

Career Pathways: Krishnankutty Sathian, MBBS, PhD, FASNR, FAAN, FANA, FRCP

“The bottom line is to know yourself and follow your passion. For me, variety has been key,” noted ASNR Past President Krishnankutty (Krish) Sathian, MBBS, PhD. Dr. Sathian is Chair of Neurology and Director of the Neuroscience Institute at Penn State Health Milton S. Hershey Medical Center and Penn State College of Medicine. He is a Professor of Neurology with joint appointments as Professor of Neuroscience & Experimental Therapeutics, and Professor of Psychology at Penn State University. As an academic leader and clinician-scientist, Dr. Sathian balances multiple interests and responsibilities, and the rich variety in his work has fueled his curiosity and contributed to a flourishing career in cognitive neuroscience and neurology.



Early-Career Training

Dr. Sathian’s interest in the brain dates back to his medical school days at the University of Madras at Christian Medical College in India. He attended a brilliant series of lectures in neurophysiology, by the late Marcus Devanandan, MBBS, PhD, that sparked his interest in neuroscience. After completing medical school, Dr. Sathian worked as a research fellow in Dr. Devanandan’s laboratory. He then enrolled in a neuroscience graduate program at The University of Melbourne in Australia. There, Dr. Sathian expanded his research skills and expertise, focusing on the area of sensory neuroscience. Specifically, his dissertation research examined the neurophysiologic basis of the tactile perception of texture, combining human psychophysical studies with recording activity in the peripheral nerves of macaque monkeys.

Subsequently, he accepted a postdoctoral fellowship at Washington University in St. Louis, working with Harold Burton, PhD. In Dr. Burton’s lab, Dr. Sathian conducted basic sensory neuroscience research, recording in macaque somatosensory cortex and also running human psychophysical studies. He also became more aware of the growing literature on the phenomenon of neuroplasticity, which he had been introduced to as a graduate student. As he reflected on the options for the next step of his career, Dr. Sathian realized that he was interested in doing both clinical practice and research. While there were still many hurdles to overcome, he recognized that forging a path combining research on neuroplasticity with clinical neurology practice would bring together multiple areas of his interests and be feasible to pursue in the United States. Following an internship in medicine at Grant Hospital in Chicago and a residency in neurology at the University of Chicago Hospitals, Dr. Sathian accepted a faculty position in the Neurology Department at Emory University.

Making Important Progress in the Field of Multisensory Perception

Prior to coming to Emory, his research had focused on the sense of touch and somatosensory neurophysiology. Planning to continue working in this area, he developed his independent research laboratory. Initially intended as a sideline, Dr. Sathian began doing some projects with

human participants. The findings from this work were fascinating and led him to change course to focus on psychophysics and neuroimaging in humans.

One of the lab's most interesting findings was their discovery that the visual cortex is involved in processing information about the sense of touch. Not only were cortical regions generally associated with vision involved in pathways for touch, but they were necessary for optimal performance of touch perception. "This revelation launched my interest in multisensory perception — particularly the interactions between vision and touch — and I'm still working on research in this field today," Dr. Sathian remarked. This work, published in *Nature*, earned him Emory's Albert Levy Award for Excellence in Scientific Research. During his early faculty career, research on multisensory perception was burgeoning, and there was a lot of excitement surrounding its clinical relevance and implications for clinical care.

Because Dr. Sathian's research was highly relevant for rehabilitation for individuals with blindness or low vision, he and his colleagues began working with these populations to try to understand the changes in the brain that occur as a result of vision loss. Neuroimaging with functional magnetic resonance imaging (fMRI) was still evolving at this time, and they began to use this technique to gain insight into how neural pathways work in individuals with and without visual impairments.

Neurorehabilitation research, service, and leadership

While at Emory, Dr. Sathian also began working with the stroke rehabilitation group there, and he got to know some important figures in the field of stroke rehabilitation. Leonardo Cohen, MD, was one of these important figures, and it was through Dr. Cohen that Dr. Sathian first got involved in ASNR. Dr. Cohen was working to broaden the scope of the organization by recruiting people from related areas into the fold of neurorehabilitation. In particular, Dr. Cohen was assembling an interdisciplinary group to participate in ASNR's Long-Range Planning Committee. In 2005, Dr. Sathian accepted an invitation to join the Long-Range Planning Committee, as well as the Sub-Committee on Training. He really enjoyed how ASNR was a relatively small professional society with great people who shared common interests and worked together to shape the future of neurorehabilitation.

When Dr. Sathian joined ASNR, the President was Peter Rossi, MD, and Dr. Rossi encouraged Dr. Sathian to consider the role of Program Committee Chair. This invitation to become involved in ASNR's leadership was a surprise for Dr. Sathian. After taking some time to think about the opportunity, he accepted. Over the next two years, Dr. Sathian served as Chair of ASNR's Program Committee and joined the Board of Directors. ASNR has a leadership pipeline where members advance through the positions of Program Committee Chair, Secretary/Treasurer, Vice President, and President. This leadership pipeline provides ample opportunities for members of the Executive Committee to learn from their predecessors as they take on each new role. Dr. Sathian learned a lot from his predecessor A.M. Barrett, MD, as well as Past President David Good, MD. Dr. Good was also the inaugural Chair of Neurology at Penn State, and Dr. Sathian later succeeded him as Chair of Neurology in 2017.

Through his work with ASNR, Dr. Sathian learned about how professional organizations work, including the roles of organizational leadership, the management group, and committees. This has been very helpful as he's gone on to leadership positions in other associations. Another major lesson that Dr. Sathian learned is the importance of hearing different viewpoints. This is critical when you are making decisions. "You can't go in with a preconceived idea of what the outcome is going to be. You have to listen to everyone and try to focus the discussion in a direction that reflects consensus as well as the strategic objectives of the organization." Dr. Sathian related.

At Emory, Dr. Sathian also took advantage of an academic leadership program where he worked with a coach on strategic planning. Learning pragmatic strategic planning for nonprofit organizations was something he really enjoyed, and this skill came in handy within his own Department of Neurology, at the VA Center he would later lead, when he was President of ASNR, and in the Neurology Department and Neuroscience Institute at Penn State. After his term as President of ASNR (2012-2014), Dr. Sathian became President of the ASNR Research and Education Foundation (2014-2016), and he served on the Strategic Planning Committee from 2017-2018. Dr. Sathian was part of a group of members who catalyzed the shift towards expanding ASNR to include members with backgrounds from a variety of disciplines beyond neurology, and he was also involved in the search for a New Editor-In-Chief of the journal *Neurorehabilitation and Neural Repair* after Bruce Dobkin, MD, stepped down.

Advancing Cognitive Neuroscience and Cognitive Rehabilitation

Over the years, Dr. Sathian's research focus shifted from stroke rehabilitation to the area of cognitive neuroscience and cognitive rehabilitation. As he rose through the ranks, his collaborative work led to joint appointments in Emory's departments of Rehabilitation Medicine and Psychology. Around the time that Dr. Sathian joined ASNR, he also had the opportunity to join the Atlanta Veterans Affairs (VA) Medical Center part-time while continuing his work at Emory. Accepting this position allowed him to join a center that was broadly interested in rehabilitation, particularly vision rehabilitation. While Dr. Sathian didn't have particular aspirations to lead the Center, after a few years, he was appointed to be the Director, and he renamed it the Center for Visual and Neurocognitive Rehabilitation. This was a formative time in his leadership experience, as he had to lead the Center through a period of turmoil. Fortunately, he was able to stabilize it, with the help of many capable colleagues, and the Center went on to compete successfully for its funding through two cycles before he left.

Dr. Sathian's work in ASNR and the VA Medical Center brought together his interests in sensory neuroscience, low vision, vision rehabilitation, and cognitive rehabilitation. In addition, the VA Medical Center needed a neurologist to run the clinic specializing in traumatic brain injury (TBI) that had recently been created to address the needs of Veterans returning home with mild TBI. He agreed to lead the clinic and began treating patients with TBI. There was a strong rehabilitation focus for these patients, including speech therapy for cognitive problems and cognitive behavioral therapy for post-traumatic stress disorder, with the goal of helping Veterans return to work.

Research in Dr. Sathian's lab was also progressing well, thanks to sustained funding from the NIH, as well as grants from the NSF, VA, and private foundations. One of Dr. Sathian's mentees at the time, Benjamin Hampstead, PhD, ABPP/CN, approached him about working together on what turned out to be a series of pivotal projects using fMRI to examine neural changes associated with cognitive rehabilitation in individuals with mild cognitive impairment (MCI). Through these studies, done in collaboration with Dr. Hampstead's neuropsychology mentor, Anthony Stringer, PhD, ABPP/CN, they showed cognitive rehabilitation was beneficial for patients with MCI, and they documented a number of neuroplastic changes in the hippocampus and neocortex. Dr. Sathian was very happy directing the VA Center, treating patients at both the VA and Emory, and running his lab at Emory University. However, his leadership appetite was further whetted by his appointment as Vice-Chair of Faculty for Faculty Recruitment & Development, and he was prompted to explore other leadership opportunities. In 2016, Dr. Sathian received an invitation to apply to be Chair of the Department of Neurology at Penn State. After a national search, he was offered the position, which he accepted after due consideration.

A Fulfilling Variety of Roles and Responsibilities

For Dr. Sathian, variety is very important. In his role as Department Chair, Dr. Sathian has been leading his department through major changes as they transition from focusing on a single medical center to a larger health system, as well as the administrative and financial separation of the health system from the College of Medicine. Contributing to the growth of an academic health system has been rewarding, but it also keeps him very busy. He is also involved in leadership and service in multiple professional organizations, and he continues to be engaged in the education of residents and medical students in their clinics.

Clinically, Dr. Sathian is a cognitive neurologist. He primarily sees patients with traumatic brain injury or older adults with memory problems from Alzheimer's disease or other neurodegenerative diseases. This is an exciting time for the field because new anti-amyloid antibodies were recently approved by the FDA to treat Alzheimer's disease and slow disease progression. In his work with TBI patients, Dr. Sathian champions multi-disciplinary rehabilitation through referrals to speech therapy, physical therapy, and occupational therapy.

Dr. Sathian's lab today is actively conducting human cognitive neuroscience research on multi-sensory perception, particularly studying audio-visual interactions that may be relevant for the evolution of language. A key member of Dr. Sathian's lab is Simon Lacey, PhD, who moved with him from Emory. In collaboration with Lynne Nygaard, PhD, at Emory, Drs. Sathian, Lacey, and their associates ask fundamental questions about how psychological processes, and the associated neural processes, are organized. The team hypothesizes that it may be possible to leverage audio-visual interactions for rehabilitation in individuals who have aphasia (an acquired language disorder that affects a person's ability to speak, write, and/or understand language). Data from their preliminary studies in people with aphasia, obtained in collaboration with Chaleece Sandberg, PhD, at Penn State, suggest that the audio-visual interactions of interest are preserved in people with aphasia, and they could serve as an avenue for individuals with aphasia to recover language skills.

This work builds on prior research examining relationships between sounds and the shapes that people associate with sounds. The idea is called sound symbolism, and it suggests that the sounds in the name of an object provide information about the nature of an object. People with aphasia retain their ability to make associations between sounds and the meaning of words, and the Sathian-Lacey-Nygaard group has demonstrated that there is a series of systematic relationships for the sounds of specific phonemes and acoustic features that underpin these audio-visual associations. Currently, they are using fMRI to uncover the neural basis of these associations and the brain regions involved.

Their group is also beginning a series of exciting studies in patients who are undergoing intracranial electrode recordings to help identify the focus of seizures for surgical interventions, and they are getting important data on real-time brain activity associated with audio-visual association tasks.

Once they have more mechanistic information, they can probe how language impairments affect audio-visual associations, and how they could potentially be harnessed in neurorehabilitation. While the project is still in its early stages, this line of research could open the door for more sophisticated approaches to cognitive rehabilitation, particularly surrounding loss of language in conditions like aphasia.

“Cognitive neurorehabilitation is the next great frontier in the field,” Dr. Sathian notes. He encourages early-career scientists to pursue research in cognitive rehabilitation and work to apply what we’ve learned about the neuroscience of recovery from decades of motor research, particularly in stroke, to various cognitive domains and to a wide array of neurological conditions, such as multiple sclerosis, neurodegenerative diseases, and other neurological disorders.

Key Lessons Learned

Throughout his career, Dr. Sathian has had a multitude of role models from whom he has adopted particular features, habits, and approaches. “I didn’t have one single role model,” he explained. “I had many role models, and I brought together the many aspects of my career which were influenced by different people. This is partly because my work isn’t cohesively focused in one single area,” he continued. Many clinician-scientists build their careers so that their clinical practice aligns with their research, as well as their teaching and administrative tasks. There are a lot of benefits with this approach. For Dr. Sathian, his interests grew and evolved organically over time. This has provided a lot of variety in his daily activities that he likely wouldn’t have if he focused all of his interests into one cohesive area. The variety has kept him from getting bored in his roles over the years and has been critical for enjoying his work.

Even though the areas of his work are not always tightly interconnected, Dr. Sathian makes it a point to consider the clinical relevance and implications of his research, and his clinical interactions spark new research ideas. Further, he is committed to educating residents, medical students, and other learners about research and clinical care, and his administrative responsibilities involve balancing both clinical and academic aspects.

“It’s a daily challenge to balance all of my interests,” Dr. Sathian reflects. He didn’t start his career aiming to become President of a professional society or Chair of a department. His main goal was to be a successful clinician-scientist and be promoted for his achievements. Though he didn’t actively seek out leadership opportunities, they always seemed to find him. When balancing leadership and other areas of your career, it is critical to be as efficient as possible with everything you do, but also recognize your limitations. Partner with people who have complementary skills so you can be most efficient in completing tasks and advancing toward your goals. If possible, Dr. Sathian recommends that clinician-scientists should aim for overlap between their research and clinical interests, even though this was not the approach he has taken.

Dr. Sathian shared his career advice for others, saying, “Ultimately, you should pursue work that you are passionate about. If you’re really passionate about something, you’ll find time to do it. You won’t mind working long hours, and your passion will drive you to work more energetically and efficiently to solve any problems that you face.”