

time to reach out to experts is of course when you finish a project and can share the results. By sending your work to people and talking to them about it, new avenues on which to travel toward next projects can become apparent.

Perhaps the most crucial moment to reach out to other researchers is when you are about to start looking for jobs in academia. As a fresh PhD, probably your name is little known in the field. But you can change the situation by informing relevant experts about your thesis results and inquiring about job information at their institutions along the way. Moreover, if your advisor can help advertise your work, that can also be quite useful. If a member of a hiring committee knows about your work, it can significantly increase your chance of getting the job.

As in any relationship, one needs to be thoughtful. Time is precious to everyone. Do your homework and fully prepare before talking to an expert. If you ask a question via email, make sure to formulate it concisely. If a conference speaker can meet you for only an hour, think in advance how to use this time slot: Which results do you want to mention? How can you explain them concisely? What questions would you plan to ask? Would you like to focus on technical details or get a sense about general ideas? This kind of preparation can also be good training for you to summarize your past research and figure out future directions.

As a concluding remark, one should not network for the sake of networking. Developing relationships with experts is like watering and fertilizing your career, but the foundation beneath everything is still your own mathematical achievement.



Dawei Chen

Credits

Author photo is courtesy of the author.

Adventures in Mentoring²

I started mentoring students and postdocs thirty years ago as a young assistant professor at Cornell. This continued after I moved to Berkeley in 1995, and I now enjoy working with young scholars in Germany. I always thought of mentoring as one of the best parts of my job.

With these notes, I'd like to share some anecdotes and experiences. These might be useful for colleagues who are starting their first tenure-track jobs and will perhaps be entertaining and thought provoking for all readers. Before beginning, I would like to use this opportunity to thank all my students and postdocs. I learned a lot from you. Please continue to teach me.

- **Doing the Opposite.** My first PhD student was older and more experienced. He came to my office once a week, for an entire afternoon, asking me for my advice on his research. I eagerly offered my advice. After leaving he did precisely the opposite of what I had suggested. The same happened the following week. I recommended A; he did not-A. The same events, week after week. I was puzzled. Is that what it meant to be an advisor? The answer is yes, for this particular student. Having already made up his mind on what to do, he just needed me to test his ideas. And to debate. He became a successful professor at a top institution.
- **A Threat.** It did not go so well with another student. One day, he messed up badly in presenting some material in a graduate seminar. I told him what I thought, right then and there. He was extremely upset because he felt humiliated in front of his peers. He threatened to shoot me if I ever did this again. I learned my lesson and decided to be more respectful.
- **Finding Good Students.** Don't ever compare students at your current institution with yourself, from back when you were a grad student. Most students are capable and motivated. Don't worry so much whether they are "good" yet. It is your job to help them become good.
- **Being an Imposter.** When I was a postdoc, I could not believe my luck. Someone paid me for what I loved doing. But how come they missed that I was not qualified for the job? That worried me. I was sitting in seminars and did not understand. I went to the library, and the math books were incomprehensible. But everyone else seemed on top of it. I decided to wait and see. Surely, some day they'll discover that I am a fraud. But this has not happened yet.

²Bernd Sturmfels, who wrote this article, is a director at the Max Planck Institute for Mathematics in the Sciences at Leipzig, Germany; professor of mathematics, statistics, and computer science at UC Berkeley; and an honorary professor at TU Berlin and Leipzig University. His email address is bernd@mis.mpg.de.

DOI: <https://dx.doi.org/10.1090/noti1924>

- **Fordern und Fördern.** This is a phrase in German that my father liked to say. It is composed of two verbs and translates roughly into “demand and encourage.” I have been awfully demanding towards my mentees, but I also strongly encourage them. Try to read that German phrase aloud. Pay attention to the umlaut. It sounds pretty nice, doesn’t it?
 - **Follow the Child.** When my children entered preschool, I learned about Maria Montessori’s famous line “Follow the Child.” She was absolutely right. You have to trust your children. They will show you what they need. You should likewise trust your students and postdocs.
 - **Questions.** Here are questions I ask mentees when we first meet. What do you excel at? Do you enjoy teaching? What have you written lately? What is the difference between pure and applied mathematics? Do you like to compute? Where will you be ten years from now?
 - **A Path Forward.** Inexperienced professors like to say, “I’ll just give it to a student” when referring to loose ends from their past research publications. This almost never works. You’d better solve your own problems. Your students are either unable to do it, or they will choose their own problems. Instead, show your students a path forward. Their own path, not yours.
 - **Excellence through Diversity.** Some people believe that there is a conflict between fostering diversity and striving for academic excellence. I found the opposite to be true. True excellence is inclusive. If you wish to train students and postdocs for academic careers at top research schools, then my advice is to build a diverse, inclusive, and supportive team.
 - **Gender.** Another lesson I learned from Montessori preschool: “Everyone has their gifts and challenges.” This applies to all learners, including you and me. Sometimes people ask how I became so successful in training outstanding female mathematicians. I already revealed two of the secret ingredients: Respect and encouragement. These two go a long way. Try to learn who your mentees really are. Gender, gender identity, and sexual orientation matter.
 - **Phase Transition.** The research seminar or group meeting can be a tough place for young scholars. Tone and atmosphere are tremendously important. I found that active participation by women and members of other underrepresented groups makes a huge difference. There is a threshold in their participation rate, around 30 percent in my empirical experience, at which a phase transition occurs. Above that threshold, seminars are fun and productive for everyone.
 - **On Writing Well.** I often recommend William Zinsser’s classic book with that title. But there are also good texts on mathematical writing. Writing a dissertation is writing. Writing research papers is writing. Writing job applications is writing. Writing grant proposals is writing. The importance of writing skills cannot be overemphasized.
- The mentor makes a huge difference. Lead by example. And make them read aloud the writings they produce.
- **On Lecturing Well.** Almost all mathematicians end up in careers where they must give clear and persuasive presentations. This is obvious for teachers and professors, but it also applies to those working in industry or government. Nobody is born a good lecturer. Practice makes all the difference. I discovered that some of the best-prepared incoming PhD students were on the debate team back in their high school. We all need to train with the debate team.
 - **On Coding Well.** To me, our cell phones are supercomputers. All of us spend most of the day performing heavy computations with these machines. But many young mathematicians are still afraid of using software for their mathematics research. Help your mentees to overcome that reluctance and to make friends with tools like Julia, Macaulay2, Magma, Maple, Mathematica, Matlab, OSCAR, R, SAGE, etc. Do admire the output of their computations.
 - **Listening.** Prospective graduate students recently visited Berkeley. Before the visit day, my current students were asking me, “What should we tell them?” I replied, “Nothing, just listen to them.” At all stages of mentoring, listening is often more beneficial than telling things.
 - **Being a Scholar.** There are many ways to become a scholar. Here are two points I recommend to my mentees. First, learn about mathematics. Here is a good exercise: for each of the two-digit numbers xx in the Mathematics Subject Classification, from “03 Logic” to “94 Information and Communications,” state in your own words what xx is about. Name one person you know who works in xx . Second, find out about the history of your specialty. Read papers that were written more than 100 years ago. Don’t fear foreign language sources.
 - **Matchmaking.** After we got married in 1990, my wife and I traveled Korea by car. On a country road we picked up a hitchhiker, an old lady who was a professional matchmaker. When she learned that my wife and I had not used a matchmaker, she was shocked: how was it possible for us to meet in Seattle without the services of her profession? That old lady had a good point. Matchmakers are useful. That is why I am a matchmaker for doing mathematics. I connect my mentees to collaborators. Many good matches have come from this.
 - **Language acquisition.** I believe the phrase “Good things happen to those who show up.” Encounters can be planned or circumstance. But if you don’t show up, then you will miss out. Students are hesitant to attend colloquia because they don’t understand anything (like all imposters). But think of this as a foreign language immersion class. Just keep going. A few months later you will understand and speak. One colleague recommended uttering unfamiliar words over and over again. One learns their meaning by gauging the reaction of

the listeners. Like a toddler. He said he tested this when he was a PhD student. He wanted to know what “homomorphic vector bundle” means. So, he went to the math lounge and repeated those three words over and over again. Now he is an expert in complex geometry.

- **Waking up to Email.** Every mentor has a different style. So does every mentee. A while back, PhD students at Berkeley complained that they do not get enough attention from their advisors. My students think that they receive too much attention from their advisor. A friend once referred to my style as “the samurai method.” It involves a barrage of emails, usually sent between 4am and 5am. While this is fine for some, it does not work for others.

In the bullets above, I shared some perspectives and anecdotes on mentoring. It is most definitely not meant as a “how to” manual. There are many ways for you to be a terrific mentor. Make yourself available to young scholars. Help them in finding their perfect match.



Bernd Sturmfels

Credits

Author photo is courtesy of the author.

Mentoring Graduate Students: Some Personal Thoughts³

My complex analysis teacher in college told me that I didn’t have the “smarts” for math. He strongly encouraged me to consider a career in banking. In graduate school, I failed my first qualifying exam. After defending my PhD, I applied for more than 150 academic positions, and I didn’t get a single bite. Perhaps out of pity, I was eventually offered a one-year visiting position with a high teaching load at a research university. I had been prepared to accept a position teaching high school algebra at a local community college.

³Ken Ono, who wrote this article, is Asa Griggs Candler Professor of Mathematics at Emory University and a vice president of the American Mathematical Society. His email address is ken.ono@emory.edu.

DOI: <https://dx.doi.org/10.1090/noti1925>

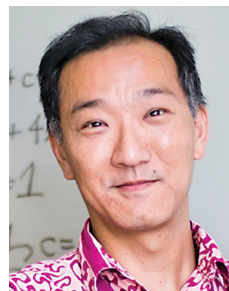
I am not quite sure how I successfully navigated the stormy seas that defined my early career in mathematics. What I do know is that I am now fifty-one years old, and I have enjoyed a privileged career as a research mathematician. I have had the pleasure of advising thirty PhD students, with most assuming postdoctoral positions at top Group 1 institutions. Furthermore, I am proud of the fact that mathematics continues to play a central role in their daily lives.

How did I make it? Good question. I do know that I needed the strong support of mentors who kept me afloat along the way. You might know their names: Paul Sally, Basil Gordon, and Andrew Granville. I learned a lot from these teachers, and I hope that I have been able to pass their wisdom on to my students of all ages.

Graduate school is hard! It is the place where students become leading experts instead of mere regurgitators of theorems. It is the place where doubt is meant to be replaced by confidence and achievement. This transformation is the result of hard work and luck. As a mentor, I now understand that one can succeed in our profession in many ways. Some students are whip-smart problem solvers (think Putnam Fellows and IMO medalists). Some students have a thirst for knowledge, learning everything they can. Some students have the gift of creativity. Some students have a knack for transporting important ideas from one subject to another. Some students have the ability to ask the right question at the right time. Of course, some students simply work very, very hard.

My job as the mentor is to figure out the skills that a mentee has and then to craft a research plan that best matches these skills. This includes steering students away from problems that are not a good match. This plan is something like a covenant. My students know that I am there for them when they are struggling. They also know that I will celebrate with them when they triumph.

Advising a PhD student is an awesome experience. It isn’t quite like raising a child, but I do recognize that I have a responsibility to do my best to guide a young person who has placed great faith in me. Although I am not quite sure how I earned the right to advise students, I hope that when my career is over that I will be remembered for taking the role of advisor very seriously.



Ken Ono

Credits

Author photo is courtesy of the author.