Qigong Massage Treatment for Sensory and Self-Regulation Problems in Young Children With Autism: A Randomized Controlled Trial

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KEY WORDS
- autistic disorder
- child behavior disorders
- early intervention (education)
- massage
- self efficacy
- sensation disorders

Autism is commonly associated with sensory and self-regulatory disturbances. This article presents a randomized controlled study evaluating the effect of a 5-month intervention directed toward improving sensory impairment, digestion, and sleep in 46 children with autism < age 6. The intervention, Qigong Sensory Training (QST), is a qigong massage intervention based in Chinese medicine. It is two-pronged: Trainers work with children directly 20 times over 5 months, and parents give the massage daily to their children. Improvement was evaluated in two settings—preschool and home—by teachers (blind to group) and parents. Teacher evaluations showed that treated children had significant classroom improvement of social and language skills and reduction in autistic behavior compared with wait-list control participants. These findings were confirmed by parent data, indicating that the gains had generalized across contexts. A model and supporting data for understanding and treating sensory and self-regulation problems in autism is presented.

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The diagnosis of autism is increasingly associated with multisystem impairment (Chauhan & Chauhan, 2006; Kern & Jones, 2006). It is common for children with autism to have impairments involving the sensory nervous system (Dunn, 2006; Leekam, Nieto, Libby, Wing, & Gould, 2007), digestion (Valicenti-McDermott et al., 2006; Wakefield, Ashwood, Limb, & Anthony, 2005), and sleep (Dominick, Davis, Lainhart, Tager-Flusberg, & Folstein, 2007); those impairments adversely affect the child's ability to focus, pay attention, and learn as well as aggravate the severity of autistic symptoms (Kern et al., 2007; Malow et al., 2006). The sensory and physiological disturbances associated with autism can place a heavy burden on families and offer an excellent opportunity for early intervention (Silva, Cignolini, Warren, Skowron-Gooch, & Budden, 2007).

For millennia, Chinese medicine has used global approaches to improving health and reversing illness such as *qigong* (pronounced "chee-gong"), acupuncture, and Chinese herbs. More than 3,000 varieties of qigong, involving massage, slow movements, breathing, and meditation, have developed. Qigong is practiced widely in China, not only in clinics and hospitals for specific illnesses but also in homes and schools for the improvement of health; qigong practitioners do not have to be experts, and almost anyone can learn to practice qigong to improve his or her own health. (For a description of qigong written for a Western audience, see Cohen, 1997.) During the past 10 years, interest in complementary and alternative medicine (CAM) modalities has grown in the Western world, and occupational therapists worldwide are showing an interest in using CAM practices such as qigong to augment their clinical practice.

Qigong, acupuncture, and Chinese herbs are theorized to have their therapeutic action on the energy field of the body, which in turn causes changes in physiology and anatomy. Briefly stated, the three disciplines use an ancient map of the bioelectric field that describes the main direction and pathways of energy flow permeating and circulating in the body, specific points that can be used to regulate that flow, and a system of channels that regulate physiology and link the sensing surface of the body to the brain and inner organs. Diseases are described in terms of their impact on energy flow, and treatment is purported to improve the quality and quantity of energy as well as relieve the specific impediments to flow.

More than 2,000 research papers have reported beneficial effects of qigong on physiological systems (Sancier, 2007). Applications include diverse illnesses such as hypertension (Lee, Pittler, Guo, & Ernst, 2007), coronary disease (Stenlund, Linstrom, Granlund, & Burell, 2005), asthma (Reuther & Aldridge, 1998), and chronic pain (Lansinger, Larsson, Persson, & Carlsson, 2007). In patients receiving chemotherapy, qigong is reported to improve immune function (Yeh, Lee, Chen, & Chao, 2006) and reduce toxicity, as evidenced by reduced diarrhea, as well as improve appetite and strength (Quizhi & Li, 1988).

For the past 7 years, our research has investigated the effects of a 5-month qigong massage intervention for young children with autism using a methodology that was developed in the 1980s by Anita Cignolini (Silva & Cignolini, 2005). The methodology has since been tailored for application in early intervention programs, and all research has been performed on children <6 years old. The intervention, now known as Qigong Sensory Training (QST), is two pronged; it involves a total of 10 hr of direct treatment of children by trained early intervention/early childhood special education (EI/ECSE) personnel as well as daily treatment by parents with a follow-through massage. Three modest, preliminary studies have reported improvements in sensory, digestive, and sleep disturbances as well as improvements in measures of autism (Silva, Ayres, & Schalock, 2008; Silva et al., 2007; Silva & Cignolini, 2005). The authors of those studies hypothesized that because of the improvements in physiology, children would be calmer, more comfortable, more aware in social situations, and therefore better able to learn social and language skills.

We are often asked to explain how results from treatment with qigong massage might differ from results obtained with conventional treatments for sensory impairment (see Baranek, 2002). Whereas conventional therapies based on the Western medical paradigm are informed by knowledge of anatomy and physiology, the Eastern paradigm is informed by knowledge of the energy field of the body, which, although ancient, is compatible with the relationship between energy and matter described by modern physics. In the Eastern model, energy circulates continuously through the body and regulates itself through an elegant and highly specific system of channels and points that are precisely described by Chinese medicine. An illness of any part of this system will affect the energy of the whole. The qigong practitioner's knowledge of this energy map informs the choice, location, and direction of manual techniques applied and allows for treatment of the part, which can be at the surface (e.g., skin hypersensitivity) or deep (e.g., diarrhea), as well as treatment of the whole. This approach is the basis for the specific and general improvements that are associated with treatment, and it is the reason qigong massage can be used to provide lasting relief from internal conditions, particularly in children. Over time, the two different scientific paradigms—one material and the other energetic—have created treatments that are different and that do different things.

Video has been used extensively in our research to record the process of change in response to the intervention (Silva et al., 2007, 2008; Silva & Cignolini, 2005). As has been reported in published results, the video shows that, concomitant with decreases in sensory impairment, children acquired foundational social abilities, such as eye contact, joint attention, and pretend play, and had improved self-regulation with regard to sleep, digestion, and self-soothing. These compelling observations and parent reports of interim change, in conjunction with significant improvement in before and after data, shaped our working model for autism, which proposes that impairment of sensory and self-regulation systems underlies the development of autism and that qigong massage treatment improves autism by normalizing sensory impairment and self-regulation.

The Western theory expounding the links among sensory, social, and self-regulatory deficits in autism can be found in the polyvagal theory, which is based on an understanding of the mammalian parasympathetic nervous system and its regulatory influence on physiological state, tactile pain thresholds, and the components of the social engagement system (Porges, 1995, 2001, 2004). Research on the mammalian parasympathetic nervous system has shown that cranial nerves regulating movements of suckling, speech, facial expression, middle ear muscles (e.g., tuning in to the human voice as opposed to background noise), and turning the head and eyes (e.g., to facilitate eye contact) share the same brainstem nuclei as those that regulate digestion and self-soothing. The polyvagal theory advances that coordinated activity between these cranial nuclei (collectively known as the vagal system) and related cortical structures is required for mammalian social and physiological functioning and that a deficit or dysregulation of vagal tone is present in autism. Data in children with autism have shown that vagal tone, as reflected in measurements of respiratory sinus arrhythmia, is different than typically developing children (Porges, 2004.)

The Eastern counterpart of this sensory, social, and autonomic linkage is found in the Five Phase Theory of Chinese medicine, in which each of the five senses is associated with a system of physiological functions, such that severe or longstanding impairment of a sense can affect the underlying system and vice versa. These sensory and system relations inform the qigong massage methodology and are often seen clinically in autism. For example, impairment of touch is associated with disturbances of the mind and sleep, impairment of vision is associated with disturbances in the physiology of irritability and aggression, impairment of taste and smell is associated with disturbances in digestion, and impairment of hearing is associated with delays in toilet training. (For further description of the Five Phase Theory, see Yanchi, 1988).

The current study continues our exploration of a model proposing that sensory and self-regulatory impairments are central to the development of autism, and it advances our investigation of the effect of the QST intervention on autism. It replicates and extends an earlier study (Silva et al., 2007) with a larger sample of 46 children and evaluates the child in two settings: the home and preschool. Because the behavior of young children with autism varies from setting to setting and is affected by multiple variables, including familiarity, predictability, and level of sensory stimulation (Lord & McGee, 2001), a more complete picture of the child's changes in response to treatment was sought from preschool teachers (blind to group) and parents. The research was designed to submit the components of the proposed model for autism to treatment and before and after testing: (1) sensory impairment, (2) physiological system impairment, (3) developmental deficits, and (4) autistic behavior. We hypothesized that a 5-month qigong massage intervention aimed at improving function of sensory and physiological systems in the body would significantly improve severity of autism as measured by standardized tests of behavior and developmental abilities.

Method

Participants

Selection of Children and Parents. Recruitment was conducted by sending an invitation letter to parents of children between ages 3 and 6 receiving autism services from two education service districts serving six counties in Oregon. Criteria for entry into the study were as follows: (1) age <6 years, (2) eligible for early intervention services for autism, and (3) no complicating medical diagnoses or chronic medication. The majority of children attended early intervention preschools 5 to 10 hr per week; four attended Oregon's Regional Program Autism Training Sites preschool program, which uses behavioral- and research-based methods a similar number of hours per week. Forty-six children (37 boys and 9 girls) met eligibility criteria and completed the full treatment protocol (Table 1). Parents agreed not to begin additional interventions for autism during the study, to transport their children to the 20 training and treatment visits, and to give their child a daily qigong massage for the duration of the study.

Approval for all aspects of this project was sought and obtained from the Western Oregon University institutional review board.

Measures. Social and language abilities and maladaptive behavior in the school and home settings were measured with the Pervasive Developmental Disorders Behavior Inventory (PDDBI) Teacher and Parent Versions (Cohen & Sudhalter, 2005). The PDDBI is a two-part rating scale designed to assess changes in response to intervention programs in children having a pervasive developmental disorder (PDD), autism, or Asperger syndrome. The two parts assess social and language abilities (Receptive/Expressive Social Communication Abilities Composite; REXSCA/C) and maladaptive behavior (Approach/Withdrawal Problems Composite; AWP/C) and include a section on sensory impairment (PDDBI Sensory). Results are reported in standard scores with a mean of 50 and a standard deviation of 10. The REXSCA/C includes core features of autism such as joint attention and pretend play as well as gestural, receptive, and expressive language. The maladaptive behavior score is not specific for autism but is a general measure of maladaptive behaviors seen in PDD, including stereotyped

Table 1. Participant Demographics (*N* = 46)

	Group	
Demographic Variable	Treatment Group (*N* = 25)	Waitlist Control Group (*N* = 21)
Gender		
Male	19	18
Female	6	3
Chronological age (months)		
Mean	65.2 (20.7)	53.3 (18.7)
Minimum	25	27
Maximum	117	92
Nature of autism		
Regressive	13	9
Nonregressive	12	12

behaviors; social interaction deficits; and a variety of behaviors such as fears, semantic and pragmatic deficits, arousal regulation, and temperament.

The parent and teacher versions of the PDDBI have questions in common, as well as questions related to the particular setting. Discrepancies between parent and teacher scores are expected, and the correlation of .32 is consistent with other published data. Discrepancies reflect different behavior in different settings as well as different relationships with the different informants.

The PDDBI has gone through extensive development and validation and has been determined by external reviews to demonstrate construct and criterion validity sufficient for use in research. The inventory has also been found to be reliable, with high levels of internal consistency (alphas range from .80 to .98 across the various domains and constructs). Test–retest stability is also high, with coefficients ranging from .60 to .99 across domains and constructs. Parent–teacher agreements were somewhat lower (.24–.82) across domains and composites.

Because the PDDBI behavioral measure is not specific for autism, the Autism Behavior Checklist (ABC; Krug, Arick, & Almond, 1980, 1993) was chosen to evaluate autistic behavior in the classroom. The ABC measures behaviors typical of autism in five domains: sensory, relating, body and object use, language, and social and self-help. It provides raw scores ranging from 0 to 167, with a score of 54 or higher being consistent with autism. Eaves and Williams (2006) reported an alpha coefficient of .89 and concluded that the ABC total score has adequate reliability for use as a screening instrument.

In the absence of a standardized parent questionnaire evaluating multisystem impairment, we developed the Sense and Self-Regulation Checklist (SSC, previously named Sense and Systems Checklist) to obtain information on changes in sensory impairment, appetite, digestion, and sleep. The choice, grouping, and weighting of the questions on the questionnaire derive from the Five-Phase Theory of Chinese medicine, as referenced in the introduction. Scores are divisible into Sense scores (ranging from 0 to 40) and Systems scores (ranging from 0 to 27). An internal consistency alpha coefficient of .826 has been demonstrated in studies to date. A before and after correlation of total scores of .623 has also been demonstrated. The Sense scores can be correlated with changes in the PDDBI Sensory component, the main difference between the two instruments being a relatively higher proportion of questions dedicated to impairment of touch and pain in the newer instrument. The SSC questionnaire is available online at www.qsti.org. Raw scores are reported as ranging from 0 to 67.

Design and Procedure

A multisite, randomized, controlled trial design was used with participating children from each of the two sites separately assigned to either QST/intervention or waitlist control conditions. A multisite procedure was used to meet the treatment design requirements at the two geographically disparate sites. Participating children included five older siblings of accepted children who were also treated. Participating children were randomly assigned (using a random number generator) to intervention and waitlist control groups with the following caveats:

- The mid-Willamette Valley and South Coast Education Service District participants were assigned separately to conditions to meet therapist to participant requirements.
- Five sets of siblings were co-assigned to conditions because of parental involvement in treatment.

These random assignment procedures resulted in the group sizes shown in Table 1.

Research questions for this investigation evaluated before- and after-treatment data for the components of the QST model—sensory impairment, system impairment, abnormal behavior, and social and language delay—in two contexts, home and school. We were also interested in testing the maintenance effect of QST after 5 months from the end of treatment.

Qigong Massage Training. The qigong massage training of trainers has a defined, skill-based curriculum in applied Chinese science relative to autism. Trainers are expected to master a theoretical and practical understanding of the child with autism according to concepts important to Chinese science: yin, yang, qi, channels, toxicity, block, and deficiency (Yanchi, 1988). Initial training consists of 50 hr of material dedicated to developing the skills and understanding necessary to lead the treatment process and train the parents. After the initial training, trainers receive weekly supervision while they work with two families of children with autism and conduct the 5-month intervention. The pilot evaluation of this training program is described in detail in Silva et al. (2008).

Trainers meet with families for 20 training visits over 5 months. At each visit, the child receives a qigong massage treatment from the therapist, and parents receive training and support in the follow-through massage given daily by the parent to the child.

Use of Video. Six of the 20 sessions were videotaped, and the videotapes were reviewed by Louisa Silva to verify fidelity with the treatment methodology and to identify trends in response to treatment. In addition, they were edited into a teaching presentation of the progress of each of the 46 children. The teaching presentation was shown to the trainers at the mid- and endpoint of treatment to allow for further skill development.

Data Collection Procedures. Data were collected for both the QST/treatment and waitlist control groups before the initiation of the QST massage intervention and immediately after the final massage sessions. A third set of data to evaluate the maintenance and stability of treatment outcomes was collected from parents 5 months after the intervention was completed. Teachers were sent packets with instructions for filling out the ABC and the Teacher PDDBI. Both instruments are designed to be administered individually or in groups and completed by the informant with assistance provided only to clarify the meaning of a question. Parents completed the Parent PDDBI, selected portions of the Vineland II Adaptive Behavior Scale (Sparrow, Cicchetti, & Balla, 2005), and the QST Sensory and Systems Checklist.

QST Trainers and Treatment Methodology. Fifteen QST trainers provided the intervention to the children in the study. Consistent with our commitment to provide training to EI/ECSE programs, 10 EI/ECSE professionals underwent training and supervision during the study.

Results

Data Analysis

Data analyses were conducted in several sequences. Initially, preassessment scores for treatment and control groups were analyzed to determine equivalence. This was important in determining the appropriate analyses to conduct to test the main hypotheses of the study. Multivariate analysis of covariance (MANCOVA) was used, with group as the independent variable, preassessment scores on the main outcome measures as dependent variables, and age in months as the covariate for parent- and teacher-generated data separately. Post hoc univariate analysis of covariance (ANCOVA) and Bonferroni-adjusted individual t tests for independent samples were conducted to further test group equivalence on the preassessment outcome measures to document more precisely any differences that might exist on more specific impairments and abilities.

The next set of analyses tested the changes that occurred in the scores from before to after intervention assessments. These analyses were conducted to document any changes exhibited from before to after in both treatment and control groups and to determine whether these changes were statistically significant. Paired t tests were used to conduct these analyses.

To test the hypotheses that the QST intervention has a significant main effect, MANCOVA was conducted separately on parent- and teacher-generated data using postassessment scores as the dependent variable, group as the independent variable, and preassessment scores as covariates. Parent and teacher data were treated separately to reflect the different contexts in which observations were conducted: the home and the classroom. MANCOVA was used because of the deviations from full random assignment, as discussed previously. Univariate ANCOVA follow-up tests with Bonferroni adjustments were used when the MANCOVA test was significant to identify specific differences in outcomes by group. SPSS 17.0 (SPSS, Inc., Chicago) generates partial eta-square (η^2) as an effect size estimate in the General Linear Model (Haase, 1983; Tabachnick & Fidell, 1989). Partial η^2 is equivalent to R^2. Using the formula for deriving r from Cohen's d (Hedges, 1982), it is possible to establish ranges in partial η^2 that coincide with Cohen's original small, medium, and large classifications (Cohen, 1988) with .01 to .06 indicating a small effect size, .06 to .14 indicating a medium-size effect, and >.14 indicating a large effect size.

A correlation analysis was conducted to determine the relationship between changes in measures of sense and system impairment and autism outcomes measured by the parents. The r^2 value is an appropriate measure of association effect size estimate (Kline, 2004) and can be interpreted as the percentage of variance in the correlational variable accounted for. For example, if $r^2 = .64$, 64% of the change in the outcome is accounted for by changes in the sense and system impairment scoring tool.

Finally, to determine whether treatment effects were maintained over time, one-way repeated measures MANOVA was conducted on parent PDDBI before and after follow-up data from an intact cohort of 19 treatment group participants. Within-group, one-way repeated measures ANOVA using post hoc, pairwise, Bonferroni-corrected comparisons were conducted to further test equivalence over time on each outcome measures.

Preassessment Equivalence

The parent- and teacher-generated preassessment data for the 46 participants completing the study were analyzed by MANCOVA using group as the dependent variable and age as a covariate on the preassessment outcome scores. The Pillai's Trace criterion was adopted as the most conservative test statistic (Olsen, 1979). For the parent-generated data, this analysis revealed no overall statistical differences between groups at preassessment (Pillai's Trace = .258, $F[7, 35] = 1.739$, $p = .132$). Although no overall differences were found, a Bonferroni adjusted post hoc univariate analysis of variance (ANOVA) identified two variables for which significant differences did exist: the PDDBI Social/Communication Composite ($F[1, 41] = 5.98, p < .05$) and the PDDBI Autism Composite ($F[1, 41] = 4.75, p < .05$).

For the teacher-generated data, this analysis revealed no statistical differences between groups at preassessment (Pillai's Trace = .198, $F[5, 32] = 1.58, p = .194$). Although no overall differences were found, a Bonferroni adjusted post hoc univariate ANOVA identified one variable for which significant differences did exist: the PDDBI Sensory domain ($F[1, 36] = 8.22, p < .01$). The presence of these differences in both the parent and the teacher data and the deviations from full random assignment indicated MANCOVA would be preferable to test for main treatment effects and to control for initial differences.

Pre- to Postassessment Changes

Sensory and system impairments, abnormal behaviors, and social and language abilities were assessed both before and after the intervention. A change in the negative direction indicates improvements on sense–system impairments and abnormal behavior. A change in the positive direction indicates improvement on developmental abilities. These results are presented in Table 2. Analyses of before and after scores indicated significant improvement for treatment group participants on all measures. With one exception, significant differences were not obtained for waitlist control group participants. The exception was the teacher measure for maladaptive behavior (PDDBI AWP/C), in which case both treatment and control group children improved, presumably because of the effect of the classroom program.

Before and After Intervention Effects

MANCOVA was used to test for the intervention effects in the classroom and home settings related to sensory and system impairment, abnormal behaviors, and measures of social and language skills. Results for teacher data indicated an overall treatment effect on outcomes ($F[4, 30] = 3.457, p = .019$, partial $\eta^2 = .316$). Bonferroni-adjusted post hoc univariate ANCOVA found significant treatment effects for PDDBI Social/Communication Composite ($F[1, 33] = 7.36, p = .01$, partial $\eta^2 = .182$) and the Autism Behavior Checklist ($F[1, 33] = 10.25, p = .003$, partial $\eta^2 = .237$).

Results for parent data indicated a treatment effect on outcomes ($F[7, 27] = 2.70, p = .029$, partial $\eta^2 = .412$). Bonferroni-adjusted post hoc univariate ANCOVA found significant treatment effects for the Sense and Systems Checklist ($F[1, 33] = 17.49, p = .0002$, partial $\eta^2 = .346$), PDDBI Sensory domain ($F[1, 33] = 9.10, p = .005$, partial $\eta^2 = .216$), PDDBI Maladaptive Behavior Composite ($F[1, 33] = 16.1, p = .0003$, partial $\eta^2 = .328$), PDDBI Social/Communication Composite ($F[1, 33] = 8.23, p = .007$, partial $\eta^2 = .200$), and the PDDBI Autism Composite ($F[1, 33] = 14.11, p = .001$, partial $\eta^2 = .299$). These results are presented in Table 3 and discussed as follows.

Table 2. Before and After Scores on Measures of Sensory Impairment, Behavior, and Developmental Skills for Treatment and Control Groups

Group and Scale	Before Assessment	After Assessment	Change
Treatment Group			
Autism Behavior Checklist	48.5	33.9	−14.6**
	20.8	18.6	12.9
Teacher PDDBI (*M* = 50, *SD* = 10)			
Maladaptive behavior (AWP/C)	50.9	44.0	−6.9**
	10.4	7.6	7.3
Social, language, and communication abilities (REXSCA/C)	53.7	56.7	3.0*
	9.7	9.7	4.9
Parent PDDBI (*M* = 50, *SD* = 10)			
Sensory score	54.2	46.2	−8.0**
	9.6	9.1	5.6
Maladaptive behavior (AWP/C)	56.8	45.6	−11.2**
	11.5	10.8	8.0
Social, language, and communication abilities (REXSCA/C)	57.5	61.1	3.6*
	6.8	7.0	5.3
Sense and Systems Checklist			
Sense Checklist (0–40)	16.4	10.8	−5.6**
	6.2	5.6	5.5
Systems Checklist (0–27)	8.2	4.8	−3.4**
	3.7	3.3	3.4
Waitlist Control Group			
Autism Behavior Checklist	64.3	59.4	−4.9
	33.8	35.4	19.3
Teacher PDDBI (*M* = 50, *SD* = 10)			
Maladaptive behavior	56.5	49.7	−6.9*
	13.3	12.2	8.7
Social, language, and communication abilities	47.0	47.6	0.6
	13.0	12.1	4.3
Parent PDDBI (*M* = 50, *SD* = 10)			
Sensory score	56.0	55.3	−0.7
	9.6	10.0	7.5
Maladaptive behavior	59.5	57.5	−2.0
	10.7	10.4	7.3
Social, language, and communication abilities	49.0	49.2	0.2
	13.1	12.8	5.0
Sense and Systems Checklist			
Sense Checklist (0–40)	19.5	18.7	−0.8
	6.1	6.6	5.5
Systems Checklist (0–27)	10.1	10.1	0
	4.5	3.4	3.5

Note. PDDBI = Pervasive Developmental Disorders Behavior Inventory; AWP/C = Approach/Withdrawal Problems Composite; REXSCA/C = Receptive/Expressive Social Communication Abilities Composite; *M* = mean; *SD* = standard deviation.

*Paired *t* test $p < .01$.

**Paired *t* test $p < .00$.

1. Treatment Outcome on Blinded Teacher Measures of Autistic Behavior and Social and Language Abilities. Scores from

Table 3. Summary of Multivariate Analysis of Covariance (MANCOVA) and Analysis of Covariance (ANCOVA) Results for Intervention Effects on Measures of Sensory Impairment, Behavior, and Developmental Skills

	Group Main Intervention Effect		
Variable	F^a	p	Partial η^2
Teacher Data			
MANCOVA	3.47	.019	.316
ANCOVA			
Autism Behavior Checklist (0–167)	10.25	.003	.237
Teacher PDDBI (M = 50, SD = 10)			
Maladaptive behavior (AWPC)	2.38	.133	.067
Language and social abilities (REXSCAC)	7.64	.010	.182
Autism composite	4.05	.052	.109
Parent Data			
MANCOVA	2.70	.029	.412
ANCOVA			
Parent PDDBI (M = 50, SD = 10)			
Sensory domain	9.10	.005	.216
Maladaptive behavior (AWPC)	16.1	.0003	.328
Language and social abilities (REXCSAC)	8.23	.007	.200
Autism composite	14.11	.001	.299
Sense and Systems Checklist (0–67)	17.49	.0002	.346

Note. Pretreatment scores used as covariates to control for individual difference. AWPC = Approach/Withdrawal Problems Composite; PDDBI = Pervasive Developmental Disorders Behavior Inventory; REXSCAC = Receptive/Expressive Social Communication Abilities Composite; M = mean; SD = standard deviation.

[a]MANCOVA *F*s are the Pillai's Trace.

the ABC and the PDDBI Maladaptive Behavior Composite and Social/Communication Composite were used in the analysis. Significant main intervention effects were found for the ABC and the PDDBI Social/Communication Composite, indicating that teachers blind to group observed significant improvements in autistic behavior and social and language abilities in the classroom in treated children. The effect sizes (partial η^2) were in the moderate category. No significant treatment effect was found on the PDDBI measure of maladaptive classroom behavior, with both treatment and control group improving significantly on before and after measures.

2. Treatment Outcome on Parent Measures of Behavior and Social and Language Abilities. Scores from the Parent Maladaptive Behavior Composite and PDDBI Social/Communication Composite were used in the analysis. Significant main intervention effects were found for both measures, indicating that in the home environment QST improved social and communication skills and maladaptive behavior. Effect size estimates were in the large range.

3. Treatment Outcome on Parent Measures of Sensory and Self-Regulatory Impairment. Scores from the SSC and PDDBI Sensory were used in the analysis. Significant main intervention effects were found on both sense and system variables, indicating that the treatment positively affected both. The effect sizes (partial η^2) are in the large category.

4. Correlations Between Changes in Parent Measures of Sense and Self-Regulation Impairment and Measures of Autism. Correlations were calculated between measures of sense and self-regulation impairment (SSC, PDDBI Sensory) and the three composite scores of the PDDBI (Maladaptive Behavior Composite, Social/Communication Composite, and Total Autism Composite). All correlations were highly significant, with the highest r values being found relating change scores on the SSC with behavioral changes: .819 ($p < .0001$) for behavioral improvement, –.409 ($p < .005$) for new social and language learning, and .686 ($p < .0001$) for total autism score. See Table 4 for all correlations.

5. Maintenance of Treatment Effect 5 Months After Study Completion. Maintenance of treatment effect after study completion was addressed by repeating the end-of-study parent and teacher measures for the treatment group 5 months after the end of the study and analyzing whether there were any differences. Descriptive data on the intact cohort of 19 are shown in Table 5. One-way repeated-measures MANOVA on parent measures was significant (Wilks' λ $F[6, 13] = 7.85$, $p = .001$). Repeated-measures one-way ANOVA on each outcome measure revealed significant differences in all scores between the 3 times of measurement. Sphericity assumptions (Mauchly's [1940] Test) were violated for Sensory ($p = .048$) and Social/Communication ($p = .01$). The Greenhouse–Geisser epsilon (Greenhouse & Geisser, 1959) was used to correct degrees of freedom. Other results were as follows: Sensory $F[1.58, 27.68] = 17.34$, $p = .00005$; Maladaptive Behavior Composite $F[1.82, 32.71] = 21.3$, $p = .000002$; Social/Communication Composite $F[1.41, 25.39] = 8.36$, $p = .003$; and Total Autism Composite $F[1.75, 31.58] = 20.62$, $p = .00004$. Post hoc pairwise Bonferroni-corrected comparisons revealed that

Table 4. Correlations Among Sensory and Systems Measures and Pervasive Developmental Disorders Behavior Inventory (PDDBI) Scores for Children in Both Treatment and Control Groups

	PDDBI			
Scale	Sensory Change	Behavior Change	Abilities Change	Total Autism Score Change
Change in Sense Checklist before and after	.520**	.736**	–.446*	.655**
Change in Sense and Systems Checklist before and after	.565**	.819**	–.409*	.686**

Note. N = 46.

*$p < .01$. **$p < .0001$.

Table 5. Intact Treatment Group Cohort Means and Standard Deviations

Measure/Variable	Assessment: Before Intervention	After Intervention	5-Month Follow-Up
Parent PDDBI (M = 50, SD = 10)			
Sensory/Perceptual Approach Behaviors	52.8 9.9	45.4 9.8	43.5 9.6
Approach/Withdrawal Problems Composite	54.2 10.3	43.6 9.3	43.9 8.3
Receptive/Expressive, Social Communication Abilities Composite	56.5 8.7	60.1 10.2	59.8 9.2
Autism Composite	49.3 11.7	38.5 11.7	38.6 9.9

Note. N = 19. PDDBI = Pervasive Developmental Disorders Behavior Inventory. M = mean; SD = standard deviation.

although all before and after and pre–follow-up mean differences were significantly different from each other, none of the post–follow-up mean differences were significantly different.

Discussion

Results of blinded teacher data in this randomized controlled trial confirmed the hypothesis that the QST intervention reduces the severity of autism as measured by standardized tests of behavior and developmental abilities. Teacher data (moderate effect sizes) were corroborated by parent data (large effect sizes). Consistent with published data for the PDDBI, calculations of parent–teacher discrepancy scores were similar across control and treatment group. Thus, effect size differences would appear to reflect differing behavior in different settings and differing roles of the informants. Because parent responses to developmental questionnaires are known to be accurate when parents are asked to assess current, observable child behavior (Squires, Potter, Bricker, & Lamorey, 1998), as in these study measures, the larger effect size in parent data may be caused by the parent's having more specific information about the child's abilities or a proximal compared with distal effect of setting on the acquisition of foundational skills (i.e., first language is usually demonstrated in the home before preschool).

The SSC developed for this research showed a significant and large improvement in sensory and physiological systems in the treatment group that was not present in the control group. The improvement was stable at 10 months, indicating that a lasting change in physiological state had occurred. Correlational analysis of changes in sensory–system scores and behavior scores showed that changes in sensory–system scores accounted for 67% of the improvements in behavior. This very high correlation between two aspects of autism that are not generally considered to be closely related reflects a principle that all teachers are familiar with: Children will behave better when they are calm and comfortable than when they are not. Not surprisingly, given the lag time necessary to learn and demonstrate specific skills, correlations between changes in sensory–system scores and measures of learning were lower, although still significant.

Examination of videotaped treatments for trends in response to treatment documented the acquisition of three foundational social abilities necessary for social learning: the ability to orient to a social encounter, the ability to disconnect smoothly from it, and the experience of pleasure in it. All three are mediated by the parasympathetic nervous system according to polyvagal theory (Porges, 2004). The first, the social orientation response, is a response whereby when gently touched or spoken to, the child is able to orient his or her face to the person, seek eye contact, listen for the voice, and be ready to receive the communication. The social orientation response to the trainer was missing at the beginning of treatment but observable by 3 weeks and was usually associated with a smile, indicating pleasure. The second, the ability to self-soothe, underlies the child's ability to remain calm while making the many transitions required by family and preschool life. This response generally appeared in the 3rd month of the intervention and followed the appearance of deep relaxation or sleep during the massage. Instead of responding to the request for change as a loss, with tears or a tantrum, the children were able to keep themselves calm while they stopped one activity and transitioned to the next. Finally, as mentioned in previous papers (Silva et al., 2007, 2008; Silva & Cignolini, 2005), as the intervention progressed, children who responded initially to gentle touch with no response or a withdrawal response normalized their tactile responses and began to show evidence of pleasure in the massage, smiling at the therapist, saying "massage?" and jumping up onto the massage table without being asked. This ability to expect and experience pleasure and satisfaction in a social encounter such as the treatment visit provided a basis for ongoing positive reinforcement of social learning behaviors.

Given that a main treatment effect of the qigong intervention was a calmer and more comfortable physiological state and increased social development, we can hypothesize that the delay in social development seen in autism is, in part, the result of a sensory and self-regulatory disability that is accessible to accommodation. This finding offers the hope that autism is a more malleable condition than previously thought and the possibility that with early intervention, the child can improve his or her learning from the social environment and overcome some or all of his or her developmental delays.

Although it is encouraging that with this study we appear to have a promising medium-term intervention for sensory and self-regulation problems in children with autism that can be easily administered by parents and trained interventionists, readers are cautioned that the research is still preliminary. Treatment data need to be collected on a much larger number of children. Data showing a maintenance effect at 10 months need to be repeated under controlled conditions, and long-term outcomes data have yet to be obtained. Clinical experience suggests that parents need to continue the home program, albeit with decreasing frequency, until the child is stable at a more normal developmental rate for 1 or more years, but a study linking the severity of autism to the optimum length and intensity of the intervention remains to be done.

It is our intention to further our research by gathering data on the effect of qigong massage on the autonomic nervous system of young children with autism, using a measure of vagal tone, as well as measure the impact of the parent component of the intervention alone. Last, but not least, as we continue training and research in EI/ECSE programs, we hope to train many more pediatric occupational therapists, because it is our belief they are ideally suited to learning the QST methodology because of their holistic orientation, training in sensory and self-regulation issues, and clinical experience with children on the autism spectrum. ▲

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