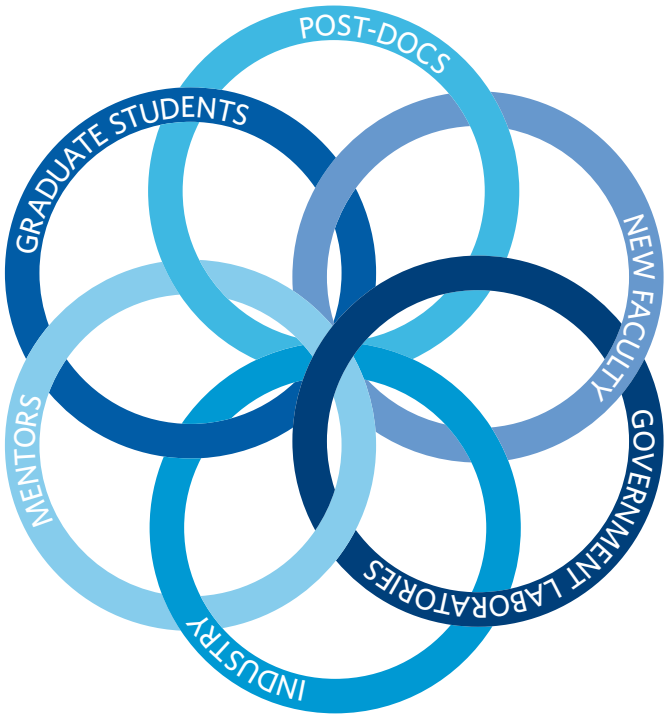
The Early Career Section offers information and suggestions for graduate students, job seekers, early career academics of all types, and those who mentor them. Angela Gibney serves as the editor of this section. Next month's theme will be good ideas.



Advice from Our Advisor and Publishing

Advice from Our Advisor: Benson Farb

Bena Tshishiku, Coordinating Editor

Benson Farb has advised 38 PhD students and mentored over 23 postdocs over the last 25 years. As a mentor, he has a reputation as a tireless advocate for his students, illustrated by the countless hours he devotes to giving advice on topics like conducting research, communicating mathematics, and navigating academia.

Benson has a knack for helping his students reach their potential. This is embodied by the following quote that Benson shared with me and his other students in 2014. The quote, from the book *Decoded* by Jia Mai, contains a message given by a professor of mathematics to his students:

> "I am a wild animal, not an animal trainer. I am going to chase you deep into the mountains and forests and you are going to have to do your damnedest to run ahead of me. The faster you run, the faster I will chase you. If you run slowly, I will chase you slowly. Whatever happens, you must run, you must never stop, whatever difficulties you face. The day that you stop running, our relationship is over. The day that you run deep into the woods and disappear from sight, our relationship is also over. In the first instance, I have given up on you; in the second, you have set yourself free."

This article contains advice given by Benson over the years, as told by some of his students and postdocs. I hope that readers will benefit both from hearing the different pieces of advice and from witnessing Benson's unique advising style.

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Dan Margalit

"Proof or counterexample!"

Some time prior, Benson had given me the following thesis problem: *Compute the automorphism group of the pants complex. Is it the mapping class group?* I had dutifully read Ivanov's paper on automorphisms of the curve complex to the best of my abilities. And by this point, I had come up with plausibility arguments for why the automorphism group of the pants complex might or might not be the mapping class group. After some time with no tangible progress, I came to my weekly meeting with Benson with another plausibility argument. He replied with "proof or counterexample!"

He did not say this in an argumentative way. But more of an assurance that one or the other existed, and I just needed to find it. Sort of a mathematician's version of "Do … or do not. There is no try."

Not long after Benson started peppering me with "proof or counterexample" at our meetings, I had a proof. As Benson loves to recall, I went from coming in with half-baked ideas to coming in with reams of calculations. I think that a part of me just needed someone to tell me that I could do it. That I had to do it. That was enough to get me to lock myself in the Regenstein Library and produce the reams, and the proof.

That was two decades ago. Still, when I am stuck on a problem, or when one of my students is stuck, I often find myself saying "proof or counterexample!" It works much more often than it should. Not just the phrase, but the knowledge that someone believes that you can and will succeed.

Sebastian Hensel

Benson Farb was my mentor when I was a Dickson Instructor at Chicago, as my first postdoc. Probably the first thing anyone notices when interacting with Benson for even a few minutes is: his enthusiasm and fascination for mathematics is infectious! No matter how bleak the outlook on any project seemed before going to meet with him (be it in his office or a coffee shop), after talking to him I was sure again that the project was worth focusing on, and absolutely doable. This kind of resilience may not seem like much—but in fact is absolutely crucial to get anywhere in math.

But what influenced me most, and what may be most indicative of his approach to mathematics, was something else. One time, when we were discussing that we couldn't prove everything we wanted in one of our papers, he told me that he would much rather write the first paper on some topic, rather than the last. This focus on new ideas and, most of all, new connections between different mathematical ideas is always at the core of his work, and is a wonderful guiding principle when approaching one's own work.

Kathryn Mann

One of Benson's go-to phrases was "keep pushing." He didn't use it in the obvious way, as a word of encouragement when I was stuck on a problem, as a means of saying "keep trying, you'll get it!" Rather, Benson's version of "keep pushing" meant keep pushing yourself. Don't take on a project that you know you could comfortably do. Push yourself to ask what the interesting problems are, what the rich and mysterious objects are, what the unexplored areas are, and set your sights there.

This was not particularly comforting advice to hear as a grad student. What I really wanted was to be handed a problem on a little metaphorical silver platter and be told "you definitely know enough to solve this and write it up, have fun!" Instead, I got "keep pushing" and "have you ever looked at these half dozen papers of Sullivan, there's some great stuff in there." In retrospect, "keep pushing" was a huge vote of confidence, and learning how to find my own problems was the most valuable skill I got from graduate school.

Towards the end of my time as Benson's student, he became very enthusiastic about the proverb "behind the mountains, more mountains," quoting it in every imaginable situation. To his credit, that image really does capture the richness and the infinite depth, beauty, and challenge of mathematics. From time to time, I still hear a voice (Benson's voice actually) in the back of my head reminding me to keep pushing. Don't stop here, it says, go look for the mountains that are just behind these ones.

Weiyan Chen

To me, Benson was not only an advisor on mathematics, but also a mentor on how to do mathematics. He devoted a lot of attention to urging me to develop good habits no matter how small they are, from having color pens to using the blackboard more effectively. Small habits matter because, as he often said, "Math is hard, so do everything to make it easier."

I still remember the very first lesson that I learned from Benson, when he saw me coming to his office bare-handed in my first student-advisor meeting, was to always bring a notebook to every mathematical conversation. I listened. This piece of advice seems trivial, but does have nontrivial impacts on me even years after I graduated. In my third year as a postdoc, when I was randomly browsing my tablet before a talk, I came across the note I took in a brief meeting with a visitor years ago, which contained the right information I needed to fill in a gap for a problem that I had been stuck on. That problem could have been much harder if I didn't keep the note.

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Figure 1. Benson with some of his students and grandstudents at his birthday conference in 2017.

This was just one among the hundreds of lessons I learned from Benson on trying to make math easier. Clearly, he remembered what it was like to be a graduate student and had the patience to pass on his experience in detail. From Benson, I truly feel the resemblance between parents and mathematical parent—they are the people in my (mathematical) life that care about my growth so much that they would give me advice so trivial that I would not hear from anyone else—although it might be years until I realize the benefits of their influences on me.

Khalid Bou-Rabee

Transforming from a graduate student into a researcher is a treacherous climb. I remember getting to the top of my first mountain during the start of my third year, after having found my first original mathematics theorem. It took me months to prove, and another few months to write up. As soon as I was ready to publicly post my results, I found another person's fresh flag at the summit. A distinguished professor from another university had just published a paper with all my results.

I was devastated. A year of work had seemingly gone to waste. And maybe I was just lucky? Will I ever prove another theorem? I started contemplating other careers.

"I understand that this is not a happy situation. But the options now are to stay bummed about it, or to use it as inspiration to show what you can do." This is Benson's views on setbacks, he converts them into opportunities, and he bleeds this ideology. He loves the challenge of the climb, believes in doing what's right, avoids being vindictive, and channels failures into growth. This is why I think Benson Farb is an advisor without equal. To me he is the embodiment of the proverb: "Fall seven times. Stand up eight."

Jesse Wolfson

Early in my postdoc at UChicago, I co-taught a course with Benson Farb and have been collaborating with him since. Around this time, I heard about a talk Benson gave where he began by asking the audience, "Can we all agree that I've proven some good theorems? Just one? Great! Now I can tell you about some beautiful mathematics that's not at all due to me, and which should be much more widely appreciated…." Another time, when we were totally stuck on some computation that "should be" known to experts, I was trying to push through on my own and Benson stopped us and said, "Let's go ask [world-leading expert]," adding in response to my expression, "Who cares how stupid we look? We'll learn more, and more quickly than anything we'll do on our own right now." Math is hard, and especially as a young person, it's easy to get caught up in a need to look or act "smart." Benson worked hard to dispel this urge, and not by pretending that insecurities can just be willed away or don't matter, but by generously modeling not taking them too seriously and emphasizing some of the main things that draw people into math—like its depth and beauty, or the joys of sharing knowledge (which requires people being willing to ask!). This is far from the only (or even the main) reason that doing math with and around Benson is so much fun, but from the perspective of mentoring, it's one I keep coming back to both for myself and for young people I'm now mentoring.

Jenny Wilson

As long as I have known Benson, he has supervised on the order of 8 to 10 PhD students at a time. Somehow, he always had time to give me feedback: on my papers, my talks, my grant and job applications.

Shortly before the first time I gave a seminar on one of my results, Benson sat down with me to critique my talk notes. His advice is still my model for preparing talks today: Cut a third of the material, and make the whole talk less technical. Follow this statement with some special cases. Illustrate that definition with a picture. Give a slogan first, then a precise theorem. Showcase this result in the easiest example. Make this comment explicitly, even if you think it is obvious. Lead with the most accessible applications. Decide what you want the audience's big takeaways to be. Keep it simple.

Throughout my time at Chicago, Benson taught me mathematics, but also the "soft skills" of a career in research. When I started he advised me on making a webpage, and how to get the most from a seminar talk (first order of advice: take good notes, even on the parts of the talk I didn't understand yet). Later, he advised me on how to choose which journal to submit to, and how to network at conferences. He shared his own experiences about how to keep motivated with research through the inevitable ups and downs. If I'm stuck on my problem, he suggested, I should find the easiest, most concrete case I don't understand yet, and tackle it. Or, if I am too discouraged to do that, I should go find some other more elementary, more

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fun math exercises to work on instead. I can come back to the research problem once I feel engaged again.

I graduated almost seven years ago, but I still reach out to Benson when I need career advice. Last week Benson wrote to me to make sure I was applying for a particular scholarship (in an email he signed "Your nagging granny"). Benson is an advisor just as he is a mathematician: fiercely dedicated, and always accessible.

Credits

Figure 1 is courtesy of Benson Farb.

Thinking About Abstracts

Asher Auel

Whether for an article, talk, or grant application, abstracts are an important part of the way we communicate our work. As with any form of writing, the most important issue to consider is your audience: who will be reading this abstract and what purpose should it serve? If it's for a conference talk, it might be the only piece of information, besides the title and your name, to help a participant decide to attend, so you might consider focusing on selling your talk as broadly as possible. If it's for a research seminar talk, including more detail and background might help local participants get excited about your work and maybe organize a pretalk for graduate students. If it's for a grant application, the abstract might be the only part of the proposal that is publically viewable, so you'll want to make it broadly accessible to a general scientifically literate audience. While seemingly everything you write or present needs an abstract these days, a quick historical tour through abstracts in scientific publishing, and how they have changed, may provide some context to help you get the most out of your abstracts.

While the notion of an abstract—a small piece of text summarizing a larger work—has been around since the beginning of writing and record keeping, its use in scientific publishing arose in the 18th century in conjunction with the editorial process. For example, a paper's consideration for publication in the Royal Society of London's journal *Philosophical Transactions* was based on an abstract prepared by the Society's secretaries after notes taken for the minute book during a reading of the paper at one of the Fellows' weekly meetings; see [5, p. 871], [4, p. 13], [2, p. 13]. In particular, these abstracts were far from being written by the paper's author. They would later (starting in 1830) be bound together and published in the journal *Proceedings of the Royal Society* (whose early volumes were entitled *Abstracts of the papers printed in the Philosophical Transactions*), which allowed for quicker dissemination of the latest scientific advances than the full publication of manuscripts; see [5, p. 877] and [2, p. 4]. For more on the history of abstracts, especially in the context of the Royal Society, see [3]. As the number of scientific journals increased, scholarly indexing and abstracting services continued the practice of publishing article abstracts to help researchers keep up with the literature in their field. In mathematics, the first such service was *Jahrbuchüber die Fortschritte der Mathematik*, established in 1868, which sought to publish a complete index, with abstracts (or reviews) written by the editors, for every work of mathematics published in Europe during a given year; see [1, p. 10]. In the 1930s, *Zentralblatt für Mathematik und ihre Grenzgebiete*, now *zbMATH*, aimed for a broader reach and quicker turnaround in publishing its indexes and reviews. When the Nazis pressured the *Zentralblatt* founder and chief editor Otto Neugebauer, who was Jewish, to resign, he eventually fled to the US and founded *Mathematical Reviews*, now *MathSciNet*, in 1940; see [1, p. 14]. The current practice of authors writing their own abstracts printed atop articles did not seem to take hold until later in the 20th century; it provided authors with much more control in crafting how their work was perceived by others.

Common advice for writing an article abstract these days include: don't make it too long (e.g., multiple paragraphs) or too short (e.g., one or two sentences), try to use a minimum of technical language, don't include formal references or displayed equations (and generally try to avoid typeset symbols when possible), and don't mention special programs or REUs or your PhD advisor. Most importantly, make it self-contained: don't assume that the reader has already read the paper, internalized the motivation, and kept track of the notation. As for the purpose of an article abstract, the traditional wisdom breaks into two camps: selling your work versus helpfully summarizing it.

In light of this contrast, no discussion of contemporary abstracts would be complete without considering the arXiv, whose open access research-sharing platform has become an indispensable venue for mathematicians to quickly learn about each others' work. Each day, thousands of people check the daily postings; they scan each posting's title and list of authors, and if interested, read the abstract; if further interested, they open the full text and scan the introduction. I would advocate for thinking of your arXiv posting's abstract more akin to a talk abstract than an article abstract. Since one of the primary goals of the arXiv abstract is to entice people to open your full text, you may want to make it more zippy, more broadly understandable, and more concise, leaving the reader with a feeling that they want to find out more. This is your article's elevator pitch moment! Later on, when your article is accepted in a journal, you can retool your abstract a bit with a view toward the permanent public record: consider making it slightly more informative

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