

I decided to pursue medicine as I had vague ideas about applying mathematical techniques to all areas of biology. This course would have given me a broad overview of the entire field of human biology. Medicine was a more stable career option than mathematics anyways. Following discussions with my parents, both ophthalmologists, I joined Manipal University for my MBBS.

In late 2012, in the second year of college, I discovered, on the internet, how some people like Prof. Nassim Nicholas Taleb had been able to predict the economic recession of 2010, using Monte Carlo simulations. I searched for existing applications of Monte Carlo methods in biology, but could not find much. I, then, came across the fields of functional neurosurgery and deep learning. Nobody really understood how neural probes interacted with the neurons, and nobody understood how neural networks worked. I felt that there might be something here, and read books by Prof. Taleb, Dr. VS Ramachandran and John Brockman, exploring the broad themes in neuroscience research.

In college, I found scientific research absorbing. I did 3 research projects, involving lab work, hospital-based study as well as community interaction. Two of my projects, on microbial biofilms on contact lenses and on anterior segment changes in glaucoma, were supported by the Indian Council of Medical Research. The study on biofilms was published in the Indian Journal of Medical Microbiology.

I presented a paper on the prevalence of asthma in school children, at the KARMIC conference Kolkata. The glaucoma study was presented at IGCLA, Manipal. Further, I presented 2 papers on

biofilms on contact lenses, and on the use of quorum sensing inhibitors against biofilms, at my college and at MIT Manipal respectively.

I attended 3 workshops on molecular biology, clinical and laboratory medicine research and neural systems. In fact, it was the workshop at IIT-Kanpur on neural systems, which cemented my interest in neuroscience. Discussions with neuroscientist Dr. Nitin Gupta, further strengthened my resolve to specialize in this field.

I was a class representative of the Student Research Forum at my college and acted as a bridge between the administration and the students on research activities. Moreover, I helped organize medical workshops and conferences, including one on medical innovations. I was also a member of the Volunteer Services Organisation, Manipal and took part in public health awareness activities.

Initially, I was looking at ways to pursue a combined career in clinical practice as well as research in functional neurosurgery. However, during my internship, I realized that either field, on its own, would be very demanding and that I enjoyed labs more than hospital wards! Also, as neuroscience was my passion, I decided to pursue a research career.

As a pathway to research, I pursued a Master's program in neuroscience at UCL as I felt that this would expose me to its entire breadth. Here, I worked in the systems neuroscience laboratory of Prof. Matteo Carandini and Prof. Kenneth Harris, where they had recently developed the

Neuropixels probes (Jun et al 2017). I investigated multisensory coding and decision making in mice using a 2-alternative forced-choice task. I used neuropixels probes to record electrical activity from the frontal cortex in mice performing this task. The project involved training mice in the task, recording from head-fixed mice and analyzing the data in MATLAB.

During my MSc, I had an idea of using t-tests to select neurons responsive to stimuli, which would imply that neuronal responses followed a parametric distribution. The code I wrote, using t-tests, was able to select responsive neurons. I also tried using t-tests on a small sample of prime numbers. That too returned a positive correlation. I was also able to obtain curves, showing a log-normal distribution for both these phenomena. I am now looking to develop this further, and use Monte Carlo simulations to infer the statistical properties of neuronal responses and prime numbers. If successful, it would prove that both these are log-normal stochastic processes, and would contribute to our understanding of neural probe function and neural networks. (code available here: <https://github.com/sidkackar/MSc-code>)

I am also generally interested in exploring the applications of probability and stochastics to all areas of biology.

In the long term, my aim would be to develop a career portfolio that will incorporate the building blocks of research, a university faculty position and consulting with the industry. In conclusion, I strongly believe that I am prepared to make useful contributions, both to the scientific community and to society in general.

