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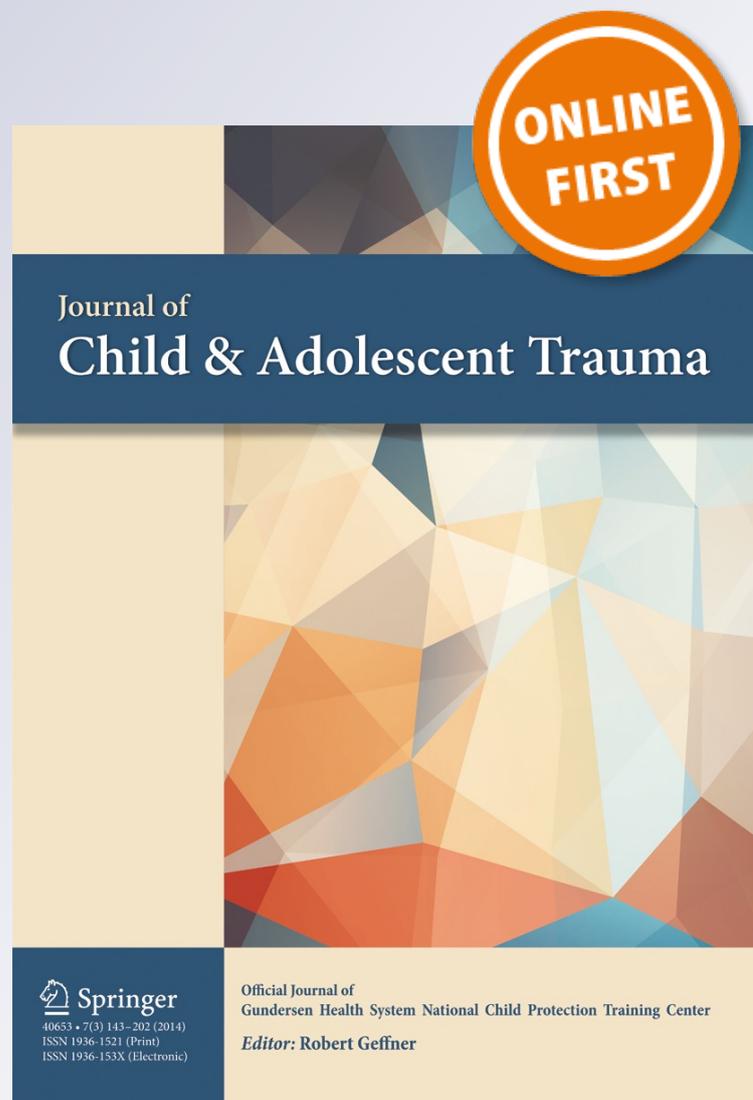
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The Body Can Change the Score: Empirical Support for Somatic Regulation in the Treatment of Traumatized Adolescents

Elizabeth Warner · Joseph Spinazzola · Anne Westcott · Cecile Gunn · Hilary Hodgdon

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Abstract Traumatized adolescents have pervasive problems with self-regulation and often have difficulties in language-based treatment models. This paper provides preliminary empirical support for the efficacy of Sensory Motor Arousal Regulation Treatment (SMART), a treatment model which targets somatic regulation as an avenue to behavioral and emotional regulation. A case vignette illustrates the intervention model. Outcomes are presented from a quasi-experimental pilot study employing a matched control design comparing the additive benefit of SMART intervention to treatment as usual (TAU) in two adolescent residential treatment sites, with a polyvictimized sample. There were significant reductions in domains targeted by SMART: Internalizing symptoms on the Child Behavior Checklist (CBCL), and the Somatic Complaints and Anxious/Depressed subscales. In secondary analyses, a trend approaching significance was found on the Overarousal subscale of the Posttraumatic Stress Disorder-Reaction Index (PTSD-RI). This pilot study suggests the contribution somatic regulation can make to stabilization and skills building in complex trauma treatment for adolescents.

Keywords Adolescents · Complex trauma · Self-regulation · Sensory integration · Somatic regulation

In the last decade, there has been a lively growth of treatment approaches designed specifically for traumatized children and adolescents. The National Child Traumatic Stress Network (NCTSN), a major force in supporting treatment development

for this vulnerable population, now lists over 40 “evidence based and promising practices” (<http://www.nctsn.org/resources/topics/treatments-that-work/promising-practices>). However, deficits in self-regulation continue to represent an area of significant clinical challenge among trauma impacted youth. The extant literature suggests that further development of non-pharmacological regulation treatments is warranted. Our results provide preliminary empirical support for a somatic regulation therapy, Sensory Motor Arousal Regulation Treatment (SMART) that targets self-regulation.

The majority of child trauma treatment outcome studies and, in particular, nearly all randomized controlled trials conducted to date, have investigated treatment of symptoms of Posttraumatic Stress Disorder (PTSD) with Cognitive Behavioral Therapies (CBT) (Silverman et al. 2008; NIMH Science Update 2008). Such research demonstrates the efficacy of CBT in reducing PTSD symptoms (Cohen and Mannarino 2010; Donnelly and Amaya-Jackson 2002; Dorsey et al. 2011). Brain imaging studies lend additional support, showing neural effects of cognitive strategies. For example, interventions utilizing reappraisal result in decreased activation of the amygdala, the site of negative emotional valuation, as well as increased activation in prefrontal cortex, the site of executive control processes (Hartley and Phelps 2010). While these studies provide evidence supporting the efficacy of cognitive approaches, there is also empirical evidence that during times of stress or dysregulation, individuals are less likely to benefit from cognitive approaches to regulation (Raio et al. 2013; Van der Kolk and Fisler 1994).

Recent research indicates that youth in residential treatment settings are best understood by a framework that accounts for the complexity of their traumatic exposure (Briggs et al. 2012; Zelechowski et al. 2013) and the consequent breadth of impact on functional and developmental domains (Cook et al. 2003, 2005; D’Andrea et al. 2012). The expanding corpus of neuroscientific findings generated by Teicher and colleagues (for

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example, 1993, 2002, 2004) and DeBellis (1999a, b, 2002) has established the manifold effects of severe or chronic trauma exposure on the developing brain and subsequent neuropsychological functioning (DeBellis et al. 2009; Spann et al. 2012). Given this strong evidence of the multidimensional effects of chronic childhood trauma, a reliance solely upon the PTSD diagnosis as an adequate explanatory model of posttraumatic functioning in such cases are misguided and outdated (Van der Kolk 2005).

The equivocal findings on the effectiveness of residential treatment for youth suggest that further parsing out of etiology, diagnosis, and treatment focus and approach is warranted (Boyer et al. 2009; Briggs et al. 2012). Findings from the Adverse Childhood Experiences (ACE) studies demonstrate a graded relationship between number of adverse childhood experiences and significant adult physical health and mental health problems (Anda et al. 2006; Felitti and Anda 2010). This finding is echoed in recent studies of youth in residential treatment in which the number of types of traumas were positively correlated with breadth and depth of symptomatology, functional impairment (Briggs et al. 2012), and treatment response (Boyer et al. 2009).

Dimensions of Effective Treatment for Complex Trauma: Regulation and Somatic Approaches

The latest published adult treatment guidelines for complex PTSD, published by the International Society for Traumatic Stress Studies (ISTSS; Cloitre et al. 2012) recommend a phase-oriented approach to treatment and specifically emphasize the need to address problems with self-regulation as an immediate goal in the first phase of the treatment (Cloitre et al. 2012). This is consistent with expert recommendations for treatment of children and youth (Ford and Cloitre 2009) which recognize disruptions in affect modulation and impulse control, both components of self-regulation, as central problems when there have been chronic and multiple stressors affecting the child and the caregiving system. Again, neuroscientific findings (Dale et al. 2009; Frewen and Lanius 2006; Schore 2003; Teicher et al. 1993) support the premise that self-regulation is a central area of deficit for this population.

Several promising, evidence-based interventions designed to treat children and adolescents with complex trauma have emerged in the past decade (Dorsey et al. 2011; Knoverek et al. 2013; Zelechowski et al. 2013). Some of these models highlight targeting self-regulation capacity as an essential therapeutic component. For example, Trauma Affect Regulation-Guide for Education and Therapy (TARGET) was designed to improve the capacity for emotion regulation of complexly traumatized youth in the juvenile justice system (Ford et al. 2012; Ford and Hawke 2012). Structured Psychotherapy for Adolescents Responding to Chronic Stress (SPARCS) (DeRosa and Pelcovitz 2006; Habib et al. 2013)

is a group intervention for adolescents with complex trauma, which has a strong focus on emotion regulation. Attachment Regulation and Competency (ARC) (Arvidson et al. 2011; Blaustein and Kinniburgh 2010; Hodgdon et al. 2013) is a comprehensive treatment framework that identifies both caregiver and child regulation as central foci of treatment.

A potentially integral, but understudied and underutilized, approach to building self-regulatory capacity is building interoceptive awareness of, attunement to, and skills for shifting physiological arousal. The adult guidelines for treatment of complex trauma state, “emotion regulation strategies, particularly those focused on *somatic experience*, facilitate PTSD reduction...” (Cloitre et al. 2012, p. 7). Interestingly, however, these guidelines do not identify somatic approaches to therapy as a recommended first or second line ingredient of treatment. This gap is likely the byproduct of both a dearth of treatment outcome research on somatic interventions as well as the failure of intervention developers to manualize their approaches. Similarly, while current understanding of child complex trauma presentations (D’Andrea et al. 2012; Ford et al. 2013; Kisiel et al. 2014) highlights somatic dysregulation as a major area of difficulty, potential utility of somatically-based approaches has been under-addressed in the emerging models of treatment for child complex trauma and has yet to be subjected to empirical investigation.

Given the impact of trauma on the brain and nervous system (Van der Kolk 1994), somatic approaches to treatment may be of potential benefit to traumatized people (Van der Kolk 2014). In particular, intervention approaches that incorporate somatic forms of regulation may benefit traumatized children and adolescents for whom somatic, affect, and behavioral dysregulation are prominent and for whom language-based approaches are difficult to implement. While the empirical literature is scant in addressing somatically-based interventions for children, there are some intriguing applications in current use.

Current Somatic Approaches

A somatic intervention for children and adolescents does not depend on verbal expression by the client, uses some form of movement-based activity, and may build interoceptive awareness, as components, or tools for improved self-regulation. A number of somatic and non-linguistically dependent interventions demonstrate some degree of effectiveness. While the operationalization of and evidence base for these approaches may be considered insufficient for wide dissemination, they do suggest routes forward. Psychodynamic play therapies with young children have always recognized developmentally-based linguistic limitations and relied on symbolic play as an avenue to improved functioning (Freud 1968; Gil 1991). Foa and colleagues, in writing the ISTSS guidelines for treatment of adults with PTSD (2009),

recognized the potential unique contribution of non-verbal routes through the creative arts therapies, although the empirical basis for such interventions remains marginal.

In addition to play- and art-based approaches, dance and movement therapists more directly utilize movement of the body identifying rhythm, ritual, and a communal, or group, context, as an avenue toward greater regulation and integration (Goodill 1987; Goodman et al. 2009; Harris 2007; Kornblum and Halsten 2006; Truppi 2001). There is empirical support for positive effects of both sports (D'Andrea et al. 2013) and exercise (Ratey 2008) on mood.

Trauma-Sensitive Yoga (TSY; Emerson and Hopper 2011; Emerson et al. 2009) is an example of a somatically-based, non-verbal approach to self-regulation that has been found in a recent randomized controlled trial to reduce PTSD and related symptoms in adults with chronic, treatment-resistant PTSD and related conditions (Van der Kolk et al. 2014). TSY is currently being utilized with adolescents in residential treatment, and initial clinical reports have been promising (Spinazzola et al. 2011). It is hypothesized that TSY, a practice that intentionally and fully engages the body, constitutes a bona fide somatic regulation intervention for use with trauma populations through systematic engagement of multiple sensory motor inputs.

Finally, and most importantly to the development of SMART, the branch of occupational therapy known as Sensory Integration (SI-OT) has demonstrated the modulating impact of sensory motor input, generated through movement, on the arousal system (Ayres 1972, 2004; Koomar and Bundy 2002; Miller and Summers 2001). A study of traumatized adults examining a protocolized version of vestibular, visual, and auditory inputs (Kaiser et al. 2010) demonstrated a positive impact on affective and behavioral regulation as measured with the Structured Interview for Disorders of Extreme Stress (SIDES). However, children and youth often gravitate to movement utilizing the whole body, for example, in sports, dance, and playground play. Preliminary clinical experience with intentionally permitting this kind of gross motor activity—which entails sensory motor inputs from the vestibular, proprioceptive, and tactile systems, as opposed to the visual, auditory, and olfactory/gustatory senses—for traumatized children and youth in a mental health treatment setting has shown the modulating effect of active and therapeutically supported sensory motor play and movement on the arousal of children and adolescents (Warner et al. 2013).

A Somatic Regulation Treatment: Sensory Motor Arousal Regulation Treatment (SMART)

The SMART model was developed over the last 5 years for traumatized children and adolescents receiving primarily talk and symbolically-based therapies at our trauma specialty

outpatient clinic, affiliate clinics, school-based programs, and residential treatment centers. The design was informed by the extant literature on child complex trauma that indicates developmental disruptions in self-regulatory capacity as a predominant area of difficulty (Spinazzola et al. 2005) requiring clinical attention in combination with the initial evidence supporting the utility of somatically-based approaches for building such capacity. On the basis of this literature, we engaged in meticulous clinical observation—centered around extensive video recording and review of treatment sessions in the context of an ongoing child trauma intervention study group—of the effects of formally and systematically integrating somatic components into our center's overall trauma-focused psychotherapy program. In addition to consistent observations of improved regulatory capacity, we frequently were confronted with an unanticipated observation, visible on videotape, of more rapid and coherent trauma processing which was emergent when the child was in a more regulated state seemingly ensuing from their involvement in somatically-based intervention. Thus, the evolution of the SMART methodology progressed through a synthesis of the extant clinical literature and our continued clinical observation to address the first two phases identified in the treatment of complex trauma: stabilization/skill-building and traumatic narrative or memory processing (Cloitre et al. 2012). As such, we endeavored to develop the SMART model in line with prevailing definitions of evidence-based practices, as articulated by Kendall and Beidas (2007); specifically, around “research support for the *ingredients* of the treatment” (p. 13).

Case Illustration of SMART Intervention Model Implementation The following identity-masked clinical vignette of SMART treatment was chosen for illustrative purposes on the basis of observed reductions in somatic complaints and symptoms of posttraumatic stress. Sam was a 13-year-old boy who came to the residential treatment center after placement in both kinship and foster homes, a hospital stay, and placement in a sexual offender program. Department of Children and Families removed him from his family after it was discovered that he had sexually molested younger sisters. Later, he revealed that an older brother had forcibly sexually assaulted him in his early latency years. Parents had abused substances, neglected supervision, and Sam had witnessed domestic violence.

At the residential treatment center, Sam talked compulsively about what had happened to him and what he had done to his sister. He felt very badly about himself and had self-injured and expressed suicidal ideation. When Sam talked, he became agitated, anxious, and less functional. Gently noticing with him how his legs began to shake and his breathing quickened, the therapist began to teach Sam how his pressure to talk did not immediately make him feel better, but in fact, the opposite. Slowing him down, the therapist explored with him what would feel more regulating. Working together, they found that

when he jumped on the mini-trampoline, or intensely bounced a basketball his energy and agitation gradually subsided. The therapist also learned that Sam liked basketball, skateboarding, and swimming, sports that gave him similar sensory motor inputs. Eventually, they discovered that deep pressure via weighted blankets and large foam-filled pillows placed on top could calm him. When Sam had urges to hurt himself, he learned “this was his body’s way of telling him” he needed to slow down and use ways to self-regulate before and while he was talking about the difficult problems in his life. Over the course of 9 months of SMART treatment, his Total score and subscale scores on the Anxious/Depressed, Withdrawn/Depressed, and Somatic Concerns subscales of the Child Behavior Checklist (CBCL) all dropped below the Clinical Range, as did his Total score on the Posttraumatic Stress Disorder-Reaction Index (PTSD-RI), dropping from 40 to 29, as his symptoms of re-experiencing and avoidance diminished.

Method

The present study is the first empirical examination of the effectiveness of SMART with adolescents with histories of complex trauma in residential care. The quasi-experimental study employed a matched control design comparing once weekly SMART intervention versus treatment as usual (TAU). We hypothesized that adolescents receiving SMART intervention would exhibit greater reduction in somatic symptoms, behavior problems, and symptoms of posttraumatic stress as compared to matched controls receiving routine treatment.

Data for this study were derived from secondary analysis of de-identified archival data routinely collected for quality improvement and clinical outcome tracking across two residential treatment centers of a large child service agency with programs located across the Northeastern United States. All Institutional Review Board and human subjects consent procedures of the host agency were followed. The two participating residential facilities both served trauma-exposed youth aged 12 to 22 years exhibiting severe emotional and behavioral problems. The two groups, SMART ($n=10$) and TAU ($n=21$), were matched on age, ethnicity, number of types of trauma exposure, and baseline severity of clinical symptoms. Study evaluation time points consisted of baseline/pre-treatment assessment and end of treatment assessment. Average length of time between pre- and post-assessment was 9 months, with a range of 6 to 12 months.

Sample Characteristics

Participants ranged in age from 13 to 20 years old ($M=16$) and 90 % were female. Racial composition of the total sample included 55 % Caucasian, 20 % Hispanic/Latino, 16 %

African American, and 7 % Biracial. Of the total sample, 61 % were diagnosed with PTSD by their clinician and 55 % of the subjects met the cut-off for PTSD diagnosis on the PTSD-RI (Steinberg et al. 2013). Participants had a high rate of co-morbid diagnoses: 48 % had three or more diagnoses and 42 % had two diagnoses, while only 10 % had just one diagnosis. The most frequently reported types of trauma were emotional abuse (77 %), neglect (74 %), impaired caregiving (73 %), physical abuse (70 %), and sexual abuse (55 %). The average number of trauma exposure types on the Trauma History Profile was 6.5 (range 1–12), indicating that this was a polyvictimized sample. Further, 74 % of the sample had involvement with child welfare and 61 % with foster care over their lifetimes.

Intervention

The SMART model was co-developed by trauma-focused child psychotherapists in collaboration with occupational therapists and experts on application of sensory motor approaches in clinical intervention. SMART embeds sensory integration and sensory motor strategies within a comprehensive complex trauma framework, and was intentionally designed for utilization by mental health practitioners in their routine psychotherapy practice. Specific elements and techniques of Sensorimotor Psychotherapy (SP) (Ogden et al. 2006) were incorporated into the SMART model with permission and licensing from the SP model developers. In the present study, a SMART intervention room was created in line with suggested parameters described in the SMART manual (Warner et al. 2011) and in consultation with staff regarding necessary site-specific adaptations. In addition to athletic floor mats and removal of office furniture, this room was supplied with sensory motor and sensory integration equipment recommended in the SMART intervention manual, such as large fitness balls, weighted blankets, a mini-trampoline, large crash pillows, and a balance beam. The clinical director and the SMART model developers adapted the therapeutic space for an adolescent residential population in order to optimize application of sensory regulation techniques while maintaining emphasis on physical safety of participants. A videotaping system was installed and appropriate consents were obtained in order for therapists to tape sessions for training, supervision, and ongoing consultation. Selection of adolescents for therapy in the SMART context was left to therapists’ perception of clinical need in discussion with their site supervisor. Therapists reported choosing clients who had difficulty talking in therapy sessions and who had chronic problems with affect and behavioral dysregulation evident in daily life.

Adolescents seen in the SMART room were encouraged to explore and experiment with the equipment and space in the room, as they felt comfortable. This invitational approach was found most effective in the evidence-based TSY model used

Table 1 Changes in mental health symptoms from pre- to post-treatment by group assignment and demographics

	CBCL Internalizing <i>M</i> , (<i>SD</i>)		CBCL Externalizing <i>M</i> , (<i>SD</i>)		PTSD Overall <i>M</i> , (<i>SD</i>)	
	Pre	Post	Pre	Post	Pre	Post
Group (<i>n</i>)						
SMART (10)	64.90 (4.98)	58.70 (6.46)*	65.30 (4.08)	63.30 (3.83)	36.60 (11.11)	29.83 (11.41)
TAU (21)	61.62 (7.68)	63.71 (6.08)	62.52 (7.21)	59.81 (8.93)	29.61 (13.45)	29.70 (11.62)
Gender (<i>n</i>)						
Female (28)	62.82 (7.15)	62.64 (6.18)	63.43 (6.69)	60.96 (8.10)	31.67 (13.56)	30.15 (11.75)
Male (3)	61.33 (6.66)	57.00 (9.17)	63.33 (4.16)	60.67 (4.16)	33.67 (6.51)	26.00 (7.00)
Race (<i>n</i>)						
Black/Afr-Am (5)	62.60 (9.86)	68.20 (3.03)	68.80 (5.72)	66.20 (3.90)	31.40 (10.16)	36.20 (8.41)
White/Cauc (17)	61.71 (6.44)	60.18 (6.10)	62.59 (6.26)	60.76 (8.02)	30.51 (15.31)	27.83 (13.25)
Hispanic (6)	67.17 (3.87)	64.33 (7.76)	60.83 (6.82)	57.00 (9.72)	39.53 (7.73)	29.50 (9.42)
Asian (1)	56.00 (0)	63.00 (0)	63.00 (0)	64.00 (0)	25.00 (0)	24.00 (0)
Bi-racial (2)	61.00 (12.73)	56.00 (0)	65.00 (7.07)	59.50 (.71)	25.00 (8.49)	33.50 (2.12)

CBCL Child Behavior Checklist; PTSD Posttraumatic Stress Disorder; SMART Sensory Motor Arousal Regulation Treatment; TAU Treatment as usual; Afr-Am African-American; Cauc Caucasian

* $p < .05$

with comparable complex trauma clients in our adolescent residential facilities (Spinazzola et al. 2011). Therapists were trained to track the type of body movement and sensory motor input sought out by the client (Warner et al. 2011) and to 'make contact' (Ogden et al. 2006) with the immediate somatic experience in a way that assisted the client to become aware of how to self- (or co-) regulate. Over the course of initial sessions, with the help of videotape review, it was possible to identify both self-regulating sensory motor input and how the teen did or did not use the co-regulation of the therapist. Treatment duration was determined on a clinical basis by site clinicians and supervisors in a fashion consistent with the site's clinical practice.

The TAU condition consisted of weekly, supportive individual psychotherapy in a traditional, office based talk therapy format. This was administered in the context of milieu approaches routinely administered to youth enrolled in the residential treatment facilities run by the Justice Resource Institute (JRI), the umbrella agency.

Measures

Trauma History The Trauma History Profile (THP; Pynoos et al. 2014) was derived from the Trauma History component of the UCLA PTSD-RI (Steinberg et al. 2013). Information is obtained at baseline and updated as needed from multiple informants, including the child, parents/caregivers, and other relatives about 20 different types of trauma exposure, including traumatic loss, bereavement, and separation.

The Child Behavior Check List (CBCL; Achenbach 1991; Achenbach and Rescorla 2001) is a caregiver report assessing

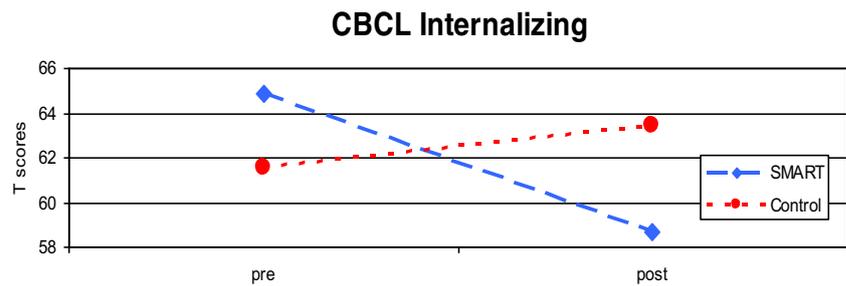
behavioral and emotional problems in children ranging in age from 6 to 18 years. The CBCL is a well-validated and widely used instrument (Ivanova et al. 2007) to measure maladaptive behavior in children. The two main summary scores – Internalizing and Externalizing – refer to two distinct ways children appear to express their distress, either internalizing their problems or acting out (externalizing) behaviorally. The Internalizing summary score consists of three subscales: Withdrawn Depressed, Anxious Depressed, and Somatic Complaints.

The Posttraumatic Stress Disorder Reaction-Index (PTSD-RI; Steinberg et al. 2013) is a 22 question, self-report scale that assesses symptoms of posttraumatic stress in youth. The PTSD-RI is a commonly used test to help diagnose, treat, and monitor PTSD levels in youth (Murray et al. 2011), yielding an Overall Severity score, which at certain levels corresponds to a PTSD diagnosis depending on the population being examined (clinical cut off for single incident trauma victims is 38 and for chronically traumatized children is 31). The three subscales correspond to the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR), PTSD symptom clusters of Re-experiencing, Avoidance, and Overarousal.

Results

Primary study analyses consisted of Repeated Measures ANOVA on the Internalizing and Externalizing Summary Scales of the CBCL and the Overall scale of the PTSD-RI.

Fig. 1 Pre- and Post-treatment T scores for SMART and Control (TAU) Groups on *CBCL Internalizing Scale*. Note. SMART Sensory Motor Arousal Regulation Treatment; TAU Treatment as Usual; *CBCL* Child Behavior Checklist



Control for multiple comparisons was undertaken using the False Discovery Rate (Benjamini and Hochberg 1995). Secondary and exploratory analyses of measure subscales were planned pending significant findings from primary analyses.

All study results are presented in Table 1. A Repeated-measure ANOVA on the *CBCL Internalizing scale* demonstrated significant reduction in symptoms from pre- to post-treatment ($F=7.286$; $p=.011$) in the SMART group (Fig. 1). Although there were reductions on the Externalizing scale of the *CBCL* and the Overall scale of the *PTSD-RI*, for both the TAU and Treatment group, there were not significant group differences on these scales. Secondary analyses of the three subscales of the *CBCL Internalizing scale* demonstrated that Somatic Complaints ($F=6.523$; $p=.016$; Fig. 2) and Anxious/Depressed ($F=5.55$; $p=.025$; Fig. 3) subscales exhibited significant reductions from pre- to post-treatment in the SMART Group.

Exploratory analyses were conducted on the *PTSD-RI Criterion subscales* (Re-experiencing, Avoidance, Overarousal) to determine if any underlying significance might be present even though the overall score was not significant. A trend approaching significance was observed in the *PTSD-RI Overarousal subscale* ($p=.06$) in the SMART group compared to TAU. Although there were greater reductions on the *PTSD-RI Re-experiencing subscale* in the SMART group compared to the TAU group, the change in scores across the groups was not statistically significant. Both the TAU and SMART groups reported lower *PTSD-RI Avoidance scores* at post-treatment, but neither within group nor across group changes in scores reached significance.

Discussion

While the number of treatment models for child complex trauma has proliferated over the last decade, there remains a need for continued exploration of alternative approaches, given the complex needs of traumatized youth in residential treatment. This pilot, quasi-experimental outcome study provides preliminary support for the potential effectiveness of the SMART intervention model in reducing internalizing symptoms associated with complex trauma in youth. Study results suggest the particular utility of SMART in addressing somatic problems and symptoms of anxious and depressed mood in this vulnerable subpopulation of child trauma survivors, as well as the potential to contribute to the amelioration of hyperarousal symptoms associated with PTSD in these youth. These findings are consistent with the model's underlying theory of change and intentional focus on somatic regulation and the cardinal problem of overarousal for both PTSD and complex trauma. While definitive statements regarding the efficacy of SMART await more rigorous controlled outcome research with a larger sample size, results from this pilot study are encouraging and support further investigation into the benefits of SMART and other somatic regulation-based interventions in use with traumatized children and adolescents, particularly as a component of the stabilization and skills-building phase of complex trauma intervention. Furthermore, the lack of change in the TAU group, while not an uncommon finding in evaluation of residential treatment effectiveness (Boyer et al. 2009), is cause for concern; it is also an opportunity to determine whether implementation of trauma-informed programming can alter this trajectory.

Fig. 2 Pre- and Post-treatment T scores for SMART and Control (TAU) Groups on *CBCL Somatic Complaints Syndrome Scale*. Note. SMART Sensory Motor Arousal Regulation Treatment; TAU Treatment as Usual; *CBCL* Child Behavior Checklist

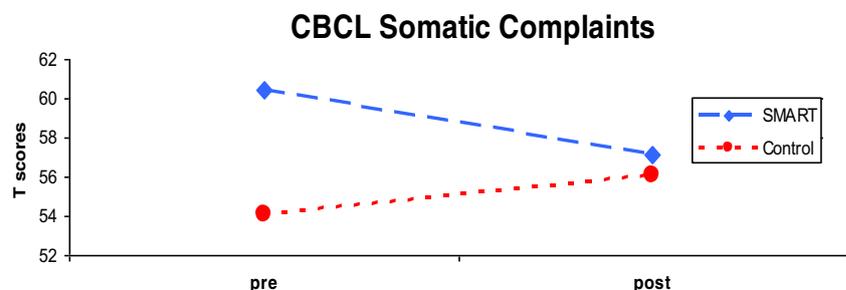
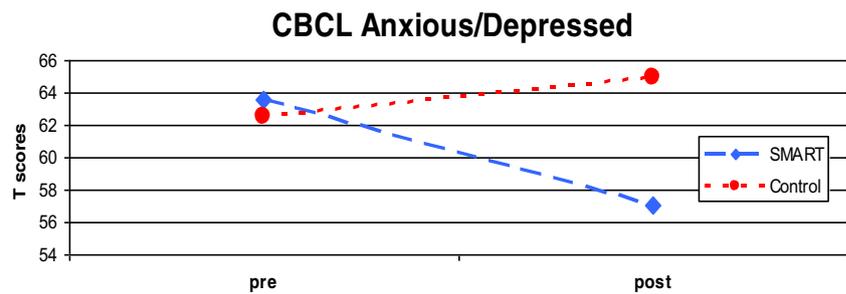


Fig. 3 Pre- and Post-treatment T scores for SMART and Control (TAU) Groups on *CBCL Anxious/Depressed Syndrome Scale*. Note. SMART Sensory Motor Arousal Regulation Treatment; TAU Treatment as Usual; *CBCL* Child Behavior Checklist



Strengths and Limitations of This Study

There were several strengths to the current study design. This present study utilized available clinical outcome data derived from a centralized quality improvement database developed by the host agency of the two residential treatment facilities from which study participants were drawn. There is no evidence that therapists, educators, milieu staff, or subjects who fill out measures were aware of the potential use of collected data for the specific purpose of evaluation of this intervention, reducing the likelihood of bias in the favor of the intervention. In addition, the measures utilized for this study reflect functioning across all parts of the day, a better measure of effectiveness than that which can be evaluated in one therapeutic hour. In that respect, data and findings derived from the present quasi-experimental study are most directly comparable to that observed in a naturalistic clinical outcome evaluation, with all the evident strengths and limitations of this form of small-scale, “real life” pilot investigation.

Videotaped session review was an essential tool for therapist training and supervision as well as monitoring of clinician fidelity to the elements and sequences of this component-based model. Nevertheless, some youth participants and some youth guardians declined consent to videotape. When this occurred, it precluded adequate supervision for the therapist, as well as adequate fidelity evaluation of model implementation. In either of these scenarios, participation in the SMART intervention was precluded, leading to a potential skewing of the study sample.

This study also had several notable limitations. Assignment to the intervention condition was not random, respecting the ethical mandate to prioritize clinical need over research dictates. Therapists, with their supervisors, chose clients for the intervention method based on their clinical assessment of the client's difficulty with verbally-based approaches and/or extent of dysregulation during daily life. Accordingly, given the lack of random assignment, the current study is unable to empirically address the important question of whether traumatized youth with particular clinical or demographic profiles may be more or less likely to respond favorably to SMART. In

addition, while we might aspire to control for type of trauma (rather than number of types), this would require a much larger sample size, given the numbers of trauma types, likelihood of multiple types for any one subject, and relevance of age and developmental stage of incidence to impact.

One unintended positive outcome of the implementation of the SMART model in residential treatment settings has been the need expressed by clinical staff to extend usage of the knowledge about regulation gained in the therapy context to the milieu and educational segments of the participating adolescents' residential treatment experience. This evident applicability to the ‘other 23 hours’ of the adolescent's day could be considered a clinical strength of the model. The treatment appeared to transfer to the milieu relatively quickly, a fact documented in detailed interviews with clinical staff regarding two adolescents in the study to be reported in a subsequent case-based paper. However, this transfer of knowledge to the milieu required close oversight by the clinician in charge. Examination of the relative contributions of SMART-based individual psychotherapy versus milieu-based applications, including potential group-based administration, is an important topic of future scientific inquiry.

Another area of inquiry is exploration of mechanisms of action of sensory motor interventions. How do sensory motor inputs to the vestibular-proprioceptive-tactile systems affect the autonomic nervous system? A first question would be whether the behavioral effects of improved behavior organization, social reciprocity, and expressive language can be reliably observed on videotape? Secondly, are these behavioral effects correlated with changes in sympathetic and/or parasympathetic functions as measured psychophysiologicaly? Answers to these kinds of questions would potentially have broader relevance for other somatically-based interventions, such as yoga, as well as child and adolescent trauma therapies in general.

This pilot study and its findings represent a small but important first step in addressing the historical lack of operationalization and empirical evaluation of sensory motor-based approaches to trauma intervention, and lends preliminary empirical support to the further development of this particular model of intervention for adolescents with complex trauma in residential treatment.

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