Between six and nine of 10 children and adults with autism have sensory difficulties that can interfere with everyday activities. They may be hyper-sensitive to sounds, sights, the feel of fabric or other sensations, or unaware of their body, for example. This can contribute to trouble playing, learning, socializing and even eating, getting dressed and bathing.
In a bustling and colorful occupational therapy gym, a boy soars on a stand-up swing, laughing as he flies higher and higher. It’s an exhilarating moment for this 5-year-old—and a data point in a groundbreaking Jefferson study that’s changing the way experts, clinicians and parents view sensory integration therapy.

Now, Roseann Schaaf, PhD, OTR/L, FAOTA, professor and chair of the Department of Occupational Therapy in the Jefferson College of Health Professions and director of the university’s Autism and Sensory Integration Lab, is conducting randomized, controlled trials gauging the effectiveness of the therapy and investigating its effects within the brain.

SENSORY INTEGRATION THERAPY:
New Science for a Hotly Debated Autism Intervention

BY SARI HARRAR
“Sensory integration therapy can help children with autism process sights, sounds and other sensations from the world around them in a better way so they will not withdraw or have difficulty doing everyday things like putting on their coat or transitioning from one activity to another,” explains lead investigator Roseann Schaaf, PhD, OTR/L, FAOTA, professor and chair of the Department of Occupational Therapy in the Jefferson College of Health Professions. “Sixty to 90 percent of individuals with autism experience sensory dysfunction that interferes with daily activities. Some children hold their hands over their ears when the toilet flushes, or can't tolerate certain textures of clothing or food. Others don't use body sensations to guide their movements during activities such as dressing and have difficulty participating in active play.”

The treatment for these sensory difficulties is to engage the child in individually selected, sensory-rich activities during play. Occupational therapists use swings, balls, scooters, pits filled with balls or foam blocks and other equipment to help kids stretch their sensory limits—and their brains. One rule: It's always fun. “When something is playful,” Schaaf says, “you're motivated to go a little outside your comfort zone.” Importantly, the activities are chosen based on each child's needs as determined by a thorough occupational therapy assessment.
Michael, one of 32 children in Schaaf’s 2013 study, “had a blast,” according to his mother, Marion G. “Sometimes it was challenging, too,” she says. “We saw improvements. Michael had been so easily distracted that he would stop doing things he really enjoyed and get up and wander away. His focus was much better after the occupational therapy.” Now 9, Michael has continued to receive more occupational therapy/sensory integration therapy even after the study was completed because it was so helpful, she says.

Popular with parents (39 percent named it their first-choice therapy in a recent survey by the advocacy group Autism Speaks), occupational therapy using the principles of sensory integration (OT/SI) hasn’t been as warmly embraced by the healthcare system. The American Academy of Pediatrics urges caution due to “limited data.” Health insurance coverage is spotty. “There has been a lack of rigorous research,” Schaaf says. “We’re just starting to change this by providing better evidence.”

**A New Science of the Senses**

Schaaf’s work is especially relevant as autism rates climb in America. It’s the most common developmental disability of childhood. The Centers for Disease Control and Prevention estimates one in 68 children has autism spectrum disorder (ASD), but a new CDC survey of 12,000 parents released in November 2015 found that one in 45 of their children had an ASD diagnosis.

Sensory integration isn’t the only autism treatment out there—and shouldn’t be used as a child’s only therapy, Schaaf says. It’s best to use this therapy as part of a comprehensive plan of treatment. “People are always looking for the cure. This is not the cure,” she says. “I have to make this clear to parents. But hopefully it will help your child function better in his or her everyday life. Kids and families need that.”

The current standard of care for autism is behavioral intervention, which is based on rewarding small improvements in behavior. Research shows it works, but the process can be time consuming and costly—requiring 25 to 40 hours a week of training for up to two years to see progress. Sensory integration uses a different approach by assessing a child’s sensory-processing gaps to find clues to difficulties—such as becoming distressed about taking a shower. While a behavioral specialist might reward longer and longer stays in the shower, an occupational therapist might use play time in a ball pit to ease a child’s sensitivity to physical sensations. And some children, Schaaf’s research suggests, could see improvements in 10 weeks.

In a headline-making 2013 study, Schaaf and her team found that OT/SI was more effective than usual care alone at helping kids with autism reach functional goals set by their parents. It was one of the most rigorous studies of OT/SI ever conducted. Thirty-two children, ages 4-8, participated. Those in the treatment group had three hour-long OT/SI sessions a week for 10 weeks. The control group received usual interventions but not OT/SI.

Every step of the study was carefully designed. Parents set goals for their kids and then Schaaf’s team assessed if and how a child’s ability to process and integrate sensation contributed to difficulties attaining these goals. These assessment data were used to identify the sensory-motor factors affecting the child’s goals and became the focus of treatment. Outcomes were measured in a systematic way to provide data about whether the treatment was working. Following this approach developed by Schaaf and colleagues, the effectiveness of the treatment in meeting parent-identified goals could be tested. “The outcomes of a therapy should be changes that are important for the child and the family,” Schaaf explains.

OT/SI programs were customized to each child’s needs. For one child, a goal might be to engage in play for a longer period of time with a friend. Sensory difficulties getting in the way might include low body awareness and sensitivity to physical sensations, like the brush of clothing or the feel of toys. “So the therapy might include having the child climb up a rock wall and use a zip line to ‘crash’ into a large pit of colorful balls and small stuffed toys providing a variety of textures,” Schaaf explains. “We have research showing that children with autism do not respond to sensation in the same way as other children, and our collaborators have shown that many persons with autism do not process two senses simultaneously so the brain doesn’t integrate them readily. Engaging in activities like this helps change
Members of “Team Solve the Puzzle” raised $52,000 to support Schaaf’s work. Photo by Roger Barone.

this. The brain is plastic—it can change. Occupational therapy using sensory integration seems to help with this processing. This is what we are studying in our newly funded NIH study.”

The 2013 study was conducted at Children’s Specialized Hospital in Toms River, N.J. All therapists were trained in the approach, and therapy sessions were video-taped to ensure that therapists followed established OT/SI techniques. Investigators who assessed participants were “blinded”—they didn’t know which treatment group they were in.

The outcomes of this randomized, controlled trial—published in Journal of Autism and Developmental Disorders—give OT/SI a more evidence-based foundation. “That’s huge,” Schaaf says. Children like Michael in the OT/SI group scored significantly higher in reaching goals (13 points higher, on average) than those in the usual-care group. They needed less help from their parents in self-care activities and socializing with others. Problem behaviors associated with poor sensory processing also improved.

“Like all treatments for ASD, sensory integration approaches need to be rigorously tested,” says Paul Wang, MD, senior vice president and head of medical research for Autism Speaks, which funded Schaaf’s study with a $500,000 grant. “We can’t assume that any treatment works, even if those treatments seem to make sense and seem to be safe. Families spend very valuable time on treatment (besides sometimes spending a lot of money), and we have to be sure that their time and efforts are going toward treatments that really help. This is a building block step … We still need the rigorous testing to show whether the therapy really helps. If it does, then we would have a strong case for insurance coverage.”
Wiggle the little toe of your left foot, and a detailed map of your body is activated in your brain. Your toe’s attached to your foot, which is in a sock, in a shoe, on the floor by the chair leg. “You have a map of your body in your brain,” Schaaf says. “A muscle sense called proprioception constantly tells your brain where your body is and provides the basis for moving it in a useful and coordinated way.”

Your sensory systems are crucial for everything you do, every day. But if you have a sensory dysfunction, the brain doesn’t process and integrate this and other senses in the usual way. You may feel less stimulation and feel unaware of your body, or be so sensitive that it’s overwhelming. Gaps in processing and integrating sensation can contribute to a surprising range of behavior and learning problems in autism. Occupational therapy using sensory integration addresses these problems focusing on these three systems:

**TACTILE SYSTEM: YOUR SENSE OF TOUCH.** The receptors of the tactile system are in your skin, and if the tactile information isn’t being processed properly, you may touch and feel things more or less than others. You may overreact to the feel of fabrics and other textures. This could be reflected in problems getting dressed, with feeling extremely uncomfortable in your clothes—or, if sensation is dulled, resulting in a decreased awareness, you may need to touch more things, more often.

**PROPRIOCEPTION: MUSCLE SENSE.** “If you’re not getting good proprioceptive feedback from your muscles and joints, you may have trouble responding with the right facial expressions or body language during a conversation,” Schaaf says. “And you may have trouble with physical activities like riding a bike or figuring out how to use a playground swing.”

**VESTIBULAR SYSTEM: THE PERCEPTION OF MOVEMENT.** Processing problems could lead to clumsiness, balance issues, even trouble using your eyes and head together in a coordinated way that could lead to reading and learning problems.
Inside the Brain

The study’s conclusions made headlines. Results for individual participants made a difference in their lives, Schaaf says. “One parent wanted their child just to be able to participate in activities with peers,” she says. “After OT/SI he started going bowling after school with his classmates. He showed better ability to regulate his behavior during the bowling activity and was more aware of his body and his boundaries. One day, he noticed that another child was having trouble and this boy went over and said, ‘Here, let me help you with that.’ He was really able to empathize. Did OT/SI do that? We can’t say, but these are the kinds of stories we hear. By changing how sensations are processed and integrated, children with autism can make better sense of the information they receive. They can relate better to others, learn more and do more. It ripples out into their lives.”

Schaaf’s research team has published the study’s treatment manual so other occupational therapists can use it. She encourages other occupational therapists to conduct their own studies with validated tools for measuring outcomes. “We see ourselves as therapists, but we need to investigate our therapies as researchers, too,” she notes.

Meanwhile, she recently began a collaboration with cognitive neuroscientists Sophie Molholm, PhD, and John Foxe, PhD, of New York’s Albert Einstein College of Medicine to look into not only how OT/SI improves the child’s functions but also if it changes the way the brain processes and integrates sensations. Using the protocol Schaaf and colleagues implemented in the prior study, they will study 180 children with autism who receive OT/SI, behavioral training or usual care. In addition, they will use electroencephalography to measure how the brain is processing sensations before and after. In 2010, Molholm and Foxe used these methods to show that the brains of children with autism spectrum disorders process sensory information differently. “We know these interventions impact brain function,” Molholm says. “We want to know how.”

The National Institutes of Health is funding that study with a $4.1 million grant. “We are so pleased to receive this grant and have the opportunity to study OT/SI on a larger scale,” says Schaaf. But it’s not just the government and big groups supporting Schaaf’s work. In fall 2015, a group of South Philadelphia mothers of children with autism held a fundraiser at a local restaurant that provided $52,000 for Schaaf’s Sensory Integration Laboratory at Jefferson. “I just think it’s so important to make people aware of the condition—that’s our number one concern,” Stephanie Bongiovanni, of “Team Solve the Puzzle,” told a local reporter. “So many people just don’t understand it. Sometimes it’s a struggle just to take your kids to the park. It’s not because they’re bad kids and we’re bad mothers—it’s over-stimulating for them.”

Schaaf says OT/SI can be one piece of the treatment puzzle for such children. “It’s not the only piece—children need a team to help them. And they need testing to determine the cause of their difficulties. Then, it can be an important piece.”

By changing how sensations are processed and integrated, children with autism can make better sense of the information they receive. They can relate better to others, learn more and do more. It ripples out into their lives.

For more information about Roseann Schaaf’s work or to support her research, contact Greg Schmidt, Director of Development for the Jefferson Colleges, at 215-955-0435 or gregory.schmidt@jefferson.edu.