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Interview Barbara Gentz

"Parents should get the support needed to make it possible to reconcile family and career"

Barbara Gentz is a professor of Mathematics at Bielefeld University, working on Random Dynamical Systems and Stochastic Processes in the Sciences. In January 2020 she was invited to the Evening of the Abel Prize organised by KNAW at the Trippenhuis in Amsterdam, where she talked about 'Woman mathematicians breaking the glass ceiling–and what whistling Vivaldi has to do with it'. Afterwards she was interviewed by Francesca Arici.

My first encounter with Barbara happened online, a couple of years ago, when we started co-organising the 2019 meeting of the German branch of European Women in Mathematics (EWM), the European association of professional women mathematicians, at the Max Planck Institute for Mathematics in the Sciences in Leipzig (DE). After our conference last October, this is the second time we meet in person. Barbara jokes that this visit was part of her 'Dutch year': she came in April 2019 as keynote speaker for the Nederlands Mathematisch Congres, then in the summer she visited Leiden for the Equadiff conference, and now the KNAW meeting.

Let's start with that, how was your experience last year at the NMC?
"I liked it very much. The talks were really interesting. And this conference is bringing everyone together from all across the country. When I was in the central courtyard, I could see groups of people discussing in the sunshine, and smaller groups sitting at the tables, working together with pencil and paper or on the computer. Such a meeting which is embraced by everyone is something very valuable for the scientific community. In my experience, such a format does not work equally well in Germany, which is too big of a country for that. Even at the specialised German meetings of the Special Interest Group for Probability and Statistics, there are several hundred participants and a large number of parallel sessions, which makes it hard to connect with people you do not know yet."


Barbara Gentz

The EquaDiff conference in Leiden was another big event you attended, how was your experience there?
"The Equadiff conference series sets a good example for large-scale conferences. Not only are the plenary speakers excellent, but the quality of the parallel sessions is also amazing. You have to be invited to organise such a session. In Leiden, Christian Kuehn and I had the opportunity to organise a session on Stochastic Dynamics with eight speakers, and we were very pleased with the talks we had in this session. The organisers of the Equadiff in Leiden did a fantastic job. Everything appeared to work without a glitch. And Leiden is a wonderful city, full of history. Walking from my hotel along the Nieuwe Rijn to the conference venue was a great way to start the day. The plenary sessions and the morning coffee breaks took place in the Hooglandse Kerk which was constructed in 1500! It was the ideal location for such a large crowd. The conference had more than 500 participants, and nevertheless I had the feeling of attending a long-awaited happy family gathering. It was easy to move around and to (re-)connect with people between the talks."

Speaking of differential equations, in your research you study the role of noise in dynamical systems, with a focus on SDEs (stochastic differential equations). Can you tell us more about that?
"I am interested in the effect of small random perturbations on continuous-time dy-

namical systems. If the underlying deterministic dynamics have a stable solution, the stochastic dynamics will typically stay for an exponentially long time close to the deterministic solution. Things get interesting when the stochastic dynamics approaches a bifurcation of the deterministic system. In this case you may observe transitions to other regions of the phase space which you would not see in deterministic dynamics. I am particularly interested in the quantification of these effects. How likely are such transitions and when do they typically happen? As it turns out, for precise results we often have to carry out a rather fine analysis of the deterministic behaviour before tools from stochastic analysis can be used to quantify the effect of noise."

Could you describe an example of such a system where noise plays a big role?
"A good example is the stochastic-resonance paradigm. Consider the overdamped motion of a Brownian particle in a double-well potential which is modulated periodically in time in such a way that during one period of time, the potential goes continuously from a deeper lefthand well to a deeper righthand well and back again. The speed at which the potential changes is a small parameter, so that the dynamics has time to relax towards the bottom of the well in which it finds itself. While the deterministic dynamics can never leave the well it starts in, the behaviour of the randomly perturbed dynamics depends on the interplay of three small parameters, namely the noise intensity, the speed of modulation and the parameter which measures the minimal barrier height. With Nils Berglund, we obtained a very precise description in terms of concentration results for the stochastic dynamics with sharp estimates on the small probability that the dynamics exits from the region of concentration [2]. Depending on how the small parameters scale, the stochastic dynamics either follows the deterministic dynamics for an exponentially long time, or periodic transitions between wells can be observed with high probability. This is something we studied a long time ago, but it is still my favourite example because it is the simplest example illustrating the effects I am studying in my work."

Is there a result that you are particularly proud of?
"I really like a work with Nils Berglund on the effect of random perturbations in the Allen–Cahn equation on a finite interval [3]. When the length of this interval increases, the PDE exhibits more and more stationary states while there are always the same two global minima of the energy functional. We investigated, how the stochastic dynamics realises transitions between these stable states and derived a Kramers-type law for the metastable transition times. We were actually coming from a discrete model: a system of n particles, coupled on a ring, which is something we analysed earlier with Nils and Bastien Fernandez [4], and treating the Allen–Cahn equation as a scaling limit of that system, we could transfer these earlier results to the stochastic PDE. This is the work I like best, because many different ideas came together. We were using our knowledge of the deterministic system, combined with potential theory, large deviations theory, and stochastic analysis."

Can you tell us a bit about your journey to becoming a mathematician? And specifically what took you to this field of study?
"In school I have always liked the hard sciences. I was interested in mathematics, physics and computer science, and it was clear early on that I would go in that direction. When I had to decide what to study, I excluded physics first because that would have required to spend my summer doing practical work, learning how to file, sand and grind properly, and I honestly did not want to do that. At that time, in the mid eighties, computer science seemed to be the future. So the truth is that I intended to study computer science. However, I finished school in January and I could not have started computer science before autumn. So I decided to start in April with one semester of mathematics at the Technical University in Berlin — and I loved it. So much that I never considered changing.

Since I entered university in April, I had a restricted choice of courses and I started with real analysis II and linear algebra I. Since that seemed too little, I picked elementary probability in addition. I quickly noticed that I had to work really hard for my class in real analysis while I was well prepared for the other two classes. So I was doing probability from the first semester on, and I loved it so much that I continued immediately with increasingly advanced courses."

Then you moved to Switzerland for your PhD…
"I was finishing my diploma with Manfred Breger when Erwin Bolthausen moved back to Switzerland and offered me a PhD position at the University of Zürich. I was one of the three people who had the opportunity to go to Zürich with him. From a personal viewpoint, the experience of moving to Zurich was very interesting. One would not think that, because the language is almost the same, but the culture in Switzerland is very different from what I was used to in Berlin. The biggest difference was in the way people interacted. Being a German I was far too frank! Scientifically, Zurich was a great place to be. With two excellent math departments in the city, the scientific life was so rich.

My first postdoc position was at ETH, a fantastic place to be as a young researcher… However, I soon came to realise that there was little hope to stay in Switzerland on a permanent basis. I could see young Swiss colleagues who did not want to go abroad moving from temporary position to temporary position. Switzerland is a small country, and my feeling has always been that the universities ensure the quality of their departments by expecting their professors to prove themselves internationally first. For a young scientist with family roots in Switzerland this system can be very hard, but if we look at the level of Swiss math departments we cannot deny that this approach to hiring is very successful.

When I had the opportunity to join Anton Bovier's group at the Weierstrass Institute, I went back to Berlin. Anton was the second referee on my thesis, and I was happy to have the chance to join his group. He turned out to be a very good mentor in this crucial time of my career. Anton is somebody who really knows what is important, scientifically and careerwise. I was still a rather young postdoc when I was invited to a review panel at National Science Foundation in the US. I honestly did not feel I was up to it. But Anton said: 'Of course you go!' This kind of support and encouragement is essential. At such a delicate stage in your career, you need someone who tells you that you can do it."

You just mentioned Anton Bovier's role as a mentor in the postdoctoral phase of your career. Is there any other support you received that you consider essential in your development?

"My parents never wavering in their support of my interests was pretty crucial. I always wanted to do little experiments, I was interested in technical things, and my parents never gave me the feeling that there was something I should do, or anything I could not do. They were supporting me financially at the beginning of my studies, until I had a position that paid enough. It was always important for them to make sure I could concentrate on my studies. These things mean a lot and should not be taken for granted.

Last, but not least, there is my advisor. Erwin's way to look at mathematics has had a strong influence on me, and his 'Do you really need this?' is excellent advice whenever you are stuck with a proof… I try to pass this on to my own students."

Photo: Max Planck Institute for Mathematics in the Sciences

Barbara Gentz during the EWM conference at the Max Plank Institute in 2019

Women in mathematics

At what point in your career have you become involved with the European Women in Mathematics association?

"A fellow PhD student told me about EWM. At that time we had e-mail, but web browsers just came into existence and information was not readily available on the internet. The members of the German section were taking turns in buying the weekly edition of *Die Zeit*, which had all the job advertisements for positions in academia. Someone would make a summary of all the positions in mathematics and send it out by e-mail. Even today, we still have a mailing list with job announcements.

In 2011, colleagues in Aachen organised the first German EWM meeting after a long time. I attended this meeting, and, sure enough, I found myself organising the next one. Since then, we have had regular meetings, on average every two years. But the German Branch is much less active than the Dutch one. I was quite impressed when I saw how many activities you have here with EWM-NL! You should keep it up, in particular the strong involvement of younger people."

How was your experience as a woman in mathematics, especially at the beginning of your career?

"When I started university, approximately 50 percent of the students in mathematics were women, maybe even more. But one has to keep in mind that prospective teachers are studying together with the other students. Later, when I had more specialised classes in probability, maybe a quarter were women. At that time, I was not paying much attention to that. I was once in a computer science class on complexity theory, and I was sitting down somewhere in first quarter of the lecture hall, so I could not see the room behind me. When the professor asked two people to come to the front to demonstrate something he asked for one man and one woman. I remained seated because I was not even aware that I was the only woman in the room."

In your address at the 'Avond van de Abelprijs' you talked about measures currently implemented in an effort to improve gender equality in mathematics, and you referred to them as 'the good, the bad and the ugly'. I found that this was a very apt definition. Could you elaborate a bit on that?

"This is how I personally like to categorise the measures which are implemented by the administration. First of all, there are the good measures like childcare, dual-career programs, and so on. Measures which can help families and do not hurt any one.

Then there are measures which are meant to guarantee women equal participation in committees but at the same time require this participation, leading to an above average workload for female scientific staff. This is in particular true for hiring committees. Serving on a hiring committee in Germany is extremely time consuming, and some studies even suggest that having more women on a hiring committee does not lead to more women hires, see, e.g., [1]. We also have to document our evaluation of all applicants in detail, choosing our words very carefully, because we know that someone will be looking at

the protocols of the meetings with a purely bureaucratic eye. This can be annoying at times, but certainly contributes to fairness. These measures take up a lot of our time, but they are also still needed to keep us on our toes, raise awareness and help preventing unconscious bias against women or other minorities.

And then there are those measures that I consider *ugly*. For me, those are the measures which involve people outside of the university where they are implemented. In our university there is a strong pressure to get outside expertise in the form of evaluations of theses or job candidates, and 50 percent of that expertise should come from women. However, in mathematics, there are not so many women professors, and achieving this percentage is simply not realistic. It is not appropriate to ask female colleagues from other universities to serve significantly more often than their male colleagues."

How does it work for you in practice?
"It is not easy. In our department, we have only a few women, but our male colleagues understand that it is simply not possible to have a 50/50 representation in all committees. So we do as much as we reasonably can, and when it is not possible to achieve equal representation, the department documents that we at least tried.

When I organise a workshop, I start by writing down the names of possible speakers — and end up with roughly 20 percent women. So I sit down and focus on adding as many women colleagues as I can in an attempt to achieve a more balanced list of speakers. In my experience, when you start sending out invitations, more women than men decline. I can think of several explanations, and I tend to believe that not only family obligations play a big role in this but that women nowadays get many more invitations because everyone is trying to invite the same few female speakers who are already well-established.

In our International Research Training Group, a graduate program which is funded by the DFG, the German Research Foundation, we made a commitment that a fixed percentage of PhD positions shall be filled with female students, and it was not easy to do so. There were simply not enough qualified applications from women and we had to reserve positions to fill them at a later time. When it comes to hiring of professors, there is a huge competition between departments for the rising stars among the young women mathematicians. When asking female colleagues whether they would consider applying to Bielefeld, I have heard more than once that they had been moving almost every year for quite some time and now want to settle and build a group at their current location. In any case, I very much hope that this trend of paying close attention to promising young female researchers continues and will finally lead to an increased percentage of women professors in the departments."

Do you see a difference in the general attitude to this issue, especially compared to when you started out in your career?
"Things are really changing. I am involved in the SIAM Activity Group on Dynamical Systems, and I noticed that SIAM must be doing something right. If you look at their committees, you see that many committees had at least 50 percent of female officers elected, which is pretty amazing. And, if I counted correctly, more than 20 percent of the SIAM journals now have a female editor-in-chief.

I can see that by now everyone is looking really carefully at applications from qualified women, and nobody puts such an application aside just because they do not know the candidate. This is an important progress because it gives candidates fair consideration, independently of the networks they and their mentors belong to. But implicit bias is still a problem. Although I have been involved with EWM for many years now, I know I am not immune. We should remind committee members regularly of this problem.

I also noticed a change in society reflected in my younger male colleagues. They spend much more time taking care of their children. And they are the ones who are objecting to meetings scheduled at times which are not family friendly. This looks minor, but it is an important step. Only when it becomes normal that mother and father spend a comparable amount of time with the kids and in the household, women can find an equal amount of time for their research.

When you go to a conference and take your children, the conference organisers nowadays often offer childcare on location. But a better solution for most families would be to take a nanny or a grandparent with them. It would be helpful if grants would generally allow to reimburse the extra cost."

In preparing your talk, you went through recent data about women in science in the Netherlands. What was your impression about the situation in the Netherlands?
"When I saw the data I started wondering whether the percentage of women in science is so low because of prejudice against women, if the Dutch system is even more in conflict with starting a family than the German one or if an academic career is simply not attractive for Dutch women. It is easy to say that we should aim at 50 percent of female mathematicians in our countries, but maybe we will never achieve this goal because there might not be a sufficiently high percentage of women willing to pay the price of spending so much time on research. What we need to do is to make sure that the women who do want to go all the way are encouraged and have a fair chance at a career. Parenting scientists should get all the support needed to make it possible to reconcile family and career."

References

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