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Toward a Consensus in Terminology in Sensory Integration Theory and Practice: Part 2: Sensory Integration Patterns of Function and Dysfunction

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Editor's Note. This is the second in a series of three articles discussing the need to reach a consensus in how researchers and clinicians use sensory integration terminology. Part 1 was published in the March 2000 issue (pp. 1–4), and Part 3 will appear in the September 2000 issue.

The purpose of Part 2 of this series is to suggest definitions related to patterns of function and dysfunction in sensory integration. Our intent in presenting these definitions of patterns is to provide a bridge in terminology between occupational therapy and other neurobiological literature and to facilitate communication among researchers and clinicians interested in sensory integration dysfunction. As noted in Part 1, occupational therapy practitioners have adopted many terms from the neuroscience literature and have applied them to observable behavior. For example, practitioners may say "this child has a low threshold" to describe the behavior of a child who is overly sensitive to a particular stimuli (e.g., "Jose has a low threshold to sound"). Neurophysiologists usually discuss threshold in relation to a physiological process that denotes the level at which synaptic activity occurs within the central nervous system (CNS) in response to a stimulus.

For clarity, we have proposed the use of the term *reaction* with physiological actions and the use of the term response with behavioral actions. Clinicians must differentiate that which takes place in the CNS at the cellular level (see column 1 in Table 1) from that which occurs at interpretative or behavioral levels (see columns 2 and 3 in Table 1). Most importantly, we must not assume that observed behaviors are the result of mechanisms that we believe may occur at cellular levels. With this in mind, we present the following descriptions and definitions of observable patterns of behavior, which we label sensory integration functional patterns and sensory integration dysfunctional patterns.

Sensory Integration Functions

We often use the term sensory integration in several contexts. The following are some examples.

- Sensory integration neurophysiological process: "Sensory systems receive information from the environment through receptors at the periphery of the body and transmit this information to the central nervous system" (Kandel, Schwartz, & Jessell, 1995, pp. 330–331).

Table 1
Examples of Differentiating Terminology Regarding Neurophysiology and Sensory Integration Functional and Dysfunctional Patterns

Neurophysiological Processes	Sensory Integration Functional Patterns	Sensory Integration Dysfunctional Patterns
Detection of sensation	Awareness of sensation	Lack of awareness of sensation (no specific DSI pattern identified)
Modulation of sensation	Ability to modulate sensation	SMD (e.g., sensory defensiveness, underresponsivity to sensation)
Discrimination of sensation	Ability to perceive qualities of sensory stimuli (e.g., intensity, duration)	Poor sensory discrimination (e.g., poor stereognosis, visual form deficits)
Integration of sensation	Normal sensory integration function	Various patterns of DSI that may include SMD, poor sensory discrimination, or dyspraxia

- Sensory integration functional behaviors: "Most preschoolers...happily pound on drums and xylophones, sing and clap, dance and spin,...swoop like kits, stomp like elephants" (Kranowitz, 1998, p. xix).
- Sensory integration dysfunctional patterns: "If the brain does a poor job of integrating sensations, this will interfere with many things in life" (Ayres, 1989, p. 7).
- Sensory integration theory: Sensory integration theory "...explain(s) the relationship between behavior and neural functioning, especially sensory processing or integration" (Fisher, Murray, & Bundy, 1991, p. 3).
- Sensory integration treatment: "Sensory integrative therapy is a holistic approach; it involves the whole body, all of the senses, and the entire brain" (Ayres, 1979, p. 142–143).
  —*Sensory integration function* is "the neurological process that organizes sensation from one's own body and from the environment and makes it possible to use the body effectively within the environment (Ayres, 1979, p. 11).
  —*Adaptive response* is an efficient and effective response to a challenge or demand (an effective environmental interaction). Ayres (1979) described adaptive responses as "the ability to adjust one's action upon environmental demand. A purposeful, goal-directed response to a sensory experience...master[ing] a challenge and learn[ing] something new" (p. 6).

—*Awareness of sensation* is the conscious realization of sensation (sensory detection is a neurophysiological process that we discussed more fully in Part 1). We recommend that practitioners use the term *sensory registration* when describing a child's behavioral responses because we do not yet know exactly what is happening at the cellular level.

—*Ability to modulate sensation* is the capacity to regulate and organize the degree, intensity, and nature of responses to sensory input in a graded and adaptive manner so that persons can maintain an optimal range of performance and adapt to challenges within particular life challenges (McIntosh, Miller, Shyu, & Hagerman, 1999).

—*Ability to discriminate sensation* is the capability to discern the qualities of, similarities of, and differences among sensory stimuli, including differentiation of the temporal or spatial qualities of sensory input.

—*Praxis* is the ability to conceptualize, organize, and execute nonhabitual motor tasks (Ayres, 1979, 1989). Praxis engages when the demands of the action are novel or challenging (not automatic) and require ideation, planning, modification, or self-monitoring for their adaptive execution.

Patterns of Dysfunction in Sensory Integration

Dysfunction in sensory integration (DSI) is the inability to modulate, discriminate, coordinate, or organize sensation adaptively. (We recommend the use of DSI [rather than SID] as an abbreviation for sensory integration dysfunction to clearly differentiate this problem from sudden infant death syndrome [commonly called "SIDS"].) DSI is a general term that implies a diminished ability to interact effectively or efficiently within the demands of one's culture, environment, relationships, or tasks (Miller, Reisman, McIntosh, & Simon, in press). Ayres (1972) originally researched DSI, and new information later came from Fisher, Murray, and Bundy (1991); Kimball (1993); Parham and Mailloux (1996); Dunn (1999); and others. All patterns of DSI that we describe below refer to behavioral responses, not neurological processes. The following definitions describe some of the key patterns of DSI currently in occupational therapy literature.

Dysfunction in praxis (dyspraxia) is difficulty planning and performing a novel motor action or series of motor actions. Dyspraxia is often concomitant with poor sensory discrimination and may occur in tandem with poor sensory modulation. Dyspraxia likewise has a cognitive element. Some researchers believe that problems with sensory discrimination underlie dysfunction in praxis (Blanche, 1998; Guiffrida, in press), although further empirical evidence is necessary because most existing research is correlational (Cermak, in press; Lazlow & Sainsbury, 1993). A disorder in cognition only or a disorder in motor execution only is not considered to be dyspraxia (Blanche, 1998; Guiffrida, in press).

When practitioners use the term *developmental dyspraxia* in sensory integration theory, they refer specifically to a disruption in sensory processing and motor planning. Dyspraxia is distinct from *developmental coordination disorders* (DCD), which the DSM-IV criteria characterize as a marked impairment in the development of motor coordination that is not the result of another medical condition that greatly interferes with activities of daily living or academic performance (APA, 1994). *Dyspraxia* is a more specific term than DCD and is likely a subtype of DCD. Dyspraxia relates to the organization of movement and motor planning and, in the occupational therapy literature, generally includes deficits in sensory processing.

Dysfunction in sensory modulation (sensory modulation dysfunction [SMD]) is a problem in the capacity to regulate and organize the degree, intensity, and nature of response to sensory input in a graded and adaptive manner. SMD disrupts a person's ability to achieve and maintain an optimal range of performance and to adapt to challenges in daily life. "When an individual over-responds, under-responds, or fluctuates in response to sensory input in a manner disproportional to that input, we say that the individual has a sensory modulation dysfunction" (Koomar & Bundy, 1991, p. 268). (We use the term *dysfunction* rather than *disorder* in this document because the conditions under which a cluster of symptoms is classified as a separate "disorder" are quite well defined in the medical and psychological fields. These criteria related to the reliability of symptoms co-occurring in persons with the disorder and not occurring in persons without the disorder [see Pennington (1991) for description of the process of syndrome validation] have not yet been established in SMD.)

SMD includes three types of response patterns.

1. *Overresponsivity* refers to responses to sensation that are greater than those that persons with normal sensory modulation processes produce under the same sensory conditions. These responses can result in various types of sympathetic nervous system symptoms. For example, sensory defensiveness is a constellation of behaviors involving avoidance or negative responses to typically nonnoxious sensation in any or all sensory domains (Wilbarger & Wilbarger, 1991).
2. *Underresponsivity* refers to responses to sensation that are less than those that persons with normal sensory modulation processes produce under the same sensory conditions. Underresponsivity may result in fewer or flattened overt responses. We propose using the term *underresponsivity* instead of *poor sensory registration* to describe behavioral responses.
3. *Fluctuating responsivity* refers to reactions to sensation that rapidly shift from greater than to less than those that persons with normal sensory modulation processes produce, which results in an inability to make adaptive responses.

Occupational therapists should be aware of the term *regulatory disorders* in *Diagnostic Classification of Mental Health and Developmental Disorders for Infancy and Early Childhood,* which is a multiaxial classification system for infants and toddlers (Greenspan & Wieder, 1994). The text defined four distinct patterns: Type I, Hypersensitive; Type II, Underreactive; Type III, Motorically Disorganized, Impulsive; and Type IV, Other.

Dysfunction in sensory discrimination is a problem in interpreting the temporal and spatial characteristics of sensory stimuli (e.g., impaired stereognosis would occur in the tactile sensory system) that results in a maladaptive response.

Conclusion

In this article, we have attempted to clarify the terms related to patterns of function and dysfunction that therapists use when working with persons who have DSI and to provide some coherence in their definitions. As with Part 1, we hope this series will provide a baseline for ongoing dialogue in the field about how to define and apply these terms. In Part 3, we will provide detailed descriptions of the observable behaviors that occur within each dysfunctional pattern described above. ■

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