PROFILES

Raphael Bernier: Decoding the mysteries of the autistic brain

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Guts and glory: Given the unconventional approach to his own life, it's no surprise Raphael Bernier is focused on the atypical brain signals seen in people with autism.

In the spring of 2002, as a new graduate student at the University of Washington, Raphael Bernier was charged with introducing his advisor, **Geraldine Dawson**, before her lecture to a room of about 40 people from the psychology department. To Dawson's astonishment, Bernier sang his introduction to the tune of *On Top of Old Smokey*. “[It was] a pretty gutsy thing for a first-year student to do,” Dawson says.

Bernier's *curriculum vitae* is sprinkled with other surprises: one year spent counseling troubled teenagers, another year with the **Peace Corps**, and almost three years on the board of a local yoga center.

A little over a year ago, **Bernier** became an assistant professor of psychiatry and behavioral sciences at the University of Washington in Seattle, delving into what makes the brain of a person with autism different from that of someone without the disorder. He has found atypical brain signals in people with autism related to a difficulty in imitating others, which may explain some of the social and language impairments associated with the disorder.

Because these signals are more quantifiable than most measures of behavior, Bernier's research refines the picture of autism, and helps bridge the gap between autism-like behaviors and their underlying causes.

Trained as both a scientist and a clinician, Bernier has tremendous energy that carries him to the conclusion of his projects, rather than fizzling in their diversity.

“Raphe has a lot of good ideas,” says Dawson, now chief science officer for Autism Speaks. “Just as important, though, is the fact that he gets things done. He is highly productive.”

Path to paradise:

Bernier's career path did not lead straight to autism research, however. In the early 1990s, as an undergraduate studying psychology at Tufts University, he moonlighted as an emergency medical

technician. Motivated to help young people struggling with behavioral problems, he went on to get a master's degree in counseling psychology from the University of Wisconsin in Madison.

In 1996, he took a job as a counselor in Boston, where he worked with teenagers who either had attention deficit hyperactivity disorder, were victims of sexual abuse, or were themselves sexual offenders. Bernier realized all these teens had something in common: social difficulties. "What was going on with their social interactions, their social communication?" he asks.

He began to contemplate how the brain mediates social behavior, and turned to autism as an interesting case study. "I realized autism was the coolest way to study [social difficulties]," he says.

This interest led him to answer an ad for a research study coordinator posted by Susan Folstein, the scientist at Boston University who, in 1977, first identified genetic factors associated with autism[1].

Over the following two years, Bernier discovered that he enjoyed many aspects of autism research, from conducting clinical interviews of families to thinking about its genetics, and he began to plan for graduate school.

He put these plans on hold to join the Peace Corps with his wife, Kimberly. "In the U.S. here, we're just so encapsulated from how the rest of the world works," he says. "I felt it was an important personal experience that I needed to have." Stationed in the Solomon Islands in the South Pacific, Bernier taught first aid and clinic management to nurses in a village on a beach, a place that he describes as "paradise."

He left research with some trepidation, however. "I was nervous they were going to find the genes for autism when I was away," he says, laughing. A few months after he returned, in 2001, he began graduate school in clinical psychology, conducting research in Dawson's lab at the University of Washington.

Mu rhythms:

One Wednesday in December, Bernier, who has a marathon runner's frame and an equally spartan office at the **University of Washington's Autism Center**, talked animatedly about his research. Easygoing, yet intense, he referred to his study participants as "kiddos" while describing the technical details of his studies.

To understand what has gone amiss in the brain in autism, Bernier uses electroencephalography (EEG), a non-invasive technique that picks up electrical activity from the brain through the skull. Participants in EEG studies wear a stretchy white cap, similar to a swimmer's cap, out of the top of which rises a bundle of wires headed toward a bank of computers. Inside the cap, 128 electrodes sense tiny electrical signals generated by the brain.

One signal detected in this way is the mu rhythm, a brain wave whose voltage rises and falls about 8 to 13 times per second. The wave pattern — which resembles the Greek letter μ — appears when a person is at

rest and dampens when a person moves or observes someone else moving. This ‘mu attenuation’ reveals a change in neural activation somewhere inside of the sensorimotor cortex, a large brain region that processes sensory stimuli as well as motor movements.

Because the brain region generating the mu rhythm is sensitive to both observing and making movements, it is suspected to be involved in imitation. Some people with autism have difficulty imitating another person’s actions — such as using a pencil to draw a line — and mimicking gestures and facial expressions[2].

As a graduate student in Dawson's lab, Bernier found that the mu rhythm is not fully suppressed in adults with autism when they observe others making a movement. This might reflect an inability to relate to others and cascade into imitation impairments, he says.

To explore this idea, Bernier measured the imitation abilities of the study participants by videotaping their imitations of hand gestures, facial expressions and actions on objects. The quality of each imitation was scored using a standardized scale developed by **Sally Rogers** and her colleagues at the University of California, Davis. For example, the researchers scored finger placement and orientation separately during hand gesture imitation.

Bernier found a connection between imitation and mu attenuation: the worse people with autism are at imitating, the less their mu attenuation when observing someone else[3].

This link to behavior “extended substantially” the understanding of the mu rhythm in autism, says **Jaime Pineda**, an associate professor of cognitive science at the University of California, San Diego.

Pineda’s group had found a similar impairment in mu attenuation in people with autism in a 2005 study[4], but had not related it to behavior. “It’s important to correlate [the finding] with the behavioral dysfunctions,” Pineda says, “so I’m glad he’s in the field.”

Now in his own lab, Bernier is trying to understand how malleable mu attenuation is. Because his earlier study links mu attenuation to imitation, he is testing whether behavioral therapy that improves imitation skills can affect brain activity.

“We know kids with autism aren't attending to social information,” Bernier says. “In an intervention, we're pushing attention to that social information and we're forcing experience that might not normally occur for [them].”

Bernier is obtaining EEGs from children who have completed two years of an intensive intervention that stresses imitation skills. If the intervention affects the part of the brain responsible for mu attenuation, he expects a difference in mu attenuation in these children compared with those who receive standard treatments.

If the children show behavioral improvement, but no difference in mu attenuation, then other brain systems may be stepping in to compensate, Bernier says. Either way, he adds, the results may help understand the effect of the intervention.

Tracking brain wave patterns such as mu attenuation may eventually help clinicians diagnose autism, identify subtypes, or even monitor treatment progress in the brain before behavioral changes are apparent.

“That’s the ideal down the line, once you know enough about mu,” Bernier says cautiously. “At this point, it remains to be seen.”

Community relations:

Bernier’s clinical skills also contribute to the search for autism’s genetic roots. He and his team are conducting the behavioral testing of children with autism who provide DNA to the Autism Genome Project and to the **Simons Simplex Collection** databases, measuring qualities such as their social responsiveness, repetitive behaviors, cognitive abilities and vocabulary.

Bernier also carries his expertise into the community. Last year, he almost single-handedly scripted and directed an **informational video** for all parents in Washington State whose child had received a diagnosis of autism. He also helped develop a program with **Felice Orlich** of Seattle Children’s Hospital to train teenagers to be mentors to peers with autism.

Beyond autism, Bernier has helped administrate a yoga center in Seattle, organizes donations of time and money to a youth gardening outfit, and analyzes data *pro bono* for a nonprofit that promotes sustainability education to students and teachers.

He is also busy building his family. Five months ago he and his wife had their first child, a daughter, Sadie. “We did our first race together,” Bernier says proudly of a 5-kilometer race that he ran in December with Sadie in the stroller.

Bernier’s diverse experiences might explain his tendency to solicit different opinions at work, from junior and senior people alike. “He loves to discuss things and he really wants to encourage everyone coming together and sharing their ideas,” says Jen Varley, a graduate student mentored by Bernier. “It feels very collaborative.”

With an office adjacent to Bernier’s at the University of Washington, **Sara Jane Webb** is frequently caught up in his swarm of ideas. A recent three-hour conversation with him about future experiments left her whiteboard covered in lists and diagrams. “Raphe's favorite saying to me all the time is, ‘Teamwork never seems [like] work,’” she says.

Teamwork aside, Bernier’s individuality is still very much a part of his work. For one, he has kept up his infamous musical ditties, which enliven thesis defenses, going-away parties and other special occasions.

“I work hard and the other folks here at the UW Autism Center work hard, so it’s fun to lighten that up,” Bernier says. “I just like to be goofy periodically, and music is one way to show that.”

References:

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