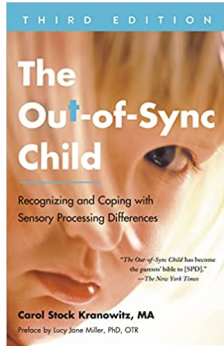


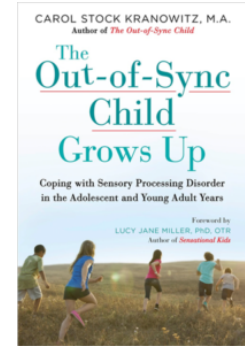
# What Are Sensory Processing Differences (SPD)?

## A Primer

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Some kids respond to unremarkable experiences in notably unusual ways. They may resist going places and being with other people. They may reject hugs, or crave them constantly. They may go, go, go, or lack get-up-and-go. They may dress sloppily, eat only pasta, drop and break everything, whimper or rage over “nothing” for no apparent reason, insist on doing things their way, and act immaturely for their age, even as they grow. With their late and slow, or rapid and intense, or otherwise “off” responses, they seem out of sync with other people and the world.

Often, these children are beautiful, creative, kind, and so, so smart. Parents and teachers wonder why they just won’t get dressed, eat carrots, finger paint, ride a bike, swing and slide, or socialize with peers the way other kids do.

The reason that out-of-sync kids don’t do what others do easily is not that they *won’t* — it’s that they *can’t*. A likely cause of their bewildering behavior is SPD.

SPD stands for Sensory Processing *Disorder* when challenges are severe and greatly interfere with everyday function, and also for Sensory Processing *Differences* when challenges are annoying or problematic in some ways but not debilitating.

SPD occurs in the central nervous system. The problem is that one’s brain cannot react typically to sensory messages coming from one’s body and environment in order to function smoothly in daily life.

To help you understand sensory processing, in this primer you will find facts about:

- Typical sensory processing, when the senses are “in sync”
- Sensory Processing Differences (SPD), when the senses are “out of sync”

## I. Sensory Processing: When Senses Are “In Sync”

Most of us use sensations every second, all day, without a thought. Stairs to climb, apples to chew, friends to hug? Using our senses, we “just do it.”

For most of us, sensory processing occurs automatically and effortlessly in our central nervous system (CNS). The brain, at the top of the CNS, receives messages through sensory receptors in the skin, ears, eyes, nose, etc., and quickly reacts to this *sensory input*, telling the body whether and how to respond with appropriate *motor* or *behavioral output*.

The result is an ever-flowing, in-and-out, sensory-motor dance, featuring sensory input coming in and corresponding actions playing out in a smooth, unconscious sequence. As we mature, we become able to engage in multistep activities — such as climbing stairs, finding our way to a new classroom, or following a complicated recipe. These complex life experiences require efficient sensory processing and much practice. A baby couldn’t do them.

Sensory processing, of course, is about senses, which help us understand and navigate the world around us. Contrary to popular belief, we have *eight* senses. Five are familiar: touch, sound, sight, smell, and taste. Three others, less familiar, are the senses of movement (*vestibular*), body position (*proprioceptive*), and internal organs (*interoceptive*).

### Our Eight Senses

The **tactile sense (touch)** provides our nervous system with information about touching and being touched. We receive tactile messages through receptors in our skin, all over the body. The tactile sense connects us to the world and enables us to:

- Touch people, food, objects, etc., and discriminate what we touch
- Be touched without discomfort, and discriminate efficiently what is touching us on the skin, on the hair, and in the mouth
- Feel heat, cold, and pain

The **vestibular sense (movement)** is about how our body moves through space. Gravity tries to pull us down, and our job is to defy it. This sense tells us where our head is in relation to the surface of the earth, and if we are balancing. Vestibular messages, received in the inner ear, enable us to:

- Stand erect and sit up straight
- Discriminate, or discern, that we are upright, lying down, upside down, or falling
- Change our head position without getting dizzy or falling over
- Move through space from one place to another
- Be moved unexpectedly and quickly regain our equilibrium, such as being jostled in a crowded school hallway

The vestibular sense has another important job: getting all other senses to work together to keep us calm and alert. This is the “master sense,” helping us develop self-regulation of our arousal level so we can adapt to the ups and downs of daily life. Self-regulation enables us to:

- Wake up ready to go in the morning
- Cope with changing routines and transitions
- Stay alert while working, playing, and learning
- Develop conscious self-control to manage anger, excitement, cravings, etc.
- Self-soothe when hurt, stressed, or upset
- Fall asleep and stay asleep

The **proprioceptive sense (body position)** provides information about where our body parts are, how they bend and stretch, and how much force or pressure we use. Proprioceptive sensations come through our muscles and joints. With good proprioception, we can:

- Flex and extend our joints and orient our limbs
- Exert the “just-right” pressure on people and objects that we contact physically, as when we hold hands with a friend, write with a pencil, or pedal a bike
- Discriminate where our body is and how fast our body parts are moving

The **visual sense (sight)** provides information about what we see. The visual sense includes *eyesight* (visual acuity), telling us that we see something, and *visual processing*, telling us what that thing means. Eyesight tells us that we see black lines on the chart; visual processing discriminates what the black lines denote — the letter *E*. The visual sense makes it possible to:

- Use both eyes together (binocularly) for merging two separate images into one, e.g., to see one moon in the sky
- Detect:
  - Movement, such as an approaching person or a fluttering curtain
  - Line, such as the horizon or the edge of the sidewalk
  - Contrast, such as sunlight versus shadow
- Discriminate differences and likenesses, such as finding a book on the shelf or a friend in the lunchroom
- Perceive the world in 3-D, understanding our position in space relative to people and objects in the environment

The **auditory sense (sound)** provides information about what we hear in the environment, enabling us to:

- Hear sounds and identify what direction they are coming from
- Tolerate loud, unexpected sounds, such as shouts and thunder
- Follow moving sounds, such as footsteps or helicopters
- Discriminate sounds, such as voices, raindrops, drumbeats, or cellphone ringtones

The **olfactory sense (smell)** provides information about scents, making it possible to:

- Smell food, people, objects, and environments
- Discriminate which smells are benign, such as flowers and a beloved's scent, and which smells are unpleasant, such as a baby's diaper, a gas leak, or rancid food

The **gustatory sense (taste)** provides information about flavors, enabling us to:

- Taste sweet, sour, bitter, salty, and savory food
- Discriminate what is edible and what is not, such as sour milk

The **interoceptive sense (internal organs)** provides information about sensations coming from inside our bodies, making it possible to:

- Be aware of heart rate, breathing, hunger, thirst, and the need to use the toilet
- Digest food
- Sweat

As we grow and develop, so do our sensory processing capabilities—our “sense-abilities.” Sensory processing starts the progression from what an infant can do to what a preschooler can do to what an adult is expected to do. Hands-on, concrete, sensory-motor experiences — especially in an outdoor, natural environment — are the foundation of skills that are necessary for doing everyday tasks in a three-dimensional world.

## **II. Sensory Processing Differences: When Senses Are “Out of Sync”**

Everyone processes sensations. People with SPD do it less efficiently than others. Because of sensory processing differences (or disorder), their central nervous system mismanages bodily and environmental sensations. People with SPD have difficulty responding in an adaptive way to sensations that others hardly notice or easily take in stride.

What is life like when sensory systems don't work well? Daily functioning is possible, but for people who struggle to learn, participate, or feel good in their daily doings, life can be frustrating, lonely, and even painful.

How does it feel when one's behavior is misunderstood? To doctors, therapists, and other professionals, SPD can look like other "look-alike" conditions, such as autism, ADHD, learning disorders, anxiety, bipolar disorder, eating disorders, and obsessive-compulsive disorder (OCD). Thus, SPD is frequently misdiagnosed and treated with medication or therapies that do not address underlying sensory issues.

“What really helps people understand overresponsive sensory problems,” says Dr. Temple Grandin, the well-known autism advocate, “is asking them to imagine extreme examples of what it feels like. Imagine wearing sandpaper clothes that scratch or itch all over, all day. Imagine washing your face in a bucket of perfume. Imagine feeling as if you're going to fall off a cliff when you walk a few steps. Imagine sitting right near the stage, next to a rock band's amplifier.”

Being deluged by these sensations is to be expected once in a while—but all day, every day? Yes, that is what SPD may feel like.

A study of a large group of general education children found that 16.5 percent have sensory overresponsivity by the age of eight (Ben-Sasson, Carter, & Briggs-Gowan 2009). The prevalence for all types of SPD is rising. If the disorder is unrecognized and untreated, many of these children develop into adults with SPD. Occupational therapists who specialize in sensory issues are dedicated to identifying and treating children as young as possible. The goal is to help all children and adults learn to manage their sensory challenges so they can lead satisfying, productive lives.

In this classification proposed by occupational therapists (Miller, et al., 2007), SPD has three primary categories, each with several subtypes.

CATEGORIES AND SUBTYPES OF SPD		
1. Sensory Modulation Challenges	2. Sensory Discrimination Challenges	3. Sensory-Based Motor Challenges
Sensory overresponsivity	Tactile (touch)	Postural issues
Sensory underresponsivity	Vestibular (movement & balance)	Dyspraxia
Sensory craving	Proprioceptive (body position)	
	Visual (sight)	
	Auditory (sound)	
	Olfactory (smell)	
	Gustatory (taste)	
	Interoceptive (internal organs)	

Below are descriptions of three SPD categories -- Sensory Modulation, Sensory Discrimination, and Sensory-Based Motor challenges -- and their subtypes. Examples will help you connect the dots between terminology and life experience.

## A) Sensory Modulation Challenges

Difficulty with regulating and organizing the degree, intensity, and nature of responses to sensory input in a graded and adaptive way. Three sensory modulation challenges are overresponsivity, underresponsivity, and craving. Also, fluctuating between being *overresponsive* to some sensations, such as unexpected touch, while craving or being *underresponsive* to other sensations, such as movement, is common. Sensory fluctuation may be caused by the time of day, environment, fatigue, stress, and other factors.

### THREE SUBTYPES OF SENSORY MODULATION DIFFERENCES

- **Sensory Overresponsivity**—Causing the person who is a “sensory avoider” to shrink from stimuli. Not only garish, malodorous, raucous, spicy, jolting, and prickly stimuli, but also mild everyday stimuli can quickly make the sensory avoider irritated . . . very irritated . . . or angry and thoroughly miserable. Overresponsivity is sometimes referred to as “defensiveness.”
  - Tactile: Light, unexpected touch bothers Emma. She can’t bear to have her hair brushed and won’t wear a hat. She wears well-worn, long-sleeved, ankle-length clothes to avoid the feeling of air on her skin. She eats soft, mushy food. Being kissed or caressed makes her uncomfortable.
  - Vestibular: Aiden gets carsick unless he is the driver. Rocking chairs, elevators, airplanes, and boats also make him uncomfortable. He experiences “gravitational insecurity,” which is extreme fear and anxiety that he will fall when his head position changes or when he moves through space, as when bending over to tie his shoes, turning his body around, scaling a ladder, or riding in a car.
  - Visual: Logan is highly irritated in milling crowds. Strobe lights and flickering fluorescent lights bother him.
  - Auditory: In lecture halls, Hannah is annoyed by fluorescent lights buzzing and by classmates whispering and tapping on keyboards. In the cafeteria, the sounds of people chewing and swallowing irritate her. At ball games and parties, boisterous noises bother her.
  - Olfactory and gustatory: Ethan can’t tolerate the smell of perfumes and body odor, seaweed, mothballs, and new-mown grass. He can’t tolerate broccoli, bananas, or off-brand cornflakes.
- **Sensory Underresponsivity**—Causing the person who is a “sensory straggler” to show slow, or little, or even no reaction to stimuli. The person may ignore body-centered and environmental stimuli. He may seem lethargic or lazy and need a lot of coaxing to get off the couch and out the door. The sensory straggler needs intense sensory input to “get it.”
  - Tactile: Kathy can walk barefoot in the snow and step into extremely hot bathwater without being aware of the extreme temperatures. She is unaware when her clothes are twisted or her tights are falling down under her dress. She doesn’t notice (or tend to) her chronic acne or cuts and bruises.
  - Vestibular: Freddy frequently trips on air. Unaware that he is falling, he doesn’t thrust out a hand or foot, in protective extension, in time to cushion the fall.
  - Proprioceptive: Valerie sits in a W position—on the floor with her knees close and feet out to the sides for extra stability. As she walks, she slaps her feet on the pavement for sensory input.
  - Visual: Gus doesn’t notice the snowball coming his way and doesn’t duck in time. He responds slowly when people gesture or traffic lights change.
  - Auditory: At a football game, Enrique doesn’t hear his friend calling, “Yo!” to get his attention.
  - Olfactory and Gustatory: Susie doesn’t detect that the cheese is moldy.
  - Interoceptive: Jenna doesn’t notice when she has eaten too much spicy salsa or that she has a stomach ache.

- **Sensory Craving**—Causing the person who is a “sensory craver” to seek certain sensations longer and more intensely than others. She seems addicted to stimuli. But added sensory input, instead of being satisfying, causes her to become increasingly disorganized and frenetic in search of ever more stimulation.
  - Tactile: Sandy constantly reaches out to touch objects and people.
  - Vestibular: Steve craves extremely invigorating activities like mountain biking, skateboarding, and downhill skiing. He is in perpetual motion, rocking on his feet when he stands and jiggling in his seat.
  - Proprioceptive: Myrna bumps and crashes into everything and everyone in her path. She constantly gnaws fingernails, hair, pencils, and straws. She always has gum, cookies, or chips in her mouth because she needs to chew. She begs for hugs to get deep pressure.
  - Visual: Sara can’t get enough of watching sliding doors open and close. At a party, she lifts her face to stare directly at the strobe light.
  - Auditory: At a concert or party, Burt gets as close to the amplifiers as possible. Music can never be too loud for him.
  - Olfactory and Gustatory: When Larry enters a room, he sniffs the air. He sniffs food, objects, and other people. Now a high-schooler, he must control his urge to lick objects and people—but he would if he could.
  - Interoceptive: Joan eats a whole pizza or a gallon of ice cream, and then some more, to get the sensation of being full.

## **B) Sensory Discrimination Challenges**

Causing the person who is a “sensory jumbler” to have difficulty discerning differences among sensory messages, such as how things look, sound, feel, weigh, taste, and smell.

### **EIGHT SUBTYPES OF SENSORY DISCRIMINATION CHALLENGES**

- Tactile (touch): Josie looks disheveled, with messy hair and unkempt clothes. Buttons, zippers and belts confound her. She seems “out of touch” with her hands and feet, as if they are unfamiliar appendages. When someone touches her she can feel it but doesn’t know where on her body she has been touched. Touching and holding objects, she has difficulty perceiving their texture, temperature, shape, size, or density, and she often drops them.
- Vestibular (balance and movement): In an elevator, Scott can’t tell if the elevator is rising or descending, and he often feels nauseous. Because of poor coordination and balance, he has never learned to ride a bike.
- Proprioceptive (body position): Sophia is confused about how much force to exert and often lifts a book with so much force that she sends it flying, or she squeezes too hard when she hugs a friend. She is clumsy positioning her body to get dressed, especially if she can’t see what she is doing.

- **Visual (sight):** Manny stands there for a while looking for the pickle jar in the refrigerator or two matching socks in the dresser drawer. Poor depth perception makes sports activities difficult, because he can't easily judge where and how balls, Frisbees, pucks, and other players are moving. Learning to drive, he has difficulty knowing where the car is on the road, where other cars are in relation to his, and especially how to parallel park.
- **Auditory (sound):** Mia is confused in large groups when several conversations are going on around her. She often mistakes a loud, friendly voice for an angry voice, or a "No!" for a "Go!" She has difficulty understanding jokes or puns or remembering song lyrics, a teacher's verbal instructions, or what a friend just told her.
- **Olfactory (smell):** Avery can't tell the difference between watermelon or cherry scents or between a clean T-shirt and the one he wore all day yesterday.
- **Gustatory (taste):** Charlotte can't discriminate when food is too salty or sweet or that she has a bad taste in her mouth and should brush her teeth.
- **Interoceptive (internal bodily functions):** Dick often doesn't realize that he is hungry or that he needs to have a bowel movement.

### **C) Sensory-Based Motor Challenges**

Difficulty with movement resulting from inefficient sensory processing, especially in the tactile, vestibular, and proprioceptive senses.

#### **TWO SUBTYPES OF SENSORY-BASED MOTOR CHALLENGES**

- **Postural Issues**—Causing the person who is a "sensory slumper" to have difficulty stabilizing the body while moving or resting in response to the sensory demands of the environment or task. The person may struggle with sensory-based motor functions, such as muscle tone, motor control, balance, bilateral coordination, and crossing the midline.

Roberto slumps at the desk and dinner table. His weak muscles, low tone, and poor core strength make it hard to sit and stay upright. He is clumsy using pencils and scissors, walking on gravel, stepping off the curb, reaching for a coffee mug, swimming, kicking a ball, and other tasks that require him to position his body accurately. He would rather stay seated, because movement takes so much energy!



- **Dyspraxia**—Causing the person who is a “sensory fumbler” to have difficulty with the steps involved in a complex task:

- Ideation, i.e., thinking of an idea for a new, multistep action.

George’s friend Don and his older brother Sam pick him up to go to the movies. Riding in the back seat makes George uncomfortable, but he has no choice. With some effort he climbs in, closes the door, and slumps back. Sam waits for a moment and then says, “Seat belt, dude.” George sighs. Oh, yeah, seat belt. Right. That, too.

- Planning and sequencing the necessary motions.

To put on this unfamiliar seat belt, George must modulate and discriminate messages from five sensory systems: vestibular, to turn his head, as well as to stay calm and alert; visual, to look for the buckle; proprioceptive, to stretch out his arm; tactile, to grasp the buckle, and proprioceptive again, to gradually draw out the belt; and auditory, to click the buckle into place. Using his senses to do all these tasks does not happen automatically, so George has to think each one through.

- Execution, i.e., carrying out the plan of action.

Sweating, George fumbles with the multistep action and eventually secures the seat belt. Ten minutes after the car pulled into his driveway, off the boys go to the movies.

Clumsiness is something we all experience now and then. Most of us falter with unfamiliar actions that have sequential steps. Try to remember the first time you rode a bicycle, went through an obstacle course, followed a complex recipe, played Ping-Pong, or dressed up for a date. Initially, everyone bungles a few steps and must redo them a few times, until these novel tasks become routine.

But unfamiliar actions are full of significant stumbling blocks for the sensory fumbler with dyspraxia. Balancing on a bike and flossing teeth may take many, many rehearsals and much, much effort. It’s easy to see that SPD could be disheartening in body, mind, and spirit, but all may — and often does — turn out well.

In sum, the red flags of SPD are unusual responses to sensory input, especially touch and movement input. One sense, several senses, or all the senses may cause problems. Different combinations of modulation, discrimination, and sensory-based motor issues may occur in one person. *SPD is not an “all or nothing” condition.* It may be a little of this and a lot of that, and the issues may differ from day to day, from place to place.

Everyone contends with changes and challenges as they develop. When the senses are out of sync, individuals with SPD struggle with a heavier load than do their typically developing peers. Treating these individuals with respect and appropriate therapy (such as Occupational therapy using a sensory integration approach, or OT-SI) is essential.

Visit [www.sensoryhealth.org](http://www.sensoryhealth.org) (website of the STAR Institute) to learn more about SPD and its research and treatment.

Visit [www.CarolStockKranowitz.com](http://www.CarolStockKranowitz.com) to learn about Carol's publications on SPD and also about In-Sync Child movement activities (with Joye Newman)



*The Out-of-Sync Child (3<sup>rd</sup> ed): Recognizing and Coping with Sensory Processing Differences*  
*El Niño Desincronizado* (Spanish translation of *The Out-of-Sync Child*) - also 14 other languages  
*The Out-of-Sync Child Has Fun: Activities for Kids with SPD*  
*The Out-of-Sync Child Grows Up: Coping with SPD in the Adolescent and Young Adult Years*  
*Growing an In-Sync Child: Simple, Fun Activities to Help Every Child Develop, Learn, & Grow*  
 (with Joye Newman)  
*In-Sync Activity Cards: 50 Simple, New Activities to Help Children Develop, Learn, and Grow*  
 (with Joye Newman)  
 A chapter in *Autism in Lockdown*  
*The Goodenoughs Get in Sync: 5 Family Members Overcome their Special Sensory Issues*  
*Answers to Questions Teachers Ask about Sensory Integration* (with Stacey Szklut, et al.)  
*Preschool SENSE: Sensory Scan for Educators (Preschool SENSE)*  
*Absolutely No Dogs Allowed!* (with Asher Kranowitz)  
*101 Activities for Kids in Tight Spaces*  
*A Year of Mini-Moves for the In-Sync Child* (with Joye Newman)