

INNOVATORS & IDEAS: RISING STAR

Danielle Beckman – a neuroscientist driven by a microscopic obsession: Unravel how viruses play a role in brain pathology

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This Genomic Press Interview features Dr. Danielle Beckman, a pioneering neuroscientist at the University of California, Davis, whose groundbreaking research bridges virology and neuroscience to uncover how viral infections trigger lasting neurological damage and accelerate neurodegenerative diseases. Dr. Beckman’s remarkable journey from Rio de Janeiro, Brazil, to becoming a leading expert in neurovirology showcases her innovative approach to developing translational animal models that illuminate the cellular mechanisms underlying Alzheimer’s disease, Long Covid, and viral-induced brain pathology. Working under the mentorship of renowned neurobiologist John Morrison at the California National Primate Research Center, she has revolutionized our understanding of how viruses like SARS-CoV-2, Zika, and HIV disrupt brain homeostasis, leading to neuroinflammation and cognitive decline that affects millions of patients worldwide. Her pioneering work includes developing novel rhesus monkey models for Alzheimer’s disease research, investigating the propagation of tau and amyloid pathology, and establishing critical connections between viral infections and neurodegenerative processes that contribute to conditions such as brain fog and memory impairment. As an active member of the World Health Network’s Long Covid advisory group, Dr. Beckman combines her expertise in advanced microscopy techniques with her passion for science outreach to advance therapeutic development and provide hope for patients suffering from post-viral neurological symptoms. Her research, published in prestigious journals, represents a paradigm shift in understanding viral neuroimmunology and offers crucial insights for developing targeted treatments for neurodegenerative diseases and Long Covid. At the same time, her commitment to mentoring Latin American scientists and advocating for diversity in STEM fields demonstrates her dedication to fostering the next generation of neuroscience researchers.

Part 1: Danielle Beckman – Life and Career

Where were you born, and where do you live now?

I was born in Rio de Janeiro, Brazil, and now I live in Davis, California, USA.

Could you give us a glimpse into your personal history, emphasizing the pivotal moments that first kindled your passion for science?

It is interesting because I was not one of those kids who dreamed of becoming a scientist from a young age. As a child, I aspired to be a writer or an artist. Growing up in Rio, I viewed a scientific career as too challenging to pursue, especially since my country struggles to provide for its basic needs and science is hardly truly valued. My perspective began to shift during high school when, encouraged by my parents, I enrolled in the Rio ORT Technical Institute, a school specialized in science and math programs. There, I chose to study biotechnology and fell in love with the



Figure 1. Danielle Beckman, PhD, University of California, Davis, USA.

health sciences. When it came time to select an undergraduate course, I chose pharmacy because I enjoyed chemistry and its practical applications for human health. However, it was during a physiology course taught by a brilliant professor during my undergrad that I truly discovered my passion for neuroscience. Although neuroscience was only a brief segment of the course, I vividly remember that class and how fascinated I became with the brain. After that experience, I knew I wanted to become a scientist, and I started working as an undergraduate student in a neuroscience laboratory—and I have not looked back on this decision ever since.

Please share with us what initially piqued your interest in your favorite research or professional focus area.

I developed an interest in neuroscience early in my undergraduate studies, but my fascination with Alzheimer’s disease truly emerged while I was



working on my master's thesis in biophysics. At that time, I was working in neuroscience, investigating the physiological role of the prion protein and how altered levels of this protein could affect dopamine and serotonin transmission. During this period, my grandmother began to show the first symptoms of dementia, and I remember how upsetting it was to witness someone so close to me change their personality due to a disease. This experience deepened my curiosity about what happens in the brain at the cellular level in Alzheimer's and other forms of dementia. More recently, due to the pandemic and new opportunities at our Primate Center, I also became involved in neurovirology. I am intrigued by how different microorganisms can impact the brain in ways that are often overlooked in traditional neuroscience studies.

We would like to know more about your career trajectory leading up to your current role. What defining moments channeled you toward this opportunity?

My trajectory would not have been the same without the professors who believed in me and gave me opportunities early on. When I first decided to move to a new city in Brazil, Rafael Linden, one of the country's leading neuroscientists, offered me my first chance to study the brain as a graduate student at the Federal University of Rio de Janeiro. After that, Sergio Ferreira, my PhD supervisor, allowed me to learn and explore Alzheimer's disease research using multiple animal models. A pivotal moment in my journey was meeting my mentor at the California Primate Research Center during a neuroscience course in Italy. It was then that I decided to move to the U.S. and begin working with nonhuman primates. My advice to the younger generation is to get involved in neuroscience courses and programs and to attend as many conferences and meetings as possible. I know it is not always easy or cheap, but it was worth it every single time.

What is a decision or choice that seemed like a mistake at the time but ended up being valuable or transformative for your career or life?

When I decided to leave Rio and move to California after completing my PhD, opting not to stay longer in my old lab to finalize my dissertation manuscript, I wanted to quickly relocate to the U.S. and start developing a novel monkey model for Alzheimer's disease. I received much advice to do things more slowly at that time, but I trusted my instincts, and I did not regret my decision. As a result, we were able to characterize and publish an important study demonstrating how soluble amyloid beta oligomers can accelerate cortical aging in the primate brain just 2 years after I arrived in the U.S. These findings highlight the early stages of neurodegeneration that can occur at the beginning of Alzheimer's disease (Beckman et al., PNAS 2019).

What habits and values did you develop during your academic studies or subsequent postdoctoral experiences that you uphold within your research environment?

Growing up and receiving both my undergraduate and graduate studies in Brazil, all my educational training was conducted in Portuguese, despite the fact that the scientific community primarily operates in English. Recognizing this challenge early on, I made a commitment to consistently engage in writing in English, whether through original articles, reviews, or commentaries. For example, I published two journal clubs in the Journal of Neuroscience, articles written exclusively by graduate students and postdoctoral researchers. I encourage all trainees to undertake similar projects, as well as more senior scientists, especially those based in non-English-speaking countries.

Please tell us more about your current scholarly focal points within your chosen field of science.

My current research focus is investigating how viruses can disrupt brain homeostasis, leading to neuroinflammation and cell death. These processes may contribute to many of the symptoms experienced by patients with chronic diseases after viral infections, such as those seen in Long Covid. Previously, I studied the effects of Zika and HIV on the brain, but it was during the pandemic that the impact of SARS-CoV-2 on the body captured my attention. Unlike HIV, which induces a slower, progressive inflammatory process, our lab observed that SARS-CoV-2 can



Figure 2. Danielle is visiting Dr. Andrew Ewing at the University of Gothenburg, Sweden, in January 2025. They are both members of the Long Covid Advisory Group from the World Health Network.

infect neurons and trigger neuroinflammation within just seven days after infection. Additionally, this virus affects the same regions of the brain that are involved in memory and cognition (Beckman et al., Cell Reports, 2022). I have decided to focus my efforts on understanding how different viral infections can contribute to brain pathology and accelerate conditions such as Alzheimer's and Parkinson's diseases.

What impact do you hope to achieve in your field by focusing on specific research topics?

My biggest dream is to make a significant impact on the lives of people with neurological conditions following a viral infection. Early in the pandemic, I observed under the microscope how SARS-CoV-2 can damage brain circuitry and the cellular effects that may contribute to "brain fog" and other symptoms that patients experience. Over the past few years, I have connected with many people in the Long Covid community and formed friendships with individuals who are severely ill and desperately seeking help. I hope to one day contribute to the development of a therapy or biomarker for this condition. Currently, there are no approved treatments, and we need to focus our efforts on assisting the millions who are not recovering after contracting COVID-19. I know this is an ambitious dream, but to achieve success, it is essential to dream big and work hard.

What do you most enjoy in your capacity as an academic or research rising star?

I enjoy working with microscopy, as it allows me to create beautiful images of the brain while investigating profound questions about how different cell types interact and contribute to disease. I also appreciate the freedom to pursue the topics that excite me the most. My work is guided by what I observe through the microscope, and following this career path is incredibly rewarding.



At Genomic Press, we prioritize fostering research endeavors based solely on their inherent merit, uninfluenced by geography or the researchers' personal or demographic traits. Are there particular cultural facets within the scientific community that warrant transformative scrutiny, or is there a cause within science that you feel strongly devoted to?

As a Brazilian and Latina woman, I have faced numerous challenges and obstacles in reaching my current position. It is important not to let these struggles define us and to keep fighting back. From an early age, girls like me must combat prejudice, often hearing that we are not on the same level and that the STEM fields are not meant for us. I feel a strong commitment to my Latin American community and to the trainees and students I have mentored in the field of neuroscience. I take great pride in having completed all my education in Latin America, where the training we receive is just as good as that in wealthier countries. We have nothing to feel inferior about.

Outside professional confines, how do you prefer to allocate your leisure moments, or conversely, in what manner would you envision spending these moments given a choice?

In my free time, I enjoy reading, painting, and drawing. I enjoy trying to reproduce some of the things I see in the microscope with pigments and colors. I also enjoy watching movies and documentaries, especially those about war history.

Part 2: Danielle Beckman – Selected questions from the Proust Questionnaire¹

What is your most marked characteristic?

It is perseverance and drive.

Among your talents, which one(s) give(s) you a competitive edge?

My passion for microscopy lies in enjoying the process of troubleshooting protocols to optimize the production of reliable and reproducible quantitative data.

If you could change one thing about yourself, what would it be?

Be more confident about myself and less anxious about things I cannot control.

What is your current state of mind?

Given the complicated world we are currently living in, my state of mind right now is, unfortunately, very anxious. However, I remain optimistic that science will continue and ultimately prevail.

What is your idea of perfect happiness?

Being able to lead a decent life and work on something that can make a meaningful impact on the world and improve people's lives. Being a scientist is a demanding career, but it can also be gratifying if you find your passion.

¹In the late nineteenth century, various questionnaires were a popular diversion designed to discover new things about old friends. What is now known as the 35-question Proust Questionnaire became famous after Marcel Proust's answers to these questions were found and published posthumously. Proust answered the questions twice, at ages 14 and 20. In 2003 Proust's handwritten answers were auctioned off for \$130,000. Multiple other historical and contemporary figures have answered the Proust Questionnaire, including among others Karl Marx, Oscar Wilde, Arthur Conan Doyle, Fernando Pessoa, Stéphane Mallarmé, Paul Cézanne, Vladimir Nabokov, Kazuo Ishiguro, Catherine Deneuve, Sophia Loren, Gina Lollobrigida, Gloria Steinem, Pelé, Valentino, Yoko Ono, Elton John, Martin Scorsese, Pedro Almodóvar, Richard Branson, Jimmy Carter, David Chang, Spike Lee, Hugh Jackman, and Zendaya. The Proust Questionnaire is often used to interview celebrities: the idea is that by answering these questions, an individual will reveal his or her true nature. We have condensed the Proust Questionnaire by reducing the number of questions and slightly rewording some. These curated questions provide insights into the individual's inner world, ranging from notions of happiness and fear to aspirations and inspirations.

When and where were you happiest? And why were so happy then?

When I spend time with my family in Brazil, playing with my two nieces brings me immense joy.

What is your greatest fear?

Losing my health and not being able to live independently as I have been for many years.

What is your greatest regret?

Living far away from my aging parents. I wish I could be closer, but my career took me far away.

What are you most proud of?

My journey. It has not been easy, but I am proud of everything I have been through.

What do you consider your greatest achievement?

Coordinating the development of novel animal models that are being used for therapy testing to make a significant impact on patients. Over the past eight years, we have developed two novel monkey models for Alzheimer's disease, one focusing on amyloid pathology (Beckman et al., *PNAS*, 2019) and another addressing tau propagation (Beckman et al., *Alzheimer's & Dementia*, 2021 and *Alzheimer's & Dementia*, 2024). Additionally, we have also worked on a congenital Zika virus model (Beckman et al., *Elife*, 2022) as well as young and aged monkey models of NeuroCovid (Beckman et al., *Cell Reports*, 2022).

What or who is your greatest passion?

Microscopy is my greatest passion. Seeing things in the microscope for the first time brings me immense joy.

What is your favorite occupation (or activity)?

Reading and spending time with my few good friends.

What is your greatest extravagance?

For a while, before the pandemic, I was trying to visit a new country every year. I visited 27 different countries so far.

What is your most treasured possession?

A violin made of Pau Brasil, a traditional tree that gave Brazil its name. Many years ago, I saved money for a while to get it for myself, and I was very proud when I could afford it.

Where would you most like to live?

In a place rich in old history. I have always been fascinated by medieval tales, and having come from Brazil and now living in the U.S., I lack exposure to many of them.

What is the quality you most admire in people?

Optimism. It's easy to feel pessimistic these days, but seeing optimistic people inspires hope.

What is the trait you most dislike in people?

Gaslighting. It is so common that it can sometimes be hard to notice and is often overlooked in our society.

What do you consider the most overrated virtue?

Selflessness. Often, people who prioritize others all the time do not have time for themselves.

What do you most value in your friends?

Honesty. I always admire people who are not afraid to tell the truth, despite how difficult or unpleasant it can be at times.

Which living person do you most admire?

My mentor, John Morrison. Besides being a brilliant neuroscientist, he is also incredibly humble, supportive, and patient. His research over the past



few decades has significantly contributed to our understanding of female health and the brain's changes during menopause. He plays a crucial role in the field while remaining kind and approachable. In addition, under his mentorship, I discovered my passion for microscopy. His career path is an example that truly inspires me.

Who are your heroes in real life?

My heroes are the neuroscientists in Brazil who do tremendous work with limited resources. I want to acknowledge the brilliant neuroscientists who trained me in Rio and inspired me to believe that I could compete on an international level: Rafael Linden, Fernando G. de Mello, and Patricia Gardino. I am also grateful to Moarcir Serralvo Faria, the professor in Florianópolis, South Brazil, who taught me a neuroscience class that I will never forget and that changed my life. Additionally, I admire Sidarta Ribeiro, a neuroscientist from the North of Brazil in Rio Grande do Norte, who conducts outstanding research in sleep science and is also a remarkable science communicator.

If you could have dinner with any historical figure, who would it be and why?

Maria Skłodowska-Curie. Not only for her pioneer groundbreaking work in science, but I would also love to hear her thoughts on resilience and her fight for feminism and gender equality.

Who are your favorite writers?

I usually read a lot, so it is challenging to choose just one favorite writer. In the realm of science, Carl Sagan for his brilliant contributions to planetary science and his exceptional skills as a science communicator. Oliver Sacks and Steven Picker are both my second favorites. Outside of science, I greatly enjoy the works of Hilda Hilst, a Brazilian poet, and Fernando Pessoa, a Portuguese poet and writer.

Who are your heroes of fiction?

Vincent Freeman from Gattaca is one of my favorite movies. I admire his determination to pursue his dreams despite knowing that he is already past his life expectancy. He is willing to risk everything for a chance at space travel, demonstrating a relentless pursuit of goals that seem

unattainable. He is constantly striving for heights beyond his reach and proving that nothing is impossible.

What aphorism or motto best encapsulates your life philosophy?

My motto is a quote from Cecilia Payne-Gaposchkin, a brilliant astronomer and astrophysicist. She once said: "Young people, especially young women, often ask me for advice. Here it is, valeat quantum. Do not undertake a scientific career in quest of fame or money. There are easier and better ways to reach them. Undertake it only if nothing else will satisfy you; for nothing else is probably what you will receive. Your reward will be the widening of the horizon as you climb. And if you achieve that reward, you will ask no other."

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