

Lecture on Regulatory/Sensory Processing

By Stanley Greenspan

Let's start off with a definition of regulatory sensory processing disorders. They are challenges that infants, young children, older children, or even adults have in taking in and responding to different sensations such as sight, sound, touch, smell, and the feeling of one's own movement in space.

We have all seen children, or have ones of our own, who over reactive to sensations like touch or sound. A busy classroom might be overwhelming to a child, who then covers his ears and huddles off into a corner. Another child in that busy classroom might get impulsive and strike out at another child. Other children in that busy classroom may be the opposite—that is, they are children who crave sensation and bang into children. They want more and more sensations.

As part of the regulatory sensory processing disorders, we also see challenges in how information coming in through the senses is processed. Children with auditory processing or language problems have a hard time making sense out of what is said to them, first in sounds and vocal gestures and then with words. It is hard for them to recognize patterns. Other children have a harder time with organizing and making sense out of what they see so that complex visual patterns may be hard. As a baby, they may see mommy's smile but not her eyes, nose, and smile together. It's harder to see the whole pattern of the face. Eventually they get there, but it takes them a little bit longer.

As I mentioned, some children have problems planning actions and can only do a one- or two-step action, such as moving a car back-and-forth. Other children can push the car into the tunnel, pull the car out from the other side and then pretend the car is an airplane and zoom it through the air.

So we will see very, very different patterns in the ways in which children respond to sensations, make sense of them, and plan actions. When you think about it, it is through the ways in which we take in and process sensations and the ways we respond to them that let us get to know our own bodies, our environments, and the world we live in. It is fundamental for the child's sense of security. It is fundamental for this child to feel regulated. It is fundamental for having a sense of one's own body because awareness in space and awareness of one's self in relation to other people depend on this. A child who gets really close to you and invades your space or touches inappropriately may not form boundaries—where they define themselves and they define others and they learn the rules of social interaction—because they have a hard time in processing sensation and planning actions.

Broadly speaking, we can think of the ways in which children modulate sensations as over reactive, under reactive, or sensory seeking; we can think of the ways in which they process or take in sensations, recognize patterns, and then interpret sensations. How well do they understand words, then sentences, and then whole paragraphs? Reading comprehension at a higher level comes of that. How well do they understand complex visual designs? They can be overreactive to things like bright lights or colors and only recognize simple patterns, or they can recognize very complex patterns and even be able to reproduce them or change them like junior architects.

The third broad area is how they organize responses: how well they plan actions and carry them out. Can they do a 10-step action plan or solve a difficult obstacle course, or are they limited to just a one-step action where they bang a toy over and over to hear the sound because that is all they can do? We see different patterns of motor planning and along with that we may see differences in coordination

and muscle tone. Some children have low tone and some have increased muscle tone. We are talking about categories that are short of those children with motor problems such as cerebral palsy. Postural control is certainly affected by muscle tone and by other factors concerning different parts of the central nervous system like the cerebellum. Balance, coordination, and postural control are all factors with which our colleagues in occupational therapy and physical therapy assess the motor system and the way in which the child can respond to his or her world.

If you look at an 8-month-old baby, you'll see that all of these systems have to operate smoothly together for that baby to begin developing a sense of who she is as a person – intentionality. Under optimal circumstances, you will see an 8-month-old who initiates interactions with big smiles and some vocalizations. Mom vocalizes back, baby vocalizes and beams back a big smile, she reaches out to take a rattle from mommy's hand, mommy offers to take it back, she hands it back to mommy, and we get a back-and-forth interaction going. We can see how all the systems are working when the child hears Mom's voice, sees her face, sees the rattle, and doesn't overreact to the sensations. Similarly, Mom doesn't have to energize up and use a really loud voice to get her attention. The little one is not under reactive. So the 8-month-old hears the voice, sees the rattle, gives her a smile and coordinates those sensations while reaching for it—coordinating three motor patterns at the same time. She gets pleased and excited without getting overexcited. Look at all of the things happening in that simple give-and-take. We see this ordinarily around 8 months. Some children won't achieve all of the systems working well until 10 months.

When the system doesn't work well, any part of the pattern may not function in the way we would like it to. We may see all kinds of difficulties—a child not responding at all, a child who cries and gets finicky because the voice is irritating, a child who doesn't reach for the rattle and instead just flails her arms and cries because she might be hungry, or a child who wants to play but doesn't know how to express her desire to play.

The regulatory sensory processing disorders or challenges can underlie difficulties with attention, including ADHD and ADD, and with controlling behavior, such as being impulsive, aggressive, or destructive. It can also underlie various learning difficulties with reading, writing, or doing math. It can underlie anxieties and problems with regulating mood. Sometimes we see a lot of mood shifts in children with challenges in their regulatory and sensory processing areas.

A side note—the reason why we call this area regulatory sensory processing rather than just sensory processing is that it has to do with the way in which security and regulation are established as a foundation for all future development. In just a moment, I will share with you how affect or emotion is a key component in a child's progress in regulatory sensory processing. I should also add as a caveat that when I say that it underlies some problems with attention, language, learning, behavior, and mood, including anxiety as well as depression, I'm not suggesting it is the only contributor. I should also mention that we see this in children with autistic spectrum disorders. Most children with autistic spectrum disorders have regulatory sensory processing challenges as a contributing factor. And it is a contributing factor in many other kinds of problems as well, often not as intense as children with ASD. For some children, it is a more important contributing factor than for others.

As I said, the regulatory sensory processing disorders underlie many common problems from attentional problems to mood and anxiety challenges to behavioral problems. Let me give you a few examples of how that works before we go into the key role of emotion or affect in organizing our senses and improving sensory processing challenges.

Consider attentional problems. If children are over reactive to sensations, they are easily distracted by different sights, sounds, and/or touch. They may not react to them immediately, but they certainly notice them more quickly than others. They can be very sensitive people and in tune with many aspects of their environment or they can be highly distractible, looking from one place to another, jumping around. It could also contribute to their being impulsive – they get overloaded and scared. As I like to say, a cat’s meow sounds like a lion’s roar, and feeling under threat, they strike before being struck. A child who is over reactive to sound and touch may easily be more anxious. Mood swings are more possible because the child gets overwhelmed so easily that they can get hyper, and then if the environment doesn’t respond in a soothing way and people withdraw from them, they may feel lost and go into more sadness and later on experience a depression where they have a hard time feeling secure because they feel they are always losing the ones that they depend on the most.

Children who are under reactive may get lost in their own dream world, hardly noticing the environment around them and seem self-absorbed because the people around them aren’t energizing up enough to attract them with their voices, movements or ideas, even though a child may be capable of responding. It may look like he has an ADD form of attentional problems, not the ADHD with the hyperactivity, but more the passive form where they daydream and stare at the tree outside.

A child who craves sensations may bang into people and be aggressive or seem aggressive because they crave so much sensation. They want to be active all the time and they may invade other people’s body space and get very close. We have discussed elsewhere the complex, interpersonal interactions that can make some of these sensory processing patterns much worse, leading to anxiety, depression, or mood instability.

A child who has difficulty with not only modulating sensations (being over reactive, under reactive, or sensory craving) but who also can’t make sense of sensations can easily have learning problems. Reading comprehension will be affected by auditory processing and language difficulties, that is, making sense of what you hear: the sounds, the patterns, and eventually what they mean. A child with visual spatial difficulties, that is, making sense of patterns and visual complexities in the world, will probably have a hard time reading graphs. The whole sense of quantity—something being more or less than something, equating numbers with sizes and shapes—has to do with how we see the world. Most of math underlies that. It is easy to memorize that $2+2=4$, but it is difficult to understand that 2 apples + 2 apples = 4 apples in terms of seeing it as a pattern. For those of us who do, it is hard to imagine those who don’t. It seems so obvious. But those who don’t see the patterns see the trees but not the forest. That can be very, very difficult and can underlie many math difficulties. Writing requires motor planning, particularly in the fine motor area. Sports or dancing require the gross motor area, where you are carrying out many actions in a row. All of these can certainly be harder with regulatory sensory processing difficulties.

These are only a few examples. What is important to recognize, however, is that these sensory processing patterns and disorders are important contributors to a range of difficulties. Take a child with ASD. If the world seems overwhelming, he may well withdraw from it. If that is compounded with auditory and language problems and making sense out of what he sees—visual spatial processing challenges—it is easy to understand why the world is not only confusing but hard to make sense of. He may have trouble developing language and social interaction patterns and may resort to or fall back on repetition, perseverative patterns if he has a good memory. Then a diagnosis of ASD may be made. The

regulatory sensory processing patterns might not be the only factor, but they may be an important contributor.

I mentioned before that we were going to look at the critical role of affect or emotion in all of this. Emotions or affects have a key role in how regulatory sensory processing challenges and disorders develop, and more importantly, in how we can help children improve their capacities and overcome some of these challenges. To understand the key role of affect or emotion, let's come back to what we call our DIR® Model. "D" stands for the developmental stages or what we call functional emotional development like engagement, two-way emotional signaling, shared emotional problem solving, using ideas to label, and being creative with emotions and logical about emotions. The "I" part in DIR® has to do with the different processing areas I have outlined – sensory modulation, motor planning, making sense of sensations. The "R" part is relationships with caregivers, teachers and anyone else you interact with. Ideally we tailor the "R" to the "D" and the "I" – to the child's developmental stage and interaction with the world.

Now affect or emotion is a key part of both the "D" and the "R" and I'm going to show you that it is also a key part of the "I" – the individual differences, the way in which sensations are processed. That is not commonly recognized.

Let's take a newborn baby in the first months of life just learning to look at mommy and focus on her wonderful voice and turn right or left, look up or down to look for that wonderful voice that is saying, "Oh, my sweet little baby, my little sweetheart, aren't you adorable! What a cute little nose you have!" How does a baby do that? Well, routinely we see that baby in the first days of life turn his little head toward that wonderful voice to see what they soon recognize as a big smile. (Later on they will see the whole face.) Look what they are doing – they are seeing, they are hearing, and they are moving, all in a coordinated way, just by turning towards mommy. We see some babies who do this easily in those early days and weeks, and other babies who have a harder time. By three or four months, or even two months, the babies are breaking into big, robust smiles as they look at mommy. We begin seeing mouth movements that are imitating almost what mommy is doing, again responding to what they are seeing and hearing with movement of their own.

So we are seeing a number of systems, and if mommy is also stroking baby on the tummy or on the hand, they are integrating touch into this system. They are integrating touch, sound, sight, and movement all into one harmonious whole. Now our hypothesis is that the pleasure in hearing mommy's voice and seeing her face (or any other caregiver's voice and face) and the ability to move to find that face is what motivates all of these senses – sight, sound, and touch – to work together and work together with movement. It allows the baby to integrate what they are seeing, what they are hearing, what they are touching, and probably what they are smelling too, and later on what they are tasting, with a movement pattern that allows them to have more pleasure and more delight in that voice. Where that affect is not pleasant, where the baby is hyper responsive to sounds and mom doesn't know that the baby needs a slightly lower-pitched voice or does better with daddy's voice than mommy's voice, we'll see the baby sometimes looking in the opposite direction or not at all. Or maybe the baby has physical problems with motor planning and they look past the voice. They may need more practice and with patience they can get it. But if you assume that your baby doesn't love you or doesn't want to talk to you or look at you and you shut down so that the baby doesn't get the extra practice, then that baby won't get what they need—that is, practice in using their emotions to coordinate all the senses.

Now part of our hypothesis is that when the baby can experience positive pleasurable affect, he organizes and coordinates the use of the senses. In most cases it does happen. (Some cases require a professional consultation. Earlier rather than later is better.) And we feel that it not only helps the baby integrate all the senses—and develop them because they are using them—but probably, and I say probably because we have seen this in animal work but don't have overwhelming research evidence for humans yet, it probably facilitates laying down the neurological pathways that coordinate and integrate the senses.

The most recent theories of autism, from the physical and biological point of view, is that it is not so much a problem of one area of the central nervous system or brain, but a problem in the coordination of the pathways between the areas of the central nervous system or the brain. We believe that there may be genetic and physical reasons that contribute to making it more difficult to form these pathways, which gets compounded by the baby who has a hard time interacting in the way we are describing. We see that by using high affect states in the baby's own natural interests early on helps the baby begin coordinating their senses and engaging in the human world. We think this helps lay the proper pathways down. Research may confirm this, but presently the brain imaging technology sometimes involves risks for a newborn baby. You certainly don't want to do PET scans or overdo neuro imaging. But sophisticated techniques are emerging, and soon we hope to have evidence that this is exactly what happens in normal, healthy development.

The one thing we do know about human beings is that the brain or the central nervous system is only very partially formed at birth. Evolution or Mother Nature has designed it so that most of our brain develops after birth and that experience with the world helps lay down pathways. That we know pretty much for sure. So we are dependent on our experiences to lay down the proper pathways. This makes sense since we can adapt to different environments. If we are in an environment that has certain sounds, we become more sensitive to those sounds and we decode them more easily. Same thing with certain sights. Children growing up in Asia decode different sounds than those growing up in America. Not that they can't learn other languages later, but it is easier for the brain to learn these from the get-go. So the brain seems to adapt to its environment and develop pathways consistent with the environment. That is why we feel this is so important in the role of emotion which is vital in integrating the different senses.

Let's jump back to our 8-month old baby beginning to get into a back-and-forth flow of interaction, reaching for a rattle, exchanging vocalizations—mommy makes a sound, baby makes a sound, mommy smiles, baby reaches for mommy's lips, mommy gives baby a kiss on the fingers, baby looks at his fingers, and we get that nice back-and-forth, almost like a dance. We call this process "circles of communication." Later, these will evolve into shared social problem solving where little Sally takes daddy by the hand and looks at the toy up on the shelf. Daddy gestures towards the toy, Sally reaches up for daddy to pick her up, daddy picks her up and she vocalizes with glee, reaching for the toy as he says, "Oh my good little girl, do you want to play with it?" Sally nods her head 'yes' even though she can't say it yet, and they get down on the floor and play with the toy. Here we see many back-and-forth interactions without using words, doing what we call shared social problem solving.

When a baby moves from the 8-month level of back-and-forth interaction to the 16-month level of shared social problem solving, we see that babies now have a capacity to control their sensory world better. For example, a 16-month-old can give you a facial expression or a sound that indicates that your voice is too loud. Then you lower your voice a little bit and say, "Oh, what's the matter?" and he goes "ahh, ohh" and you hear a nice sound. A 16-month old can put his hands over his ears as a signal to be

more soothing. So we see now back-and-forth communication with the baby where he regulates his own sensory world by giving you feedback to what he likes and doesn't like.

This is a tremendous advance from the feeling of getting overloaded or overwhelmed where all children can do is go into the fight-or-flight patterns, get panicked, and avoid or run away. Or where they strike out or get impulsive. Or where they just shut down and withdraw from the world.

As soon as the baby starts to be able to interact with emotional signaling, they can exercise control over their world. The more responsive caregivers are, the more the child has that sense of control and mastery and that sense that "I can have impact on the world" and "I can help my own sensory system."

Emotional progression through the stages can help a child not be dysregulated even with a tendency to be over reactive. We use the emotions in the "D" and the "R" part (the different levels of emotional development, and the different learning relationships) and they contribute to the "I" part, the individual differences.