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Proof by example   Portraits of women in Dutch mathematics

Jo Ellis-Monaghan

Jo Ellis-Monaghan is a full professor in Discrete Mathematics at the Korteweg-de Vries Institute (KdVI) for Mathematics at the University of Amsterdam (UvA). After several years in different US institutions, Jo arrived in the Netherlands in 2020 when the new research programme on Discrete Mathematics and Quantum Information was established. She has recently become Head of Department at the KdVI Mathematics Institute at the UvA. She shared with us her interesting and unorthodox personal journey and some of her views on mathematics and art.

Let's start from the beginning. Could you tell us a bit about the journey that brought you to work in mathematics? Was it something you always wanted to do or was it a long process?
"It was a long process. I actually hated math growing up. I literally campaigned against it!"

Really? What did you do?
"I was very impatient with what was going on at school. I remember, it was probably second or third grade, being bored with the math book and not wanting to do it. The teacher said "Well, I am sorry, we have to go through this book" so I took it home and did the whole book over the weekend and I brought it back to her. So she said "Ok, you are done. You can use the math period as study time" so I was allowed to sit in a corner during math class and just read. Also, I thought that math at the time was a lot about memorization and that was really not for me. But then in high school I had a geometry class and then it was when the fun start-

ed! That's when I started to grasp mathematical beauty and it fired my imagination. Art was my thing. For me it was all about theater, art and creative writing classes. So the idea that mathematics had this beautiful creative side was really a novelty. And I saw it for the first time in

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geometry class: you didn't have to deal with numbers, you could see things! So it fed right into the artistic abilities, the abilities to visualize things. There was this math competition team, the Mathletes, and I was part of the team and one of the top scorers that year. But then the following year was trigonometry, and I actually failed the class, because again it was all about memorization."

And after high school what did you do?
"I went to art school. I was a dance and drama major when I first went to college. That's what I thought I was going to do with my life. But then, for a variety of reasons, I ended up switching over to visual arts: ceramics and paintings."

And how did math come back into the picture?
"Well, while I was in college you had to do some distribution of courses. It was an American liberal art education, so you had to take courses in different fields. I just took math courses to fulfill my distribution requirements and what ended up happening was that these math courses became a little bit of refuge for me. I think it was because the answer was final and objective. Like, the answer was square root of two, that's it. There was not someone sitting there and saying 'But why did you choose that shade of green there?' or 'Can you
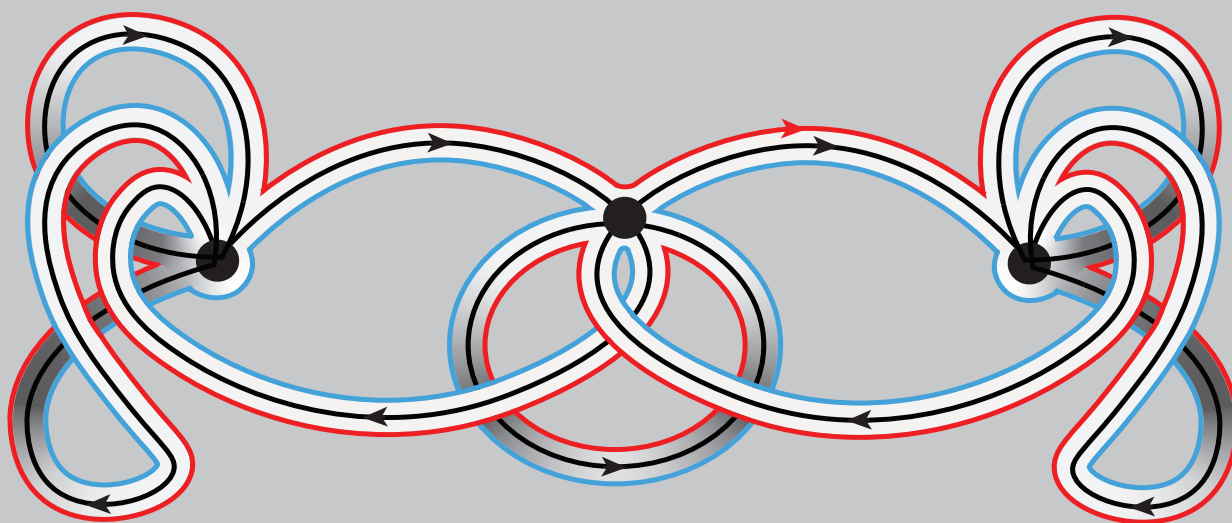
Figure 1 A ribbon graph representation of a graph embedded in a surface, which used artistic visualization and drawing skills. Sewing a disc into each of the red and blue curves reconstructs the surface.

emote a little more?'

There was only one full time math teacher (who was actually Dutch!), because it was more of an art school. I typically had just myself or one or two fellow students in my math courses. So they really noticed if you cut class. It also meant that we learned what he wanted to teach and we didn't learn other stuff. So I had a whole bunch of analysis and never had a linear algebra class! So it was really not a traditional education, but I enjoyed that the focus was always on creative thinking."

And what did you want to do after college?
"I wanted to continue with art school. However, the person I wanted to work with was at the University of Vermont which did not have a graduate programme in art. She was willing to serve as my mentor anyway, so I thought 'Ok I will go to Burlington, where the University of Vermont is, and do the starving-artist-thing. I'll wait tables and at least we'll be in the same town and I'll be able to work with her. And I will be an artist!'

My college mathematics teacher said 'But why should you do that? You should go to grad school'. 'But there is no grad school in art!' 'Just go to grad school in math!' He explained to me how the scholarship system worked and he convinced me that it was the best way to support myself and continue with my art ambitions. The idea that I could get paid while

doing a master was completely new to me because it is not true in the humanities. I managed to get into the grad students' housing and in my dorm there was a ceramic studio in the basement that I could use for free, so it actually worked out perfectly for me!

But then, amazingly, I started to really enjoy the mathematics I was doing, and was quite good at it. The beginning of graduate school was a kind of tipping point: you had to pass from simply regurgitating what was in the book to producing your own creative mathematics. There were two very good professors in Algebra at the University of Vermont, Dave Dummit and Richard Foote, and I fell in love with Algebra. I learned that it had nothing to do with memorizing numbers but I could rather visualize structures in my head."

Do you think that your artistic training helped you in that?
"Definitely. It was a huge help throughout all of my career. The brain process of thinking about mathematics and art is for me exactly the same. And there was a moment when the creative energy started shifting from what I was doing in the ceramic studio to what I was doing in mathematics."

And then what happened?
"Well, at that point two life-things happened. The first one was that I got heavy metals poisoning from the art studio and

that was a bit of a wake-up call that made me realize it was dangerous stuff. And the other thing that happened is that in the second year of my master, I fell in love with the man I am still married to. We got married and I had my first child.

I started to redirect my choices: I stayed at the University of Vermont as an instructor, I continued to do art, but I began to consider the idea of a PhD program in mathematics, that was unfortunately not available at the University of Vermont. There was not an easy solution for our young family. My husband was working at IBM as an engineer and they had a program that would support him to go to grad school. He didn't have to do it and he was not particularly interested in a PhD, but he suggested he could pursue this opportunity anyway, so that I could go to grad school as well. That's a measure of marital love: put yourself through a PhD program for no other reason than that your spouse could also do a PhD!"

Wow, that's love!
"So we literally sat down at the kitchen table with a map and two compasses and drew circles around the grad programs that could work for each of us and we looked where there was an overlap where we could live and go to the two schools. We ended up in the research triangle area in North Carolina: he went to North Carolina State University and I went to the University of North Carolina. And then, I

just flew! My PhD thesis was on Algebraic Combinatorics and Applied Graph Theory and my research line started.

What did you want to do after grad school?
"I wanted to continue doing research in mathematics. However, IBM had paid for my husband and me to go to grad school, so we then owed IBM a certain number of years, which meant that we had to go back to Vermont. The University of Vermont is the only research institution in the state and they did not have a tenure track hire in my field for many many years. So I went back to Vermont with research ambitions and nowhere to take them. Eventually I took a teaching position at Saint Michael's College, a small liberal art college which was focused on undergraduate education. We also became foster parents at the time, which meant that we were not allowed to leave the county, let alone the state. So I had no geographical mobility."

And how did you manage to keep your research active during the years?
"Both Saint Michael's and the University of Vermont (where I had a visiting position) were very supportive of my research activities. But it was a lot of personal determination and hard work. I grew up in Alaska and what remains with you is a sort of frontier spirit, this idea that you can just do things. Period. So if you don't have a research community, it means you have to create one for yourself. I took the lead in organizing seminar series, writing grants, and generally contributing to an active research community in the area."

Can you tell us a bit more about your decision to move to Amsterdam?
"The agreement with my family was that when my two younger sons were finished with high school I could move to a research institution and that is when the offer from Amsterdam came along, so the timing aligned kind of miraculously. This position was a dream job for me. There was a research group with interests closely aligned to my own and we were building combinatorics in the Netherlands so it was an incredibly exciting time."

You are so the only full time female Full Professor in our department. Do you feel an extra responsibility on your shoulders because of that?
"Yes, bluntly yes. It was actually a surprise when I moved to the Netherlands. It is such a socially liberal country that I simply assumed that there was a good gender balance across society and it was a shock to realize that in Dutch academia we are still far off from gender equality. It was very different from my expectations. I do feel obligations towards my gender because of that. I do feel the need to have more of a presence than I would otherwise if there were more female Full Professors".

To finish, we are curious to hear if you still have time to do art.
"Hold on a second."

Jo stands up in her house in Vermont, where she is while we are doing the interview on Zoom. She disappears for a moment. She comes back with her last artwork.

"I make icons, that's what I do these days. In the past I also did a lot of figurative paintings, but I don't have a lot of time recently. A lot of my art time has gone into learning Dutch, which has taken a phenomenal amount of time." [Jo is almost fluent in Dutch, attracting admiration and envy from the other international members of the department.]

Has now art become a refuge as math once was when you first were an art student?
"Actually it's kind of funny that you mentioned that. I never thought about that before. What happened is that mathematics has become less restful and more like the art. When you do research in mathematics you do make choices like you do in creating art. And a reviewer can come back and ask you to justify your particular choices as art critics do.

But going back to iconography: the composition and the thinking in iconography is very geometric so painting icons is a good mix of art and creative mathematical thinking. I grew up Greek orthodox so iconography also connects me with my heritage. And I do find a lot of rest and restoration in it. So yes, your question is spot-on, art became more of a restful place for me."

We really would like to thank Jo for her time and the very inspiring conversation. She is really an amazing role model for young mathematicians like us still struggling to find their own original path. ⟸┈┈
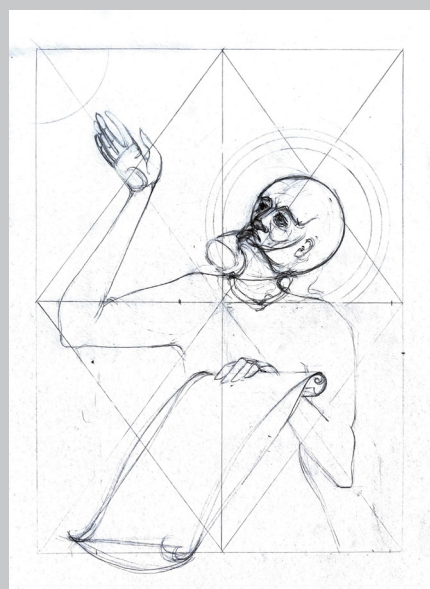

Figure 2
(l) A study for an icon of the Prophet Isaiah, with underlying geometry. (r) An icon of Saint Michael the Archangel, under master iconographer Dmitri Andreyev of the Prosopon School of Iconography.