Parental discord	Age 2–13 Age 5–11 Entire childhood Age 10–11 Entire childhood	309.81 PTSD 299.8 Asperger's	Since age 10
3	WCON	Physical abuse Sexual abuse Emotional abuse Neglect Parental discord	Since age 3 Age 12 Since infancy Age 11–12 Since infancy	296.33 MDD 309.81 PTSD 294.9 Cog disorder NOS	Past 3 years
4	WCON	Physical abuse Sexual abuse Emotional abuse Neglect	Age 10 and under Age 12 and under Entire childhood Age 11	300.6 Deperson. 300.0 Anxiety NOS with PTSD features	Adolescence Past 3 years
6	WCON	Emotional abuse Physical abuse	Entire childhood Entire childhood	309.29 ADO	Since childhood
9	WCON	Physical abuse Sexual abuse Emotional abuse Neglect Parental discord	Age 12 Toddler–age 13 Entire childhood Entire childhood Age 15	309.81 PTSD 296.32 MDD BPD traits	Past 12 years
10	WCON	Physical abuse Sexual abuse Emotional abuse Neglect Parental discord	Toddler Toddler Entire childhood Entire childhood Entire childhood	V 71.09	Past 12 months

Note. XPER = experimental group; MDD = major depressive disorder; PTSD = posttraumatic stress disorder; OCD = obsessive–compulsive disorder; NOS = not otherwise specified; WCON = control group; ADO = adjustment disorder; BPD = borderline personality disorder.

had multiple mental health diagnoses according to the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM–IV;* American Psychiatric Association [APA], 1994) assigned by their individual therapists at the beginning of treatment (see Table 2). Commonly occurring diagnoses were PTSD ($n = 5$), major depression ($n = 4$), and anxiety disorders ($n = 4$).

TABLE 2 Participant Treatment History

Group	#	Treatment history
XPER	1	Individual psychotherapy age 9–10, late adolescence, and currently for 6 months
XPER	2	Individual psychotherapy for past 11.5 years
XPER	5	Individual and group psychotherapy continually since age 13
XPER	7	Individual psychotherapy for past 5 years
XPER	8	Individual psychotherapy periodically since age 10
WCON	3	Individual psychotherapy for past 3 years
WCON	4	Individual psychotherapy for total of 3 years, periodically since adolescence
WCON	6	Individual psychotherapy periodically since childhood
WCON	9	Individual psychotherapy periodically for last 12 years
WCON	10	Individual psychotherapy for last year

Note. XPER = experimental group; WCON = control group.

Recruitment was accomplished by distributing fliers to existing FCC clients explaining the study. The sole inclusion criterion was a history of childhood interpersonal trauma, defined as physical abuse, sexual abuse, emotional abuse, neglect, parental discord, or a combination, which occurred prior to the age of 14. Participants were not required to meet full diagnostic criteria for DESNOS because our hypothesis was based on symptom improvement. Exclusion criteria were blindness and mental retardation.

The first 10 individuals who agreed to participate and met inclusion criteria were enrolled in the study. All participants signed formal consent forms before assessment began. No individuals were excluded due to exclusion criteria. Due to the various capabilities and orientations of the participants' current therapists, no attempt was made to limit the type of ongoing psychological treatment to any particular method or theory. Medication use or changes were not monitored.

Participants were assigned to either the experimental (treatment) group or wait-list control group by using a random number table. The experimental group took part in the complete SLP treatment regimen in addition to psychotherapy as usual with their current therapist. The wait-list control group continued psychotherapy as usual with their current therapist. All experimental group participants engaged in SLP treatment during the same 30-day time period. Information from each participant's therapist was obtained about the participant's treatment utilization during the study to confirm that treatment was taking place as usual. After completion of the treatment and pre–post assessment cycle, wait-list control group participants were offered the SLP program. Three of the five participants in that group then underwent the treatment regimen. These three participants and the five participants who were treated earlier were then reassessed.

Sensory Integration Treatment

SI treatment was applied using SLP regimen and protocols (Sensory Learning Center International, 2004). All SLP treatments were administered by the first author (Erika M. Kaiser), who was trained in the procedures by the Sensory Learning Institute for the purpose of carrying out the study. The equipment was installed in a 16’ × 12’ room in an office building. The room was an interior room in which nearly complete darkening could be accomplished during treatment.

All participants received the same gated music sequence and the same color sequence each day. Participants were alone in the room for the treatment session. One participant was not comfortable alone in the dark and requested the experimenter’s presence during treatment.

After 12 days of treatment, each participant took home a light instrument for 18 days of light therapy only. The light instrument is a box measuring 4” × 6” × 5” with a circular aperture in the front through which the light shines. Light instrument therapy consisted of one 20-min session on awakening in the morning and one 20-min session before bed in a quiet, completely darkened room. Only one color, magenta, is used during this stage of treatment. The light repeatedly fades in and out during the course of each session.

Assessment of Auditory and Visual Indexes

Assessment of visual indexes

Participants were initially evaluated for visual sensory patterning using kinetic perimetry (Rantanen, 2003). Visual scores are created by detecting when a participant is able to recognize different-colored targets that are moved into his or her visual field. Greater integration is associated with a wider visual field. Participant responses are plotted on a sheet of concentric circles that are graded with increasingly higher scores. The innermost circle is given a score of 5, the next circle a 10, the next circle a 15, and so on. Therefore, higher scores are associated with greater SI. Visual scores used in the analyses for this study were calculated by averaging three scores for each color stimulus. The individual who conducted the assessments was trained and experienced in the process and was blind to participant group.

Assessment of auditory indexes

Participants were initially evaluated for auditory sensory patterning using an Interacoustics Screening Audiometer AS208. The audiometer was used to detect and plot decibel levels at frequencies ranging from 125 Hz to 8,000 Hz. Greater SI is represented by a level listening profile and convergence of left and right ear values at each frequency. Certain patterns in the audiogram are also thought to have certain psychological interpretations, but there is little published research to support these assertions. We created variables that were calculated by average decibel difference from zero and variables that were calculated by left–right convergence. These data were used to chart pre–post treatment changes. The individual who conducted the assessments was trained and experienced in the process and was blind to participant group. Due to hypersensitivities in their listening profiles, 2,000 and 8,000 Hz were filtered for three participants (5, 7, and 8). For one other participant (9), 3,000 Hz was filtered. No filters were applied for the other participants (1, 2, 3, and 4).

Assessment of Trauma Symptoms

Trauma symptoms were assessed using the Structured Interview for Disorders of Extreme Stress (SIDES; Pelcovitz et al., 1997). The SIDES is a 45-item instrument that assesses past and current functioning on six domains: (a) affect dysregulation (overreaction to stressors, use of self-destructive measures for emotional regulation, problems expressing or modulating anger, suicidal preoccupation, difficulty modulating sexual impulses); (b) disturbances in attention/consciousness (dissociation, depersonalization); (c) disturbances in self-perception (negative views of self being helpless, ineffectual, damaged, and undesirable to others); (d) disturbances in relationships (difficulty trusting others, revictimization, and victimization of others); (e) somatization (multiple somatic difficulties that defy medical explanation or intervention); and (f) disturbances in meaning systems (viewing the world through a dark lens; no longer believing life makes sense or has a purpose; Luxenberg, Spinazzola, & van der Kolk, 2001). A total score is also produced by summing the domain scores. Two versions of this instrument are available: a clinician-administered version and a self-administered version. The clinical interview version was used in this study.

During the *DSM–IV* field trials, the interview version of the SIDES demonstrated both good interrater reliability ($\kappa = .81$) as well as internal consistency with coefficient alpha ranging from .76 to .96 on the six domain scales (Pelcovitz et al., 1997). Several studies have been conducted that support the construct validity of the SIDES instrument (Ford, 1999; Zlotnick & Pearlstein, 1997; Zlotnick et al., 1996). Although the DESNOS construct was not accepted as a formal diagnosis in the *DSM–IV,* its components are currently referenced under associated features of PTSD (APA, 1994).

The SIDES can be scored either based on DESNOS classification (based on cutoff criterion for each of the six DESNOS domains) or symptom severity, both of which were computed for this study. Participants were asked about the presence and severity of each symptom both currently (last 30 days) or in their lifetime. To distinguish the two methods in this article, scores computed by the diagnostic method will have a “DX” appended.

For instance, Total-DX has a range of 0 to 3, whereas Total Score (second method) has a range of 0 to 135. The latter method was used for the bulk of the statistical analyses. Finally, in this study we adopted recommendations from more recent research (Ford, 1999; Spinazzola, personal communication, March 8, 2008) to omit current criteria for somatization as a requirement for DESNOS classification, as these symptoms appear to be reflected in only a subset of individuals with complex adaptation to traumatic stress.

The SIDES was administered to each participant at pretreatment (T1), posttreatment (T2), and follow-up (T3). Assessments at T1 and T2 were conducted by a master's-level clinician who was trained in SIDES administration by the first author and was blind to the experimental hypothesis and participant group. The same clinician assessed all participants. Assessments at T3 were conducted by a doctoral-level clinician who was trained in SIDES administration by the first author and was blind to the experimental hypothesis and participant group. T2 was defined as 45 days after completion of in-home light therapy, because the items on the SIDES assess how the participant functioned "within the last 30 days." Use of the 45-day period prevented responses from relating to the time during which participants were undergoing treatment.

RESULTS

Equivalence of Experimental and Control Groups

Poststudy analysis revealed that the treatment and wait-list control groups were not equivalent on all variables of interest. Although chi-square analysis indicated equivalence in therapist diagnosis and prior exposure to therapy, there were significantly more men in the experimental group (three men, 2 women) than the control group (five women), $\chi^2(1, N = 10) = 4.286, p < .03$. A comparison of groups regarding participant age was not significant.

With regard to dependent variables, the experimental group (XPER) scored significantly higher than the control group (WCON) at pretest (T1) on several SIDES variables: Affect Regulation, $t(8) = 2.748, p = .03$; Meaning, $t(8) = 2.515, p = .04$; and Total Score, $t(8) = 2.715, p = .03$.

SIDES Variables

Statistical analysis was performed using independent *t* tests of difference scores. The use of *t* tests was chosen to allow directional hypotheses that provided maximum power to detect expected changes, particularly considering our small sample sizes. The use of one-tailed tests for this purpose might be controversial, but we believe it is justified in light of the obtained large effect sizes as well as the fact that a negative effect, although potentially interesting in a larger study, could be considered equivalent to no effect in light of our hypothesis. In fact, there were no significant negative group mean changes for any of the SIDES variables. We believe this approach provides the best combination in a small sample pilot study of adequate protection against Type I error while minimizing the probability of Type II error.

Table 3 presents the results for changes between the pretest (T1) and posttest (T2), comparing the experimental group (XPER) with the wait-list control group (WCON). All *t* tests met criteria for distribution normality and equality of variance. Improvement in SIDES scores was demonstrated by pre–post reductions in score magnitude (less severe symptoms). Statistical significance was evaluated at the .05 level of Type I error.

The Self-Perception and Meaning domain pre–post mean difference scores and the Total SIDES pre–post mean difference scores were significantly different for the experimental group compared to the control group, with greater pre–post symptom improvement for the experimental group. Differences in the other domains were not significantly different from what chance would predict.

Analyses of the SIDES variables were repeated for changes between T2 and T3. In this case, the wait-list control group received the SI treatment and is now labeled as the treated wait-list control group (TCON). The XPER group was used as a control group for the TCON group. Our expectations were that there would be a significantly greater change for the TCON group following treatment compared to the previously treated XPER group. It is important to note that two WCON participants dropped out of the study following T2. These two participants had the least symptomatic SIDES scores at T1 and T2. Table 4 presents the results of the T2–T3 *t* tests.

TABLE 3 *t* Test Comparisons of SIDES Domain and Total Pretest–Posttest (T1–T2) Difference Scores

	XPER *M*		WCON *M*		Diff *M*			
Domain	Pre	Post	Pre	Post	XPER	WCON	*t* value (8 *df*)	Prob[a]
Affect/Impulse Regulation	21.6	13.4	12.2	11.0	8.2	1.2	1.633	.07
Dissociation	9.0	6.6	5.2	3.8	2.4	1.4	0.657	.27
Self Perception	10.8	6.2	6.6	6.2	4.6	0.4	2.341	.02*
Relationships	6.2	5.6	5.2	3.6	0.6	1.6	−0.839	.79
Somatization	5.6	5.4	3.2	3.4	0.2	−0.2	−0.134	.45
Meaning	9.0	5.2	4.6	3.6	3.8	1.0	2.064	.04*
Total Score	62.2	42.4	37.0	31.6	19.8	5.4	2.085	.04*

Note. $N = 10$ (5 XPER and 5 WCON). SIDES = Structured Interview for Disorders of Extreme Stress; XPER = experimental group; WCON = wait-list control group.

[a]Probabilities based on directional hypotheses of reduction in symptoms (T1 > T2) with a greater reduction in the experimental group than the wait-list control group (XPER > WCON).

*$p < .05$.

TABLE 4 *t* Test Comparisons of SIDES Domain and Total Posttest Follow-Up (T2–T3) Difference Scores

Domain	XPER *M*		TCON *M*		Diff *M*		*t* value (6 *df*)	Prob[a]
	Post	F/U	Post	F/U	XPER	TCON		
Affect/Impulse Regulation	13.4	13.4	15.7	7.7	0.0	8.0	2.391	.03*
Dissociation	6.6	3.8	5.3	3.3	2.8	2.0	−0.588	.71
Self Perception	6.2	6.6	8.6	1.3	−0.4	7.3	4.746	.00*
Relationships	5.6	5.0	5.0	3.0	0.6	2.0	0.565	.30
Somatization	5.4	5.0	3.4	0.7	0.4	2.7	0.785	.23
Meaning	5.2	4.8	5.0	2.3	0.4	2.7	0.719	.25
Total Score	42.4	38.6	43.0	18.3	3.8	24.7	2.236	.03*

Note. $N = 8$ (5 XPER and 3 TCON). SIDES = Structured Interview for Disorders of Extreme Stress; XPER = experimental group; F/U = follow-up; TCON = treated control group (wait-list controls [WCON] after treatment). TCON posttest means are different from WCON posttest means in Table 2 because they are based on $n = 3$ due to participant dropout.

[a]Probabilities based on directional hypotheses of reduction in symptoms (T2 > T3) with a greater reduction in the treated control group than the original experimental group (TCON > XPER).

*$p < .05$.

Posttest follow-up difference scores for the Affect/Impulse and Self-Perception domains as well as the Total Score reflected significantly greater symptom reduction for the treated TCON group compared to the XPER "control" group. Effect sizes of the difference scores for T1–T2 and T2–T3 are shown in Table 5. Effect sizes were calculated by dividing the mean difference between T1 and T2 (as well as T2 and T3) scores divided by the standard deviation of the difference scores. This is as an estimation of Cohen's *d* (Gravetter & Wallnau, 2007).

TABLE 5 Effect Sizes for SIDES Scores at T1–T2 and T2–T3

Domain	Group	T1–T2 effect size	T2–T3 effect size
Affect/Impulse	XPER	1.23	0.00
Regulation	W/TCON	0.17	1.32
Dissociation	XPER	1.58	1.46
	W/TCON	0.46	1.15
Self Perception	XPER	1.77	0.16[a]
	W/TCON	0.13	4.80
Relationships	XPER	0.24	0.15
	W/TCON	1.78	1.00
Somatization	XPER	0.04	0.09
	W/TCON	0.05[a]	1.06
Meaning	XPER	2.56	0.09
	W/TCON	0.38	0.64
Total Score	XPER	1.70	0.25
	W/TCON	0.53	3.70

Note. XPER = experimental group; W/TCON = wait-list and treated control groups.

[a]Change is in direction of worsening symptoms.

Examining T1–T2 differences for the Affect Dysregulation, Dissociation, Self-Perception and Meaning domains, and Total Score, the treated XPER group reflected large effect sizes, whereas the W/TCON effect sizes were much more modest or minimal. For the Somatization domain, effect sizes for both groups were very small, and the WCON group had a higher posttest mean than their pretest mean. In the case of the Relationships domain, the W/TCON group had a very large effect size, whereas the XPER group effect size was modest.

Because SIDES scales can be considered ordinal at best, a nonparametric analog procedure (Mann–Whitney) was performed along with the *t* tests for T1/T2 and T2/T3 comparisons for all SIDES variables. The patterns of significance for all nonparametric tests were in parallel agreement with the *t* tests.

Comparison of SIDES Scores to a Treatment Outcome Research Reference Group

The Trauma Center SIDES manual (The Trauma Center, 2003) contains baseline data from a PTSD treatment outcome research sample of 84 community participants with a diverse history of trauma (van der Kolk et al., 2007). This community-based research sample is the closest we found for a "normative" reference group. Comparing total scores for the experimental and wait-list control groups indicated that: (a) for XPER, pretest scores were significantly greater than the norm group, $t(87) = 3.645$, $p = .00$, although posttest and follow-up scores were not significantly different; and (b) for the wait-list control group (WCON, TCON), scores at pretest and posttest were not significantly different from the norm group, although at follow-up TCON scores were significantly less than the norm group, $t(85) = 2.050$, $p = .04$.

DESNOS Diagnosis Using the SIDES

DESNOS diagnosis was determined using the diagnostic scoring method on the SIDES. At T1, six participants met criteria for DESNOS. This number decreased to three at T2, and two at T3 (see Table 6). Diagnostic improvement between T1 and T2 was shown by two treatment group participants and one wait list participant, while the remaining seven participants showed no change in diagnosis. Improvement between T2 and T3 was shown by one delayed treatment participant. Those who showed diagnostic improvement between T1 and T2 continued to maintain that improvement.

Table 6 also shows a general decline in Total-DX scores across time. A repeated measures analysis of variance confirmed that the decrease in Total-DX was significant for the main effect of time, $F(2,14) = 5.91$, $p = .01$ but not differential for group by time, $F(2,14) = .62$, $p = .55$. Post-hoc testing

TABLE 6 DESNOS Diagnoses and Total Severity Scores at T1, T2, and T3

	Pretest (T1)			Posttest (T2)			Follow-up (T3)	
ID #	Criteria	Total-DX	TX	Criteria	Total-DX	TX	Criteria	Total-DX
1	Yes	1.94	✓	No	1.18		No	0.44
2	Yes	1.72	✓	Yes	1.60		Yes	1.22
5	No	1.26	✓	No	0.26		No	0.82
7	Yes	1.68	✓	Yes	1.50		Yes	1.71
8	Yes	2.00	✓	No	1.06		No	0.57
3	Yes	1.69		Yes	1.02	✓	No	0.39
4	No	0.79		No	1.04	✓	No	0.18
6	No	0.25		No	0.17		No data	
9	Yes	1.33		No	0.82	✓	No	0.58
10	No	0.49		No	0.50		No data	

Note. DESNOS = Disorders of Extreme Stress Not Otherwise Specified; DX = diagnostic; TX = sensory integration treatment. Positive for DESNOS diagnosis if criteria are met for all six domains, or for five excluding Somatization (see text).

(Tukey–Kramer Multiple Comparison Test) indicated that the time difference was significant for T1 to T3.

Sensory Integration Variables

The SLP includes assessment of visual and auditory variables before and after treatment. We performed these assessments on XPER and WCON participants at T1 and T2.

Visual variables

Table 7 summarizes the analyses of visual variables. It also reveals that there were significant differences between pre–post change scores for the

TABLE 7 Visual Sensory Integration Scores at T1 and T2

	XPER *M*		WCON *M*		Diff *M*			
Variable	Pre	Post	Pre	Post	XPER	WCON	*t* value	Prob[a]
Somatic R eye	8.00	9.33	11.66	9.00	1.33	−2.66	3.090	.01*
Somatic L eye	8.67	8.67	12.00	10.33	0	−1.67	1.287	.12
Emotional R eye	6.66	9.67	10.33	10.00	3.00	−0.33	2.262	.03*
Emotional L eye	8.00	9.00	12.00	10.67	1.00	−1.33	1.400	.10
Cognitive R eye	7.00	8.67	10.00	9.33	1.67	−0.66	2.062	.04*
Cognitive L eye	7.33	8.33	10.67	10.67	1.00	0	0.651	.27

Note. XPER = experimental group; WCON = wait-list control group.
[a]Probabilities based on directional hypotheses of sensory integration improvement (T2 > T1) with greater improvement in the XPER group than the WCON group.
*$p < .05$.

XPER and WCON groups. The width of right eye visual fields improved significantly for the group treated with SI.

Auditory variables

Analyses using *t* tests of difference scores of auditory variables between XPER and WCON resulted in no statistically significant differences. Given this lack of statistically significant differences, effect size analyses were not performed on these variables.

DISCUSSION

Our primary hypothesis was that SI treatment would accelerate improvement in trauma symptoms in adults who had experienced childhood trauma, were in ongoing psychotherapy, and met (or were close to meeting) criteria for DESNOS. Our findings supported this hypothesis in that several domains of the SIDES revealed symptom improvement in SLP-treated groups that were significantly greater than the untreated groups. Specifically, results of the analyses of SIDES scores indicated improvement following SI treatment in Total Score (T1/T2 and T2/T3), Self-Perception (T1/T2 and T2/T3), Affect/Impulse Regulation (T2/T3), and Alterations in Meaning (T1/T2). Although no direct conclusions can be drawn based on the design of this pilot study, findings regarding DESNOS Total Score improvement are supportive of our working hypothesis that SI treatment might constitute a means of facilitating systemwide reorganization of neural connections adversely impacted by early and chronic trauma exposure.

Limitations to this pilot study are evident. The small sample size presented obstacles in the statistical analyses, both in terms of statistical power and in the types of analyses that could be performed. Although sample size has been a general impediment to the statistical analyses, a small sample aids scrutiny of individual changes. Individual score patterns that are atypical can have a strong effect on outcome variables. It is noteworthy that the two participants who did not complete the follow-up assessment were both in the wait-list control group and produced the two lowest initial total SIDES scores. Neither met DESNOS criteria at either T1 or T2. It is reasonable to speculate that their motivation to complete the final phase of this study based on perceived need to receive the study intervention might have been lower than that of other wait-list control group members.

There was no placebo or alternate treatment group. The SLP treatment requires extensive contact and involvement. Therefore the treated participants were involved in many more treatment sessions than untreated participants. Nonspecific factors such as attention, degree of involvement, and expectancy could have been powerful and were not controlled. An alternative treatment involving some participation demand that is not directly hypothesized to produce SI would have provided a suitable alternative (placebo) treatment.

An additional limitation was the failure to take into consideration the type of therapy being provided by each participant's individual therapist and participants' medication use during the study. Future studies could focus on whether certain types of interventions are more effective when combined with SI than other interventions. Also, in a delayed treatment study, participants are not blind as to whether they are receiving the treatment or not.

A demonstration of specific changes in SI that directly parallel specific expected changes in trauma symptoms would be needed to fully support our hypothesis. Although we did detect differential changes in visual integration, design of this pilot study did not permit examination of a direct causal relationship between these alterations and changes in specific trauma symptoms.

Results from this pilot study should be considered preliminary. Nevertheless, study findings are intriguing, and they suggest the potential application of SI as an adjunctive intervention in the treatment of complex adaptation to traumatic stress. As such, this study demonstrates that further outcome research in the efficacy of this heretofore underrecognized mode of intervention for posttraumatic stress is warranted. Such research should include a larger sample size, suitable placebo or comparison group, and tighter controls (e.g., statistical or design controls for baseline symptoms, extent of ongoing treatments, etc.) to address the previously mentioned concerns and provide a more rigorous test of study hypotheses. Moreover, as previously mentioned, the measures used in this experiment could not directly pinpoint the pathway or nature of the effect of SI on neural connections. Use of PET scans or fMRIs before and after treatment in future studies could provide important information about the effect of SLP on neural connections and structures.

REFERENCES

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

Ayres, A. J. (1998). *Sensory integration and the child*. Los Angeles, CA: Western Psychological Services.

Bérard, G. (1993). *Hearing equals behavior*. New Canaan, CT: Keats.

Bremner, J. D. (2003). Long-term effects of childhood abuse on brain and neurobiology. *Child Adolescent Psychiatry Clinics of North America*, *12*, 271–292.

Bremner, J. D. (2005). Effects of traumatic stress on brain structure and function: Relevance to early responses to trauma. *Journal of Trauma Dissociation*, *6*, 51–68.

Bremner, J. D., Krystal, J. H., Charney, D. S., & Southwick, S. M. (1996). Neural mechanisms in dissociative amnesia for childhood abuse: Relevance to the current controversy surrounding "false memory syndrome." *American Journal of Psychiatry*, *153*(7), 71–82.

Bremner, J. D., Vythilingam, M., Vermetten, E., Southwick, S. M., McGlashan, T., Nazeer, A., et al. (2003). MRI and PET study of deficits in hippocampal structure and function in women with childhood sexual abuse and posttraumatic stress disorder. *American Journal of Psychiatry*, *160*, 924–932.

Castro, A. J., Merchut, M. P., Neafsey, E. J., & Wurster, R. D. (2002). *Neuroscience: An outline approach*. St. Louis, MO: Mosby.

Cloitre, M., Koenen, K. C., Cohen, L. R., & Han, H. (2002). Skills training in affective and interpersonal regulation followed by exposure: A phase-based treatment for PTSD related to childhood abuse. *Journal of Consulting & Clinical Psychology*, *70*, 1067–1074.

Ford, J. (1999). Disorders of extreme stress following war-zone military trauma: Associated features of posttraumatic stress disorder or comorbid but distinct syndromes. *Journal of Consulting and Clinical Psychology*, *67*(1), 3–12.

Gravetter, F. J., & Wallnau, L. B. (2007). *Statistics for the behavioral sciences* (7th ed.). Belmont, CA: Thompson.

Greenspan, S. I., & Porges, S. W. (1984). Psychopathology in infancy and early childhood: Clinical perspectives on the organization of sensory and affective-thematic experience. *Child Development*, *55*, 49–70.

Heim, C., Newport, D. J., Heit, S., Graham, Y. P., Wilcox, M., Bonsall, R., et al. (2000). Pituitary-adrenal and autonomic responses to stress in women after sexual and physical abuse in childhood. *Journal of the American Medical Association*, *284*(5), 592–597.

Heim, C., Newport, J., Wagner, D., Wilcox, M., Miller, A., & Nemeroff, C. B. (2002). The role of early adverse experience and adulthood stress in the prediction of neuroendocrine stress reactivity in women: A multiple regression analysis. *Depression and Anxiety*, *15*, 117–125.

Herman, J. (1992). Complex PTSD: A syndrome in survivors of prolonged and repeated trauma. *Journal of Traumatic Stress*, *5*, 377–391. doi:10.1002/jts.2490050305

Hoehn, T. P., & Baumeister, A. A. (1994). A critique of the application of sensory integration therapy to children with learning disabilities. *Journal of Learning Disabilities*, *27*(6), 338–350.

Iverson, S., Kupfermann, I., & Kandel, E. R. (2000). Emotional states and feelings. In E. R. Kandel, J. H. Schwartz, & T. M. Jessell (Eds.), *Principles of neural science* (4th ed., pp. 982–997). New York, NY: McGraw-Hill.

Kandel, E. R. (2000). Cellular mechanisms of learning and the biological basis of individuality. In E. R. Kandel, J. H. Schwartz, & T. M. Jessell (Eds.), *Principles of neural science* (4th ed., pp. 1247–1279). New York, NY: McGraw-Hill.

LeDoux, J. E. (1998). *The emotional brain: The mysterious underpinnings of emotion*. New York, NY: Simon & Schuster.

Liberman, J. (1986). The effect of syntonic (colored light) stimulation on certain visual and cognitive functions. *Journal of Optometric Vision Development*, *17*, 4–15.

Luxenberg, T., Spinazzola, J., & van der Kolk, B. (2001). Complex trauma and disorders of extreme stress (DESNOS) diagnosis, part one: Assessment. *Directions in Psychiatry*, *21*, 373–387.

McLean, L. M., & Gallop, R. (2003). Implications of childhood sexual abuse for adult borderline personality disorder and complex posttraumatic stress disorder. *American Journal of Psychiatry*, *160*(2), 369–371. doi:10.1176/appi.ajp.160.2.369

Meares, R., Stevenson, J., & Gordon, E. (1999). A Jacksonian and biopsychosocial hypothesis concerning borderline and related phenomena. *Australian and New Zealand Journal of Psychiatry*, *33*, 831–840. doi:10.1046/j.1440–1614.1999.00637.x

Mesulam, M. M. (1998). From sensation to cognition. *Brain*, *121*, 1013–1052.

Moro, C. D. (2007). A comprehensive literature review defining self-mutilation and occupational therapy intervention approaches: Dialectical behavior therapy and sensory integration. *Occupational Therapy in Mental Health*, *23*(1), 55–67.

Nemeroff, C. B. (2004). Neurobiological consequences of childhood trauma. *Journal of Clinical Psychiatry*, *65*(Suppl. 1), 18–28.

Parham, L. D., Cohen, E. S., Spitzer, S., Koomar, J. A., Miller, L. J., Burke, J. P., et al. (2007). Fidelity in sensory integration intervention research. *American Journal of Occupational Therapy*, *61*(2), 216–227.

Pelcovitz, D., van der Kolk, B. A., Roth, S., Mandel, F., Kaplan, S., & Resick, P. (1997). Development of a criteria set and a structured interview for disorders of extreme stress (SIDES). *Journal of Traumatic Stress*, *10*(1), 3–16. doi:10.1002/jts.2490100103

Perry, B. D., Pollard, R. A., Blakley, T. L., Baker, W. L., & Vigilante, D. (1995). Childhood trauma, the neurobiology of adaptation, and "use-dependent" development of the brain: How "states" become "traits." *Infant Mental Health Journal*, *16*, 271–291.

Porges, S. W. (2003). The polyvagal theory: Phylogenetic contributions to social behavior. *Physiology and Behavior, 79*(3), 503–513. doi:10.1016/S0031–9384(03)00156–2

Pynoos, R. S., Steinberg, A. M., & Goenjian, A. (1996). Traumatic stress in childhood and adolescence: Recent developments and current controversies. In B. A. van der Kolk, A. C. McFarlane, & L. Weisaeth (Eds.), *Traumatic stress: The effects of overwhelming experience on mind, body, and society* (pp. 331–358). New York, NY: Guilford.

Rantanen, E. M. (2003). Measurement of the visual field. *Perceptual and Motor Skills*, *96*(1), 92–95. doi:10.2466/PMS.96.1.92–94

Rauch, S. L., van der Kolk, B. A., Fisler, R. E., Alpert, N. M., Orr, S. P., Savage, C. R., et al. (1996). A symptom provocation study of posttraumatic stress disorder using positron emission tomography and script-driven imagery. *Archives of General Psychiatry*, *53*, 380–387.

Rimland, B., & Edelson, S. M. (1994). The effects of auditory integration training on autism. *American Journal of Speech-Language Pathology*, *3*, 16–24.

Schaaf, R. C., & Anzalone, M. E. (2001). Sensory integration with high-risk infants and young children. In S. S. Roley, E. I. Blanche, & R. C. Schaaf (Eds.), *Understanding the nature of sensory integration with diverse populations* (pp. 275–311). San Antonio, TX: Therapy Skill Builders.

Schore, A. N. (2003). *Affect dysregulation and disorders of the self*. New York, NY: Norton.

Sensory Learning Center International. (2004). *Sensory learning program provider training workbook*. Boulder, CO: Author.

Siegel, D. J. (2001). Toward an interpersonal neurobiology of the developing mind: Attachment relationships, "mindsight," and neural integration. *Infant Mental Health Journal*, *22*(1–2), 67–94. doi:10.1002/1097–0355 (200101)22:1<67:AID-IMHJ3>3.0.CO;2-G

Spitler, H. R. (1941). *The syntonic principle*. Eaton, OH: College of Syntonic Optometry.

Spitzer, C., Chevalier, C., Gillner, M., Freyberger, H. J., & Barnow, S. (2006). Complex posttraumatic stress disorder and child maltreatment in forensic inpatients. *The Journal of Forensic Psychiatry & Psychology*, *17*(2), 204–216. doi:10.1080/14789940500497743

Spitzer, S., & Roley, S. S. (2001). Sensory integration revisited: A philosophy of practice. In S. S. Roley, E. I. Blanche, & R. C. Schaaf (Eds.), *Understanding the nature of sensory integration with diverse populations* (pp. 3–42). San Antonio, TX: Therapy Skill Builders.

Teicher, M. H. (2002). Scars that won't heal: The neurobiology of child abuse. *Scientific American*, *286*(3), 68–75.

Toates, F. (1998). The interaction of cognitive and stimulus–response processes in the control of behavior. *Neuroscience and Biobehavioral Reviews*, *22*, 59–83.

Tomatis, A. A. (1991). *The conscious ear*. Barrytown, NY: Station Hill Press.

The Trauma Center. (2003). *Trauma center assessment package*. Brookline, MA: Author.

Trevarthen, C. (1993). The self born in intersubjectivity: The psychology of an infant communicating. In U. Neisser (Ed.), *The perceived self: Ecological and interpersonal sources of self-knowledge* (pp. 121–173). New York, NY: Cambridge University Press.

Uttal, W. R. (1973). *The psychobiology of sensory coding*. New York, NY: Harper & Row.

van der Kolk, B. A. (1996a). The body keeps the score: Approaches to the psychobiology of posttraumatic stress disorder. In B. A. van der Kolk, A. C. McFarlane, & L. Weisaeth (Eds.), *Traumatic stress: The effects of overwhelming experience on mind, body, and society* (pp. 214–241). New York, NY: Guilford.

van der Kolk, B. A. (1996b). The complexity of adaptation to trauma: Self-regulation, stimulus discrimination, and characterological development. In B. A. van der Kolk, A. C. McFarlane, & L. Weisaeth (Eds.), *Traumatic stress: The effects of overwhelming experience on mind, body, and society* (pp. 182–213). New York, NY: Guilford.

van der Kolk, B. A. (2002). Posttraumatic therapy in the age of neuroscience. *Psychoanalytic Dialogues*, *12*(3), 381–392. doi:10.1080/10481881209348674

van der Kolk, B. A., & Fisler, R. E. (1994). Childhood abuse and neglect and loss of self-regulation. *Bulletin of the Menninger Clinic*, *58*(2), 145–168.

van der Kolk, B. A., Pelcovitz, D., Roth, S., Mandel, F. S., McFarlane, A., & Herman, J. (1996). Dissociation, affect dysregulation and somatization. *American Journal of Psychiatry*, *153*(Suppl. 7), 83–93.

van der Kolk, B. A., Spinazzola, J., Blaustein, M. E., Hopper, J. W., Hopper, E. K., Korn, D. L., et al. (2007). A randomized clinical trial of eye movement desensitization and reprocessing (EMDR), Fluoxetine, and pill placebo in the treatment of posttraumatic stress disorder: Treatment effects and long-term maintenance. *Journal of Clinical Psychiatry*, *68*, 1–10.

Vargas, S., & Camilli, G. (1998). A meta-analysis of research on sensory integration treatment. *The American Journal of Occupational Therapy*, *53*(2), 189–198.

Winnicott, D. W. (1971). *Playing and reality*. New York, NY: Tavistock.

Zlotnick, C., & Pearlstein, T. (1997). Validation of the structured interview for disorders of extreme stress. *Comprehensive Psychiatry*, *38*(4), 243–247. doi:10.1016/S0010–440X(97)90033–X

Zlotnick, C., Warshaw, M., Shea, M. T., Allsworth, J., Pearlstein, T., & Keller, M. B. (1999). Chronicity in posttraumatic stress disorder (PTSD) and predictors of course of comorbid PTSD in patients with anxiety disorders. *Journal of Traumatic Stress*, *12*, 89–100. doi:10.1023/A:1024746316245

Zlotnick, C., Zakriski, A. L., Shea, M. T., Costello, E., Begin, A., Pearlstein, T., et al. (1996). The long-term sequelae of sexual abuse: Support for a complex posttraumatic stress disorder. *Journal of Traumatic Stress*, *9*(2), 195–205. doi:10.1002/jts.2490090204