Interview with Nalini Joshi

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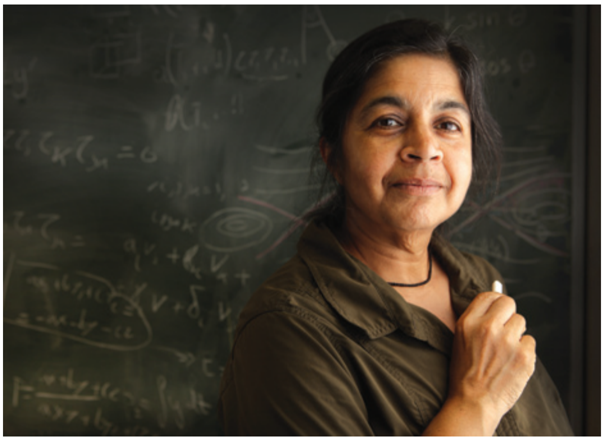
Pristine Ong



Nalini Joshi
(Photo courtesy: Ted Sealey)

Professor Nalini Joshi was the University of Sydney's first female mathematics professor. She is the Chair of Applied Mathematics and the Associate Head of the School of Mathematics and Statistics. She is about to take up a Georgina Sweet Australian Laureate Fellowship awarded by the Australian Research Council.

Professor Joshi spoke to Pristine Ong about her life in mathematics.

Pristine Ong: Congratulations on your fellowship, it's a significant recognition of your achievements in mathematics. You have come a long way since your family first migrated to Australia from Burma when you were 12. Can you tell us how you first got interested in maths?

Nalini Joshi: I realised a long time ago that I really liked patterns. I was born in Burma, where we played a lot of games, such as variations of hopscotch, which involved repetitive patterns. You would complete a certain pattern or movement and it would change slightly each time.

I also noticed at a very young age that I love counting. The numbering system in Burmese allows you to count numbers very easily, like in Chinese and Japanese. English has irregular words like eleven and twelve, but in Burmese, eleven is 10-1 and twelve is 10-2. I have read papers recently which suggest that the numbering system does have an influence on how easily children pick up mathematical pattern recognition. These things laid the groundwork for how I started thinking about mathematics.

In retrospect, it was quite difficult for me to move countries and cultures. There were lots of things that I could not understand in my life, so I found myself thinking about deeper things. I was a bit of an introvert and I liked thinking things through in my head like how the universe evolved. So I got more and more interested about reading science and I got very interested in astronomy and astrophysics. I wanted to become an astronaut, which at that time and place was just not considered to be very appropriate for a girl!

PO: So what did you do when you got to university?

NJ: I wanted to do science but my father, who was a doctor, wanted me to do medicine. It is so common in Asian families because parents want you to earn a good salary and have a safe career. We knew that the reason we survived our immigrant experience was because doctors like him were needed in Australia. He wanted me to have the same opportunities. But because of this dreaming that was going on in the background in my head, I decided on enrolment day that I would do science and so I changed course. When my father found out at dinner time, he stopped talking to me for a month! He was just so disappointed. Of course, when he saw how interested I was in science, he came around and he was very proud of me afterwards.

When I started studying science in the first year, I quickly realised that the way I think is more suited to mathematics. I had no physical intuition whatsoever! So it was very difficult for me to do subjects like physics. In contrast, things are so well defined in mathematics and I could think about them in terms of patterns that I could discover.

I also realised that to understand the universe did not necessarily mean just gathering external information, but also trying to work out if and how that information fitted together. There are things going on in the universe which are very mysterious and which mean that you need to think more deeply in a mathematical way. I knew there were much more subtle ways of thinking about the world and I decided that mathematics was the way to do it.

PO: Have you ever been intimidated by how much is out there that you do not know?

NJ: No, I just thought of it all like incredible treasure hunts. You pick up clues and you put them together to find ways of proceeding. You go and explore those directions. If one direction is wrong, you come back and try another way. This is the way research works in mathematics. Once you understand that and can come back to try different ideas, you can eventually find the solution to the problem. I found that an incredibly satisfying and empowering thing. To me, the metaphor of the treasure hunt describes that process so well.

PO: You have mentioned before that maths lets you find the answers that you cannot find in everyday life. In your personal life, has maths given you the satisfaction of solving problems that you cannot work out otherwise?

NJ: There are lots of things in life that are not predictable and not totally understandable. I think one lifetime is not enough to understand what life is about.

When I was young in Burma, they used to have a system where the better your results were the further forward you sat. There was one year when I knew I was the best because I was sitting in the number one spot. I am not trying to brag about it but it was an explicit demonstration of the fact that I was doing very well in my subjects. But I never ever got the number one prize given to students for achievement at the end of the year. It would be given usually to someone — unlike me — who was ethnically Burmese and an achiever in areas like Burmese dancing or other cultural things. Even though they were described as achievement prizes, they were not about academic achievement but more for celebrating a certain culture.

As a child, I did not really understand that. I am sure there are many people in the world who still suffer those kinds of rejections. All I knew was that there was something wrong with me and that I could never be acknowledged for what I was able to do well. All I could do was retreat into maths and know that I could solve the problem. That was satisfying. I know that I was right because maths allows you to check if you are right. Real life does not.

PO: And yet, despite the introspective nature of maths, you are constantly pushing yourself to get out there and communicate your ideas to people. What drives that impulse?

NJ: I think about mathematics very differently from most people. I know this because when I come out with my ideas, they are so unusual that people do not believe me. They cannot understand it, so I have to find ways of making it more accessible. My communication style adds to the development and acceptance of that idea.

I work on the Painlevé equations which are nonlinear differential equations which have turned out to be very important in theoretical physics. This area was discovered by French mathematicians about a century ago but these results languished until about 20 or 30 years ago when their importance started becoming widely recognised. I asked what I could learn about the solutions by looking at the equations in a direct way. Can I estimate how big or small the terms are? Can I work out what those solutions are doing somewhere else far away from where I started looking at them? I have developed methods that most people find unusual.

PO: Has your unusual methodology created any conflict between you and other mathematicians?

NJ: My philosophy and the kind of exploration that I do are seen as too direct, sometimes even undiplomatic. By offering an alternate way of looking at things, I am sometimes seen as implicitly criticising people who would prefer their way of doing things. I understood over many years that people's defensiveness comes from insecurity. I just wait until my results are recognised for what they are, solving problems that others have not thought about.

Many prefer to look at linear equations rather than nonlinear equations. This is a strong methodology for approaching the Painlevé equations because they have associated linear equations and in many people's philosophy it is easier to analyse the linear equations first and then apply the resulting information to the nonlinear case.

Unfortunately, these approaches do not allow you to solve all the major problems. Whenever I point that out people get very upset. For them, this linear way of looking at things is — they would like to think — the only way, the proper way. But for me its got nothing to do with "properness" but with effectiveness.

You have to grab every tool you can get to understand the solutions. Mathematics is wonderful because it allows you to develop all the tools that you might need — if you cannot extract a screw from a piece of wood with a hammer, then you can invent a screwdriver. Some people would say that we should always use a hammer, but it does not matter to me what tool we use.

PO: Do you feel like your work is recognised?

NJ: Yes, now it is, but it took a long time. A major sign along the way was that people started to want to work with me, because I am an unusual thinker. I have now developed collaborative relationships with many people across Asia, America and Europe.

The second sign was that I was able to attract very good honours and PhD students. These are not external recognitions but it was a big step for me that students could see that my work filled an important gap between mathematics and physics.

The next step was getting grants. I am very grateful for the assistance I have received from the Australian Research Council. I have been supported with grants since 1992 and they have allowed me to attract more visitors, to work with young people, to travel.

Other signs of recognition came with getting the Chair at the University of Sydney, being elected to the Australian Academy of Science and most recently being awarded a Georgina Sweet Australian Laureate Fellowship.

PO: Do you think your recognition will extend to books that people read a century from now?

NJ: Recognition and influence are evanescent and subtle. I have started noticing little things like people using metaphors I have used in my papers I have used the metaphor of Swiss cheese a few times to define the domain of functions that become infinite as certain points. You have to cut out little holes around places where they blow up, leaving you with something that looks like Swiss cheese.

I started noticing this metaphor in other people's papers and even though they did not necessarily cite me in their bibliography, I knew they had read my papers. My ideas are trickling through and that's influence and recognition of a sort.

There is a competitive aspect to recognition, similar to that between any two corporations in the business world. In some fields, the cultural attitudes mean that the competition is the most important part. But for me it is the invention of new ideas that is the most important.

PO: How do you get your new ideas?

NJ: I just dream and tinker.

PO: What do you get inspired by?

NJ: It is very difficult to explain. I do not know how to describe my process of inspiration except to say that I am sitting in a room and I suddenly realise that I can open a window I have not seen before to let the light and air in.

I get a lot of ideas but they are not in words and to make them go forward I need to explain it to other people. So I need more students and more collaborators to talk to. But the number of people around that I can talk to waxes and wanes.

PO: So how important is the teaching component?

NJ: It is communication that is the most important thing. Education is part of it but it comes along with a lot of other parts that can destroy this initial creativity like having to do all the administration with regard to assessment, scheduling classes, making sure that certain webpages are up and running, and so on. Nonetheless, education is great because it involves communication. I am not just a teacher. I am also a communicator. I believe in reaching out to people in the academic community but also to the human race. It is hard to do this in maths because if people do not have the maths education, the language can be very difficult. I want to convey to people the sense that they can belong in mathematical thinking. The analytical pathways are available to everyone and I want that to be communicated.

When I tell people I do maths, almost everyone responds by saying that they were terrible at maths in school. It is almost a universal statement, saying that we are all united by disliking maths at school. I want to convey the opposite message: actually everyone can do maths. Perhaps you were not encouraged and your confidence level is low but I truly believe there is a beauty in mathematics that people can come to see, like they see it in music.

PO: Do you think the grading system in academia is detrimental to the spirit of adventure?

NJ: You need to have a system to encourage a learning process and show better ways of doing something. That is what grading does — it gives you feedback. Whether or not you take that on-board and improve, that is a different matter. It is very personal I think. When I came to Australia I could not write in English. My Year

6 teacher realised this and told me to sit next to a girl and copy out everything she wrote. That is how I started learning to write in English. I did not run away and never write again because I was terrible at it. Once you put something into it, you get the rewards of learning more and more and more.

I had a love for reading. My school had a strict division between junior and senior fiction in the library. When I read through the junior section, I went exploring in the non-fiction section and discovered the great novels of English literature in the non-fiction section! I started reading wonderful English authors like Charlotte Bronte, Jane Austen, and George Eliot. That is how I learnt English. People say to me I write my grant proposals like a Victorian novelist. Well, it started from that point!

PO: Does perfectionism sometimes stop us from progressing because we hate doing things we are not good at?

NJ: I think so! It depends on how important it is, but ultimately we have to learn to relax a little bit. I am very bad at anything that requires physical coordination but I could appreciate that there was something satisfying about physical activity. So I found a book, the Royal Canadian Air Force Exercise Plans for Physical Fitness Guide. There were exercise schemes for men and women, and I did the XBX scheme which takes only 11 minutes a day. It was great because I could achieve a level of fitness at home.

PO: You were the first female maths professor at the University of Sydney, but have you found that being female has affected your career in any way?

NJ: I think being female means that I was less visible in my field. I am talking about a competitive instinct that meant some people could just neglect my papers. Sometimes, there are things that happen and no matter how I deconstruct it, the only conclusion I can come to is that it happened possibly because I am female.

For example, about 10 years ago, my collaborator and I proved a certain property about the tritronqué solutions of the first Painlevé equation. Although we had some difficulty getting our paper published at first, it is received a great deal of recognition now because you cannot deny the first global proof about a solution which has become very important in applications.

Now, when I go to conferences, I sometimes hear people say, "We have to thank Nalini for reminding us what was first proven in 1913." This is a way of trying to say that what we have done is nothing more than what was first done a century ago. Obviously it is not true. But I can only hope that others see the flaw in that statement and ask how trustworthy other statements by that person might be.

Perhaps the issue here is microaggression, a term for when people say or do things that are not overtly meant to be discriminatory but have the effect of being discriminatory. That is the next stage we have to get to in our evolution as a society — to recognise cases of microaggression and to be able to resolve it.

PO: How have you addressed microaggression when you have encountered it?

NJ: A couple of times I have tried direct criticism. Once, at the end of someone's talk, I said out loud to this speaker in a room full of people that he had not referenced my work even though I had worked on the problem extensively. I pointed out that I thought he was deliberately ignoring my contributions and the fact that I published it before him. He apologised and said that it was inadvertent. The rest of the audience laughed because of our repartee. However, some people said to me later that it was a bit uncalled for because I was criticising a colleague. I was taken aback because they had not recognised that there was already an implicit criticism of my work in the way the speaker presented the field

I weighed the two up in my mind and decided that I could continue to be direct and truthful, but I also had to find generous ways of saying the truth so that the overall impact is not negative. You have to say positive things as well as negative things, not just in maths but in all human interactions.

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