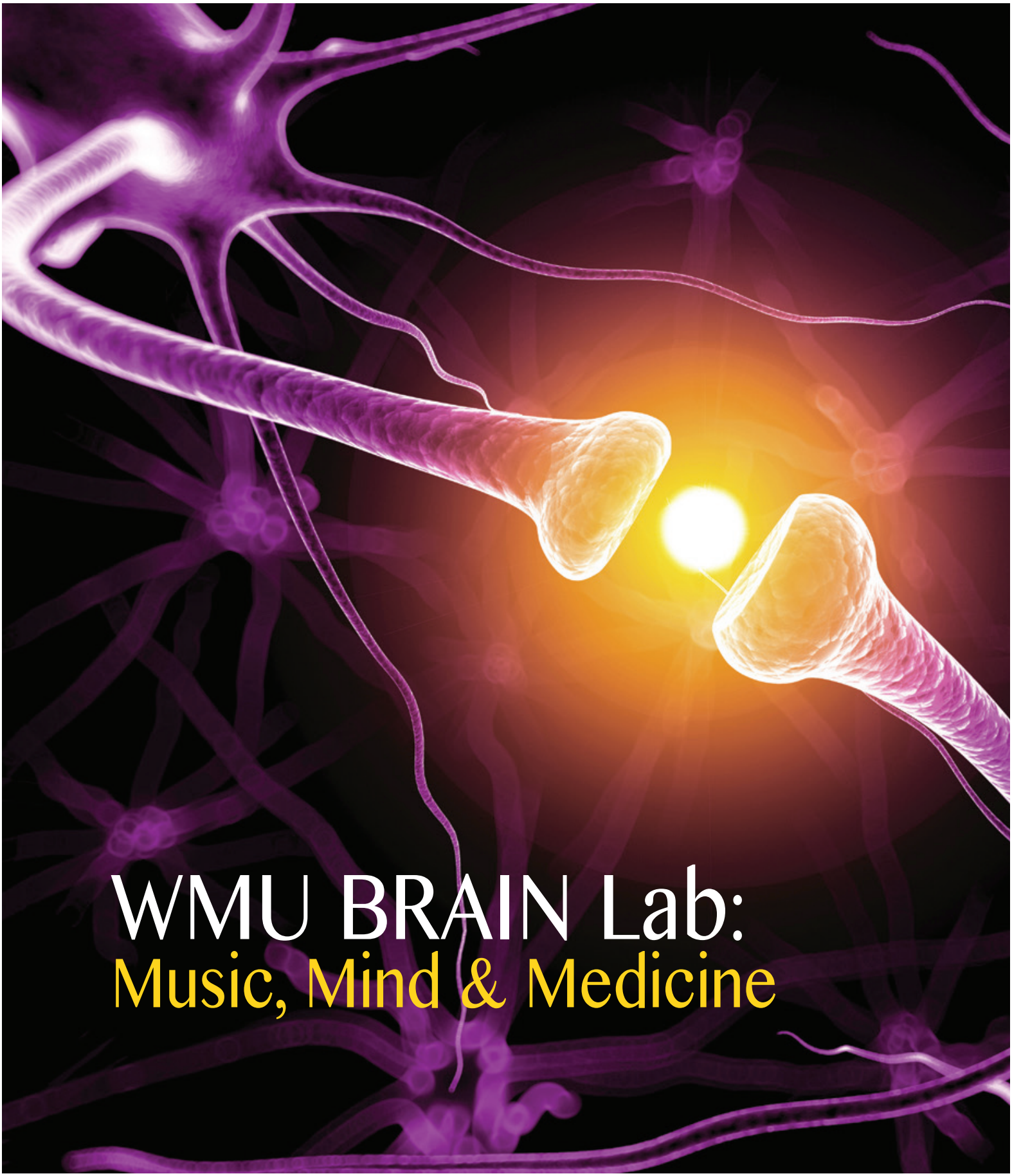

WMU BRAIN Lab:
Music, Mind & Medicine

It was Christmastime in the mid 1980s, and American Jeff Barr was visiting a small farming community in Germany.

He knew few people and didn't speak the language, but Barr says he had an unforgettable experience one night that kindled in him a feeling of unity with perfect strangers.

"It was two days before Christmas, singing Christmas carols with a bunch of German townspeople—them in German, me in English, as the bürgermeister led the way… The most community I've ever felt, and I knew maybe two people out of the approximately 75 that were there," he says.

"It sure was a sense of community that transcended language, and it was brought on by music."

It may have felt like magic, but there is likely a neurochemical explanation behind that sense of connection Barr felt, and that many others also report experiencing, while creating or even listening to music together.

Deciphering the neurological underpinnings of this kind of experience is the subject of a study based in WMU's Brain Research and Interdisciplinary Neurosciences Lab, a lab directed and cofounded by Ed Roth, a music therapy professor in the School of Music and a fellow with the Academy of Neurologic Music Therapists.

For this and other BRAIN Lab studies, researchers are attempting to understand human behavior or disorders and their underlying neurobiology, leading to specific treatments for people with neurological disorders.

The scientific suspicion behind the feeling of unity Barr related is that the hormone oxytocin—sometimes called the "love" hormone—and another hormone, vasopressin, are part of what underlie these feelings of communion.

"We want to understand what facilitates that process. What creates this feeling of oneness and unity that people describe when they talk about making music together," Roth says.

As a clinical application, this knowledge may help inform how a music therapist provides treatment, says Jason Keeler, a graduate student working with Roth on the BRAIN Lab research.

Keeler notes that in some "clinical populations," such as people suffering from anxiety or depression, "oxytocin may be dysregulated. It may not be functioning the way it would in a typical, healthy adult."

"There are a few studies suggesting that in music experiences, particularly group singing, when we feel this connectedness, oxytocin may be mediating that social bonding. But more evidence is needed to fully understand what is going on," Keeler says.

"To me, the question is: What can we learn about the body's response to music and how can we use that to help people?'"

A separate study set to begin this spring may lead to a pain relief therapy. It will explore the affect of music on acute pain.

BRAIN Lab researchers attempt to understand human behavior or disorders and their underlying neurobiology, leading to specific treatments for neurological disorders.

Yet another project, in collaboration with a researcher at Johns Hopkins Medicine, is investigating musical improvisation as a possible treatment for children who have experienced trauma and suffer from alexithymia, a condition that hinders one's ability to express emotion in speech.

BRAIN Lab beginnings

Roth established the BRAIN Lab about five years ago to tap into disciplines across the University, including researchers in music therapy, psychology, occupational therapy, biological sciences and exercise physiology.

All are pursuing applied and clinical research using techniques driven by neuroscience.

"It was something that I had been wanting to do for a long time because I knew if we were going to make any meaningful headway into this type of research, we had to do it as a team effort," Roth says.

Roth

Members of the lab take seriously an interdisciplinary approach to scientific discovery.

"It's not just, I say my spiel and the other person contributes their information, but we actually try to teach each other so there is some overlapping of knowledge and skill sets," he explains.

As such, some of the research springs from the clinical neuromusicology field, and some of it expands into non-musical disciplines.

Dr. Ben Atchison, professor and chair of the WMU Department of Occupational Therapy, is a founding member of the lab.

"All of us on the team have a general interest in neuroscience. There are people who are much more aware and knowledgeable, but I've spent most of my career working with brain-behavior connections," he says.

Atchison specializes in treating and researching sensory-processing disorders in pediatric populations, with his most recent work focusing on children exposed to maltreatment. These disorders make it difficult for those afflicted to experience or react to information through their senses in an ordinary way.

At times, a child dealing with a sensory processing disorder, particularly one who has not yet been definitively diagnosed, may seem to be simply misbehaving.

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"You and I hearing background noise, noticing certain smells or getting exposed to common fabrics in clothing may be able to ignore it," Atchison says.

"But a child who has difficulty processing these stimuli would get irritated and have significant discomfort and maybe even have a meltdown because it's so overwhelming."

He says that "from the occupational therapy point of view, what we want to determine is: Can we make an impact on a child with our interventions and measure that impact using valid, hard neurological assessment methods?"

One BRAIN lab study is trying to plumb the neurological root of food selectivity in some children with autism. In extreme cases, the youngsters put such rigid, self-imposed limits on eating that it can affect their health.

"What we hypothesize is that children who have this food selectivity are having a sympathetic nervous system response to food—a fight or flight response," says Dr. Michelle Suarez, an assistant professor of occupational therapy who is leading the study.

Discovering the true cause of the child's self-restricted diet versus dismissing it as stubbornness can help support appropriate treatment.

An electroencephalography cap is a tool used by researchers and in medicine to detect electrical activity in the brain.

Music as medicine

The lab's study on alexithymia in children who've experience trauma demonstrates how different corners of science collaborating can potentially lead to novel therapies.

This study draws on expertise in WMU's Child Trauma and Assessment Center, on a neurologist at Johns Hopkins Medicine interested in music perception and on Roth's background in music and music therapy.

"You often hear people say colloquially that music picks up where speech leaves off. And music can talk in ways that language can't," Roth says.

"It hit me that we have a population of people who have difficulty, or for whom it is impossible, to use speech to express emotion, and we have this tool called music that people always refer to as being able to express emotion better than speech."

This combination of thought came around the same time a colleague of Roth's at Johns Hopkins did a TED Talk about what's happening in the brains of jazz musicians while they improvise.

Dr. Charles Limb's primary finding was that the part of the brain involved in auto-biographical self expression—the medial prefrontal cortex—becomes highly active when jazz musicians are improvising.

Meanwhile, one part of the brain involved in error detection and self-monitoring behavior modification, goes dormant.

"So jazz musicians have this perfect storm of neural activity related to uninhibited self expression," Roth says.

Using functional magnetic resonance imaging at Johns Hopkins, researchers plan to look at what's happening in the brains of two discrete sets of children, those who have not experienced trauma and those who have.

Both groups will improvise musically with Roth using a specially designed keyboard in Limb's lab.

"Using musically modified techniques, we want to see if we can recreate the same neural activation patterns that my research partners found when studying professional jazz musicians," he explains.

Ultimately, the research will lead to a fully-randomized clinical trial to determine the behavioral and emotional outcomes in children who are improvising with a trained music therapist.

The bottom line goal of this multiple-year project is to investigate whether music improvisation would be effective in treating children who have trauma backgrounds but who cannot express their emotions.

"For many people, expressing something musically is to do so with much greater emotional emphasis than to express the same thing through speech, and we're hoping to demonstrate the clinical application of this experience," Roth says. W

BRAIN Lab study explores food selectivity in children with autism

Have you ever prepared a meal only to have your child steadfastly eschew your pan-roasted brussels sprouts recipe, spurn spinach or reject broccoli out of hand?

For some children with autism, such ordinary picky-eater behavior can go to an extreme with the child refusing a whole food group, consuming only a limited range of foods or rejecting meals to a degree that it impinges upon their nutritional needs.

Mealtimes may become periods of great anxiety for child and parent.

WMU researcher Dr. Michelle Suarez has begun a new study aimed at learning more about what underlies the extreme "food selectivity"—self-imposed dietary restrictions—that some children with autism display.

"Between 40 and 60 percent of children with autism have food selectivity," Suarez says.

An assistant professor of occupational therapy, Suarez is conducting this study through WMU's Brain Research and Interdisciplinary Neurosciences Lab.

"The main motivation is to understand what is occurring with these kids internally," says Suarez, who frequently works with youngsters who have difficulty articulating their thoughts due to a communication or speech disorder or similar circumstance.

"They can't really tell us how they feel when they see a food necessarily or why they choose to avoid certain foods."

Researchers hypothesize that some children who are autistic and who exhibit highly selective dietary behavior are experiencing a sympathetic nervous system response—a fight or flight response.

This kind of physiological reaction occurs when a person is frightened or startled by something and their response is set in motion even before conscious thought.

So for these youngsters, their aversion to some foods may have a deeper meaning than simply disliking what's on their plate.

"We know that children with autism have more sensory processing disorders," Suarez says, and can be highly sensitive to stimuli, such as a food texture, that may not register with another person.

"Kids with food selectivity are more apt to over-respond to a stimulus, but at this point, we don't know anything about cause and effect," she says.

In the study, researchers are using electrodermal screening equipment from the BRAIN Lab to measure electrical changes on the skin's surface. This tool is often used to detect autonomic, or involuntary, responses of the nervous system.

Researchers match pairs of youngsters who are the same age—one who has exhibited food selectivity and one who has not—and measure their reaction to a variety of foods presented to them. The children are between 4 and 10 years old.

"This lab and this equipment provide an avenue for detecting some of what's going on with these children without them having to articulate it," Suarez says.

"By capturing their internal response, we can give it more weight in our treatment, and not just look at these food refusals as a behavior that they are choosing to do in order to control the situation or manipulate a relationship with their parents. Instead, it may be something they can't necessarily control."

As part of her occupational therapy practice, Suarez has long worked with children who have self-restricted diets.

> **"Between 40 and 60 percent of children with autism have food selectivity."**
>
> —Dr. Michelle Suarez, reseacher

Apart from this study, she runs a Finicky Feeders Clinic based in the Unified Clinics of the WMU College of Health and Human Services.

Children treated in the clinic are generally 2 to 10 years old and don't necessarily have autism or another diagnosed condition.

But the youngsters consistently reject eating one or two whole food groups—no fruits, no vegetables or no proteins, for instance—or eat fewer than 10 foods as part of their regular diet.

Clinicians have sometimes found that there's a medical comorbidity behind a child's self-limited diet. Perhaps, the child has severe acid reflux and eating is painful. Or, they may have difficulty swallowing.

"I work with a lot of children who can't advocate for themselves. They don't have a voice as much because of their communication issues or their special needs or their behaviors," Suarez says.

"I very much want to know what they are feeling and what they're thinking and what they need… One of my passions is treating food selectivity."

To learn more about this study on food selectivity in children with autism or about the Finicky Feeders Clinic, contact Dr. Michelle Suarez at michelle.suarez@wmich.edu or (269) 387-8467.