

# State of Measurement in Occupational Therapy Using Sensory Integration

## MeSH TERMS

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- sensation

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This article presents the current state of measurement in the area of sensory integration within the field of occupational therapy in three areas: (1) phenotypic characterization, (2) intervention adherence and dosage, and (3) outcome measurement. The need for additional measurement tools in all three areas is addressed. In regard to outcome measurement of occupational therapy using sensory integration, the use of both qualitative and quantitative methods to obtain outcome data is recommended. Further, a strategy is recommended for obtaining outcome data from direct report from the child or other stakeholder.

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**S**ensory integration includes perception, modulation, and integration of sensory information as a foundation for participation in activities across social, physical, learning, and daily living tasks (Ayres, 1972). Ayres (1979) proposed a conceptual model of sensory integration that illustrated this process and created assessment instruments to ensure that practitioners could assess the concepts and constructs in a reliable and valid way to inform treatment. These instruments include sensory questionnaires, observational tools, and standardized tests such as the Southern California Sensory Integration Tests (Ayres, 1977) and the Sensory Integration and Praxis Tests (SIPT; Ayres, 1989). Accordingly, the sensory integrative approach encompasses use of assessments that measure specific sensory and motor performance areas that may be related to sensory integrative functions, intervention that is guided by specific principles, and documentation of sensitive, meaningful outcomes.

Building on Ayres' work, scholars and researchers have continued to expand the knowledge base on sensory integration within occupational therapy. They have provided a rich understanding and further explanation of the theory (Bundy, Lane, & Murray, 2002; Parham & Mailloux, 2010; Smith Roley, Blanche, & Schaaf, 2001) and explication of intervention principles (May-Benson et al.,

2014; Parham, Cohn, et al., 2007; Parham et al., 2011; Schaaf & Mailloux, in press). Further, they have developed new assessment tools to measure aspects of sensory integration functions (Dunn, 1999; May-Benson & Koomar, 2007; Parham, Ecker, Miller Kuhaneck, Henry, & Glennon, 2007), including praxis (Ivey, Lane, & May-Benson, 2014; Lane, Ivey, & May-Benson, 2014; May-Benson & Cermak, 2007), and identified sensitive, meaningful outcome measurement tools (Mailloux et al., 2007). This work provided the foundation for three randomized controlled trials (Miller, Coll, & Schoen, 2007; Pfeiffer, Koenig, Kinnealey, Sheppard, & Henderson, 2011; Schaaf et al., 2013) and several published single-subject and case report studies that demonstrate the efficacy of occupational therapy using sensory integration intervention (OT–SI; e.g., see Schaaf, Hunt, & Benevides, 2012).

These recent efforts represent significant advancements in measurement related to sensory integration, informing practice and providing a guide for future inquiry. It is timely, therefore, to examine the current state of measurement related to sensory integration and identify the most pressing needs to ensure continued progress in the field. Accordingly, this article addresses the following questions:

- What assessment tools can occupational therapy practitioners use to identify and describe the range of sensory and motor characteristics (i.e., phenotypic characterization) in children with difficulty processing and integrating sensation?
- What measurement tools are needed to ensure that researchers and clinicians stay true to the theoretical propositions of sensory integration intervention and provide the correct dosage of intervention?
- How can practitioners identify the outcome measures that are the most sensitive and meaningful to the children and families who seek occupational therapy intervention?

## Phenotypic Characterization of Sensory and Motor Characteristics

Occupational therapy practitioners assist clients in acquiring the skills and behaviors necessary to participate in their daily life activities. They use the sensory integration conceptual framework to guide assessment and intervention when difficulty processing and integrating sensory information affects clients' participation. Current best practice in sensory integration suggests that assessment of sensory perception, discrimination, integration, modulation, praxis, and other related motor skills (e.g., posture, balance, bilateral coordination) is needed to identify the sensory and motor factors that may be influencing function and participation (Watling, Koenig, Davies, & Schaaf, 2011). Current assessments used for the characterization of sensory integration problems include the SIPT (Ayres, 1989), the Sensory Processing Measure (SPM; Parham, Ecker, et al., 2007), and the Sensory Profile (SP; Dunn, 1999), along with structured clinical observations of postural and motor skills that are both nonstandardized (Ayres, 1972; Blanche, 2010; Blanche, Bodison, Chang, & Reinoso, 2012) and standardized (Wilson, Pollock, Kaplan, & Law, 2000).

The SIPT provides an objective, standardized assessment of tactile, proprioceptive, vestibular, and visual discrimination and perception as well as of some aspects of sensory reactivity. The SIPT also measures praxis and other

motor skills shown to be associated with poor sensory integration, including eye-hand coordination, balance, and bilateral coordination. Specific patterns of dysfunction are used to interpret assessment data and guide intervention (Ayres, 1989; Mulligan, 1998). The SPM and the SP complement the SIPT and add additional data for a comprehensive characterization of sensory functions and their impact on daily life. These measures use parent or proxy report to gain information about responses to sensation and their impacts on daily activities in varied contexts.

The use of an objective assessment (e.g., SIPT) by a trained assessor, in combination with structured clinical observations of postural and motor skills and parent or proxy report of behaviors associated with poor sensory processing (e.g., SPM, SP), provides a strategy for obtaining a comprehensive characterization of sensory integration factors that may be affecting participation. However, expansion of this strategy is warranted. Assessments are needed that address wider age ranges (the SIPT is limited to 4 yr, 0 mo, through 8 yr, 11 mo), provide standardized measures of postural and motor skills associated with poor sensory integration, support parent or proxy report with objective data, and evaluate ideational praxis. In addition, measures are needed that are cost- and time-effective and that may be used across practice settings (e.g., both school-based and clinic-based practice). Measures of neurophysiological functions to identify responses to sensation are emerging and have been used experimentally but have not been applied in clinical assessment.

## Measures of Intervention Adherence and Dosage

An important aspect of research evaluating the efficacy of sensory integration is determining whether the intervention used is congruent with the theoretical principles. Measurement of fidelity (i.e., adherence to core principles) ensures that a research study has been conducted in a valid, feasible, and replicable way. Parham, Cohn, and colleagues (2007) determined that published studies of occupational therapy using sensory integration did not report treatment fidelity and did not provide suf-

ficient information about the intervention to allow for replication. Furthermore, interventions that researchers called "sensory integration" often were not consistent with intervention principles described by Ayres. To address the need for a measure of fidelity, Parham and colleagues (2011) developed the Ayres Sensory Integration<sup>®</sup> Intervention Fidelity Measure. This measure provides a valid and reliable measure of the core principles of sensory integration intervention (May-Benson et al., 2014; Parham et al., 2011) and has been used in the randomized control trials evaluating OT-SI (Miller et al., 2007; Pfeiffer et al., 2011; Schaaf et al., 2014).

Along with adherence to the intervention principles, measurement and documentation of dosage are necessary to guide research and practice. May-Benson and Koomar (2010) examined dosage of intervention in 27 efficacy studies of OT-SI and determined that a wide range of frequency and intensity of intervention was reported. This type of variation makes a definitive comparison of results of effectiveness difficult. To date, only a few studies have reported on the feasibility and dosage of OT-SI (Miller et al., 2007; Pfeiffer et al., 2011; Schaaf et al., 2012). Schaaf and colleagues (2012) determined that it was feasible to implement OT-SI with children with autism spectrum disorder 3 times per week for 1-hr sessions for 10 wk and that it could be implemented with high fidelity to the core principles. These studies begin to address essential elements of intervention research necessary to ensure that Ayres' sensory integration intervention is conducted in a manner that is measureable and replicable.

## Sensitive and Meaningful Outcome Measures

Occupational therapy practitioners are primarily interested in outcome measures of participation (Law, 2002). Thus, measurement of factors that may influence successful participation and health (also known as *proximal outcome measures*) and evaluation of participation-based outcomes (also known as *distal outcomes*) are important aspects of OT-SI research and practice. The *International Classification of Functioning, Disability and Health (ICF; World Health*

Organization, 2001) and the *Occupational Therapy Practice Framework: Domain and Process* (3rd ed.; American Occupational Therapy Association, 2014) provide complementary frameworks to examine the relationships between and among the multiple levels at which OT–SI may effect change, including factors at the body structure and function level (e.g., measures of physiological processing and integration of sensation), factors at the activity level (e.g., assessment of functional skills such as dressing or feeding), and participation in desired occupations (e.g., measures of engagement in activities at home, in school, and in the community). Research designs and outcomes assessments that address multiple levels of the *ICF* and *Framework* will provide an understanding of the variables that contribute to desired outcomes.

In regard to participation-related outcomes, developing measurement strategies that are sensitive and meaningful to the children and families served is perhaps the biggest and most important challenge for intervention research (Patient-Centered Outcomes Research Institute, 2012). Incorporating parent, teacher, and child perceptions and reports of performance before, during, and after treatment promises to provide important information about how clients experience changes in sensory integration. Critical information includes the rate of change and the direct effect of changes on participation in activities across social, physical, learning, and daily living tasks. Gathering and measuring these data require a multimethod approach that includes qualitative as well as quantitative methods.

Qualitative information about the concerns and problems facing a child and family is vital if occupational therapy researchers and practitioners are to understand the effectiveness of OT–SI. Families are able to tell us about the difficulties a child is experiencing in participation in daily life and the reasons they are seeking help from occupational therapy practitioners. This information, in combination with standardized assessment results, provides a full picture of the child's life before treatment, the problems that families want to see change, and the evidence practitioners need to collect to substantiate change. The collection of qualitative in-

formation through interviews and questionnaires further informs the intervention approach for a particular child and family by identifying their current life dilemmas, the kinds of challenges they are facing as a result of the child's sensory processing difficulties, the current strategies they are using, strategies they would be open to trying, and the kinds of outcomes they are seeking from occupational therapy intervention.

Cohn and Cermak (1998) urged researchers studying intervention effectiveness to consider the everyday occupations of children in the context of their families. Similarly, Parham and Mailloux (1996) argued for the need for studies to “explore outcomes that are most meaningful to the families and children to ensure that intervention programs are responsive to the needs of the people being served” (p. 349). Numerous studies exploring parents' perspectives regarding hopes and outcomes for their children with sensory integration challenges note that parents' desired and valued outcomes for their children include social participation, self-regulation, and perceived competence (Cohn, 2001; Cohn, Kramer, Schub, & May-Benson, 2014; Cohn, Miller, & Tickle-Degnen, 2000). May-Benson and Koomar's (2010) systematic review of sensory integration effectiveness studies concluded that positive outcomes have been found in the areas of sensorimotor skills and motor planning, attention and behavioral regulation, academics, participation in active play, and achievement of individualized goals but noted that outcomes in the areas of participation and parent and family perspective were still needed. Schaaf and colleagues' (2013) recent randomized controlled trial showed that families reported improvements in independence in daily living skills and socialization and gains in individual goals.

Other outcomes families value, such as their child's perceived competence (i.e., ability to successfully carry out an action), are still missing from the intervention effectiveness literature. Children's experience of therapy and their perceptions of competence are critical to demonstrating intervention effectiveness. In a study of 248 parents of children who had participation challenges related to poor processing and

integration of sensation, parenting sense of competence, as measured by the Parent Sense of Competence Scale, correlated with children's behaviors, as measured by the SP (Cohn, May-Benson, & Teasdale, 2011). Although intervention may have valuable outcomes for parents, to date we have no measures of parent understanding of sensory integration. Further, Cohn (2001) reported that parents value the ability to understand their children's behavior from a sensory integration perspective, which in turn assists them in developing realistic expectations for their children, structuring activities and the environment to support success, and advocating for their children. Collectively, these valued outcomes support parents' sense of competence in their parenting occupation.

One assessment method that has proved useful for identifying and measuring outcomes meaningful to parents is goal attainment scaling (GAS; Kiresuk, Smith, & Cardillo, 1994; Mailloux et al., 2007). The use of GAS in a valid and reliable way ensures that goals can be independently rated, evaluated for equivalence between groups (comparability), and scaled with equidistance and that they have measurable criteria and clearly identifiable benchmarks (Ruble, McGrew, & Toland, 2012). Several randomized controlled trials have shown that GAS measures are among the most sensitive tools for detecting change after OT–SI intervention (Miller et al., 2007; Pfeiffer et al., 2011; Schaaf et al., 2012). Given the increased emphasis on measurement of outcomes that are meaningful to the client or family, the use of GAS to measure OT–SI intervention outcomes may provide a model for best practice.

## Directions for Action

Great strides have been made in our ability to measure the constructs of sensory integration within occupational therapy practice, especially in the characterization of the clients who may benefit from this approach, the development of measures to evaluate treatment adherence, identification of outcomes at each level of the *ICF* framework, and measures that consider the child's and family's experience and specific goals. To further advance the use of sensory integration in occupational therapy, we propose the following recommendations:

- Additional measures are needed to ensure a comprehensive assessment of the sensory and motor factors that may be influencing function and participation. Key areas that would benefit from additional development include examiner-administered measures of sensory modulation to complement the currently available caregiver and teacher questionnaires; broader assessment tools of sensory perception and discrimination, including expanded assessment of proprioceptive and vestibular functions; formal standardized assessments of posture and balance; and measures of specific areas of praxis (e.g., ideation, motor planning).
- Assessment measures need to be developed to address a wider age range. Mandates for early identification indicate that reliable and valid measures of sensory integration and praxis for young children are essential, yet few adequate tools are available. In addition, measures for adolescents and adults are currently lacking, resulting in this population being underserved.
- Neurophysiological studies are needed to define the underlying neural functions that may explain diverse patterns of sensory integration difficulties, to expand our repertoire of intervention strategies, and to measure changes in neural functions that may result from intervention.
- Although much has been accomplished with regard to measurement of fidelity to the core principles of OT–SI, expansion of this research is needed to develop measures that will allow application of this approach in varied settings and with different populations.
- Studies are needed that evaluate dosage to understand the best candidates for intervention and the appropriate intensity and frequency of intervention.
- Practitioners and researchers need to continue to identify outcomes that are meaningful to clients and sensitive to the changes observed after intervention. Although measures at each level of the ICF have been used in existing studies, more assessments are needed at every level. Proximal outcomes that measure changes in sensory and motor behaviors associated with sensory integration and

neural functioning are needed to determine whether the changes in function and participation observed are concomitant with changes in nervous system functioning. Measures at the activity level of the ICF are also needed and may include specific performance-based skills such as improved balance, posture, or praxis or changes in daily activities. Distal outcome measures of participation are needed that are sensitive and meaningful to families. Consumer satisfaction, quality of life changes, longitudinal effects, cost-effectiveness, and caregiver and societal burden are all important outcomes that need focused attention. ▲

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