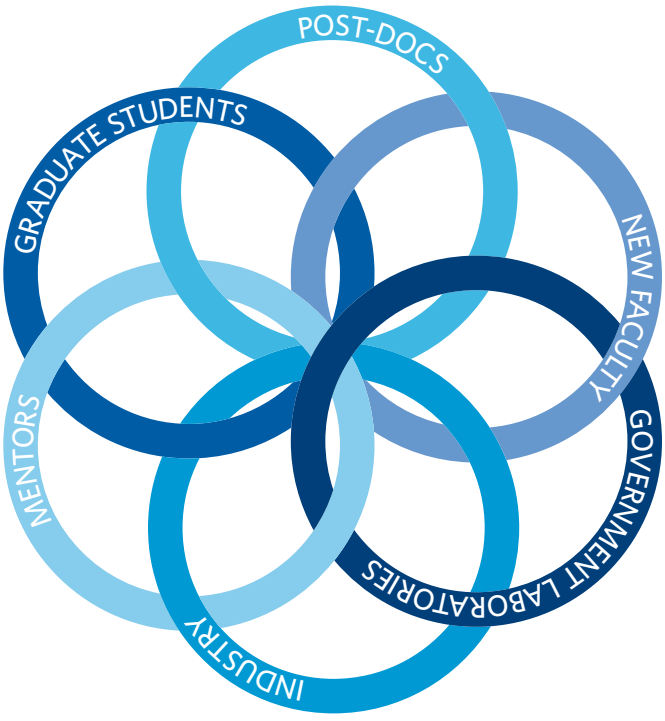
The Early Career Section is a compilation of articles that provide information and suggestions for graduate students, job seekers, early career academics of all types, and those who mentor them. Angela Gibney serves as the editor of this section. Next month's theme will be good ideas.



Planning Ahead for the Joint Meetings

Giving Good Talks

Satyan L. Devadoss

Motivation

Mathematicians are like rock stars: after recording an album, they need to go on tour. Like an album, a paper conveys a polished, finished product, with all the notes perfectly in place. A talk, on the other hand, is akin to a concert performance, highlighting the essential parts of our mathematics through the brushstrokes of intuition and personality. Sharing our work through seminars, colloquia, and presentations offers an invitation for a far larger audience to explore our writings, building community and fostering collaboration. Although the skills for publication have some overlap with those for performance, the distinctions are greater: giving good talks involves not just a command of words and images but speech, body movement, control of time, and a disproportionate emphasis on storytelling.

Developing and sharpening these skills is important now more than ever, for our data-driven world is hungry for quantification, paying particular attention to mathematics. Consider the notion of "applied" mathematics: The twentieth century relegated this to certain subjects such as PDEs, numerical analysis, and probability. In our twenty-first century, however, nearly every area of mathematics is rich in applications, from algebraic geometry (phylogenetics) and homotopy theory (data analysis) to complex analysis (computer graphics) and number theory (cryptography). And so, the opportunities to present and showcase all types of research mathematics to corporations, government agencies, think tanks, and a thirsty public are proliferating, highlighting further the importance of proper presentation.

My communication philosophy can be explained by considering a steak (or a stalk of celery, from a vegetable view-

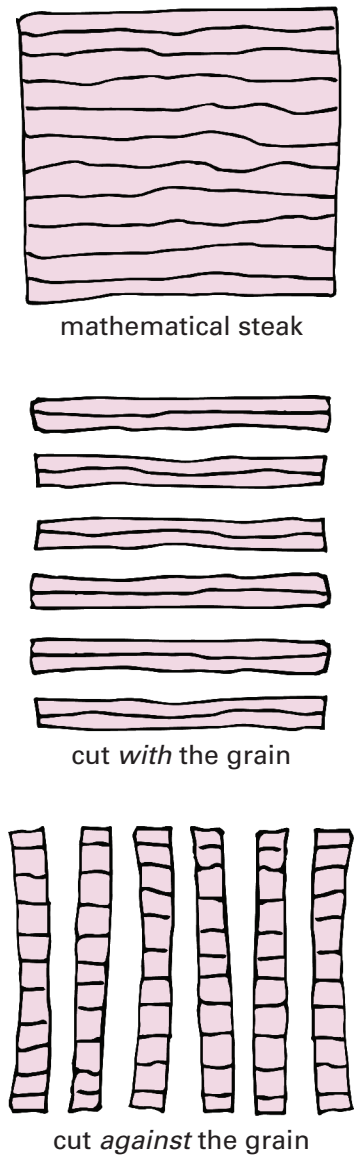


Figure 1.

Satyan L. Devadoss is the Fletcher Jones Professor of Applied Mathematics and a professor of computer science at the University of San Diego. His email address is devadoss@sandiego.edu.

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point); see Figure 1. The steak is the sum total of information, and the job of the presenter is to cut the steak into digestible pieces for the audience.

If the steak is cut *with* the grain, the listeners are forced to chew through the tough fibers; a piece of lovely mathematics is turned into an unpleasant meal. On the other hand, if we're intentional beforehand and cut *against* the grain, the hard work of breaking up the fibers has already been done, leaving the audience with an enjoyable taste in their mouths. This article offers a few general principles of how to do just that.

Story Driven

More fundamental than the label of mathematician is that of human. And as humans, we're hardwired to use stories to make sense of our world (story-receivers) and to share that understanding with others (storytellers) [2]. Thus, the framing of any communication answers the key question, what is the story we wish to share? Mathematics papers are not just collections of truths but narratives woven together, each participating in and adding to the great story of mathematics itself.

The first endeavor for constructing a good talk is recognizing and choosing just one storyline, tailoring it to the audience at hand. Should the focus be on a result about the underlying structures of group actions? Or the process in which a topological invariant was discovered? Or possibly the relationships between competing numerical approximation methods? Once chosen, the next (and likely the most difficult) task is to adhere firmly to this decision. Keep the bits that move the story forward and remove the pieces that digress from it. The hardship arises due to the special love we have for certain parts of our work (theorems, remarks, connections) that do not follow the chosen narrative. Unaddressed, these embellishments lead to tangents (at best) and distractions (at worst) that might bring us personal satisfaction at the cost of confusing the listener. Sir Arthur Quiller-Couch gave the following advice to writers [5], which is equally applicable in crafting talks:

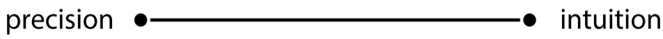
> *Whenever you feel an impulse to perpetrate a piece of exceptionally fine writing, obey it—whole-heartedly—and delete it before sending your manuscript to press. Murder your darlings.*

Do the hard work in killing the parts that move away from the central point, regardless of how fabulous they are. The main thing is to keep the main thing the main thing.

Another facet of the connection between humans and stories is realizing that the storyteller is important to the story itself. As Francis Su argues, the pursuit of mathematics is a human endeavor, and mathematical thinking can help fulfill such longings as love, freedom, play, justice, and community [6]. Theorems are not the only stars of the show; you are as well! Your viewpoint and approach to mathematics make your talk unique, and your frustrations and joys are part of this story. Analogous to the contrast between a musical score and a musical recording, a talk allows your personality to come forth and shine through. Highlighting rather than hiding this aspect will not only improve the experience of the listener but your enjoyment as the presenter. Being a showperson or a comedian isn't what matters: your passion for your mathematics will be the fuel. And as your storytelling skills improve, so will your writing prowess.

Words and Images

Although the content of a talk is similar to a written paper, they carry out different functions. In most cases, the presentation serves as a pointer to your research paper. Thus the amount of precision involved, especially when framing definitions and theorems, is substantially different between the two mediums. A paper requires a high degree of precision, a mathematical composition of clarity and accuracy, a place of reference for future works. A presentation format, with its time constraint, forces ideas to be painted in broad strokes, denying opportunities to consider the finer details. High precision stands in tension with intuitive storytelling.



Consequently, you should hide subtle nuances in definitions and give only a framework for important proofs, relegating their details to the paper. The talk should be a pointer and not a substitute for written mathematics. Having said this, however, do not abuse this freedom to do sloppy mathematics. The balancing act comes in providing clarity without magnifying subtlety.

For talks involving slides (rather than a wonderful chalkboard), it becomes even more paramount (and more difficult) to kill your darlings. Overwhelming the audience with information becomes easy, simply by adding extra slides or jam-packing each one. All of this is done with very little cost to the speaker, while the listener pays the price. Keep each slide limited to a handful of sentences, with a large font, and generous whitespace in the margins and between sentences. If there are appropriate illustrations or figures, please, please, please use them. Pictures serve as marvelous substitutes for a thousand awkward words.

Figure 2 shows two examples of good slides: note the clean fonts, clear images, abundant spacing, and simple titles. Each of these slides can easily take one to five minutes of presentation time, depending on the listening audience and the chosen storyline.

If you need to use notes, carry a notepad, keeping your slides uncluttered. Let each slide breathe, giving them a welcoming look. When (not if) people get distracted during your talk, the slide titles should offer a smooth reentry back into the presentation. And if the slides have been properly written and formatted, the need for a laser pointer should

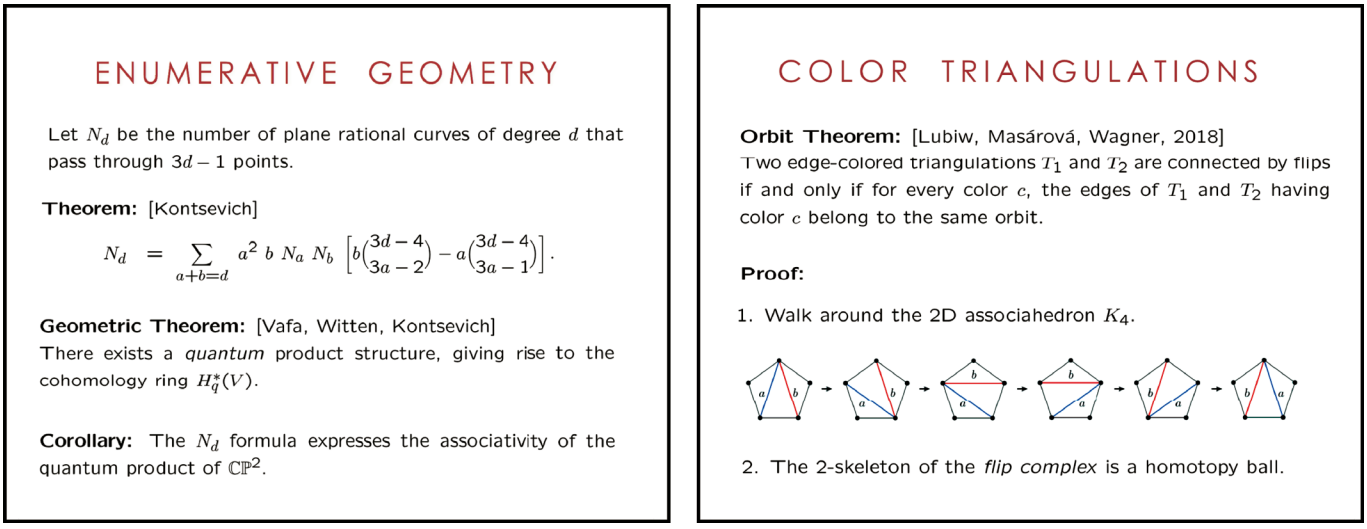


Figure 2.

evaporate, with the hands and the body more than capable of being the guide.

Just as every written word conveys information, the same is true of images. Pay careful attention to the choice of colors, shading, line widths, compositions, and other aspects of figures and drawings. A classic book by Edward Tufte [7] is a good place to start, offering terrific advice on how best to present visual information. Realize that images themselves are a form of notation. The great John Littlewood writes [3]:

> *A heavy warning used to be given that pictures are not rigorous. This has never had its bluff called and has permanently frightened its victims.*

For example, a pentagon whose interior is shaded is different from one that is not; the former conveys a two-dimensional object whereas the latter shows its one-dimensional boundary. If certain figures pack a high amount of information or are of particular importance, make them fill the entire slide. Have the audience fall into the beauty of such pictures.

Time and Space

A radical difference between a paper and a talk is the importance of time and space. The use of space is the greatest untapped potential in most presentations. Being human, we're gifted with not just minds and mouths but bodies. Use your whole body during your talk, including your hands and feet. (Under the rare circumstances when restricted to a podium, your hands play a far more important role.) For instance, when transitioning from one point to the next, move from one side of the room to the other. Walk with intention, stopping to emphasize critical ideas, coordinating your body movements with the arcs of your storyline. When making a key point, speak quieter and slower, to draw your audience in. Not moving at all or moving with abandon (both of which can be attributed to nervousness) creates a dissonance between what is being said and what is being enacted, distracting the listener.

Although time is the most restraining element in a talk, any mathematical work can be presented in 50 minutes, 30 minutes, or 5 minutes, or even as a 20-second elevator pitch. What it requires is hard work to distill the vast range of ideas in your work into a laser-focused story. Blaise Pascal [4] once famously wrote:

> *Je n'ai fait celle-ci plus longue que parce que je n'ai pas eu le loisir de la faire plus courte.*[1]

In other words, it's easy to give a long talk but takes discipline to make it shorter. Speaking faster or cramming more lines of text doesn't convey more information but muddles it, wasting precious time. If the pace is hurried, the audience will feel your anxiety and stress. So spend the days and weeks before the talk doing the heavy lifting, shaving off unnecessary darlings. Learn to enjoy the silence, using it to both highlight key points and allow your ideas to be absorbed. Silence is a powerful tool that most in the Western Hemisphere fail to appreciate [1].

In spite of seeming like a waste of time, spend an inordinate amount of time on the introduction. It's reasonable to allocate 40% of allocated time to it, with 50% for the body and 10% for a conclusion. Without this long runway of time to develop an opening gambit, instrumental in providing motivation and foundation, there'll be little interest or investment from the listeners for the remainder of your talk. Of course, experts in the field will not be in need of this, but the talk isn't for them. They're already equipped to read your paper without a need for motivation. (Having said this, I'm always pleasantly surprised to hear that even the experts are quite appreciative of a lovely and lengthy introduction.)

[1] *I would have written a shorter letter, but I did not have the time.*

Most importantly, do not go over the allocated time. No one complains about a talk that ends early, but each and every minute outside the timeframe becomes exponentially excruciating (as we can all testify). The best method in helping perfect your timing is practice, practice, practice, either in front of others or by yourself. Ideas that look reasonable in notes or on slides often don't work when said out loud. Giving voice to the written word also reveals new and better ways to frame and articulate your mathematics.

Through all of this, keep in mind that attending a talk is a far costlier investment than reading a paper. While the latter can be done at leisure, the performative nature of the former forces the audience to arrive at a specified space at a specified time. We should honor their sacrifice by cutting the steak properly to give them an enjoyable and enriching presentation of mathematics.

Myth

A word of warning as your ability to give good talks improves. There is a disproportionate number of seminars and colloquia given by high-caliber mathematicians that leave most of the audience bewildered and confused. Over time, we come to expect this outcome, due to the following mathematical myth:

> *The deeper the mathematics involved, the worse the talk will be.*

This correlation exists not because this myth is true, but the skillset needed for creating extraordinary mathematics is quite different from the one needed for talking beautifully about it. And so, having digested your delectable meal, some might assume that your mathematics must be simplistic, without appreciating the skill and time it took in framing complex ideas through a strong narrative. A word of encouragement: it is undoubtedly worth the effort and the cost in pushing through these judgments, bringing mathematics that is a joy to hear to a world that is eager to listen.

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Satyan L. Devadoss

Credits

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10 Ancient Rules for Giving a Conference/ Seminar/Research Talk in Mathematics

A New Translation from the Original Cuneiform Stone Tablets

A. Kercheval

1. Thou shalt finish your talk on time. This is the prime directive; obey this rule above all others. Preferably you should end slightly early: you will please your audience with the gift of extra minutes in the day. If you are late, you steal time from your audience and displease the gods.
2. Do not accomplish the goal of finishing on time by the artifice of speeding up a talk that is too long. The gods will not be fooled. Your audience did not volunteer to hear a 3-hour talk in 45 minutes. Instead, select what is best and omit the rest.
3. Practice your talk for time and pace. If you check the clock during your presentation and say, "Uh oh, I'd better speed up!" this angers the gods. Prioritize. Do not spend more time on a topic than is warranted by your overall goal.
4. Have an overall goal. Keep it clearly in mind while preparing your talk. Remember that your job is to inform, not confuse or impress.
5. It's easier to inform if your audience is paying attention. Therefore the gods grant you permission to entertain, as long as it does not interfere with your goal or violate

Alec Kercheval is a professor of mathematics at Florida State University. His email address is akercheval@fsu.edu.

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the prime directive (rule 1). Give the talk you would like to hear.
6. Know your audience—you must know what things you should explain, what things require only a reminder, and what things everyone already knows. Explain what is needed, but don't belabor the obvious.
7. The gods must be able to compile your talk. Therefore figures must be clearly labeled, and all terms and notation must be clearly defined before use.
8. If you project figures or words onto the cave wall, omit anything that you do not plan to explain fully. Describe; do not read.
9. Praise those whose work in the same crops have contributed to your harvest.
10. Do not hide your own weaknesses, or the gods may expose them for you on their own terms. The gods have not selected you to sell used chariots but rather to educate.


A. Kercheval

Credits

Author photo is courtesy of the author.

Advice for the Campus Interview

Amanda Folsom and Alex Kontorovich

Introduction

Congratulations, you're invited for a tenure-track job talk! What should you expect for your visit, and how should you plan your lecture? We will decompose our discussion according to whether you are interviewing for a predominantly *research* versus *teaching* position. Some of our advice will overlap with more general suggestions for how to give a department colloquium; for the latter, the reader is invited to peruse, e.g., [Ell10, Ger97, Gow07, Hal74, Kra13, McC99, Tao09].

Amanda Folsom is a professor of mathematics at Amherst College. Her email address is afolsom@amherst.edu. *Folsom is partially supported by NSF grant DMS-1901791 and NSF CAREER grant DMS-1449679.*

Alex Kontorovich is a professor of mathematics at Rutgers University. His email address is alex.kontorovich@rutgers.edu. *Kontorovich is partially supported by NSF grant DMS-1802119, NSF CAREER grant DMS-1455705, NSF FRG grant DMS-1463940, and BSF grant 2014099.*

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Research University Interview

Pre-interview

The single most important bit of advice happens well before the job talk:

Prove the absolute best theorems you can!

If you want an offer from a research university, there is simply no substitute for first-rate work. There are lots of other places to read advice on your research program; we won't rehash such discussions here, but feel it is important to restate the obvious.

Next, also well before the job talk: When you apply to a position, it is important to try to find someone in that department close to your research (ideally someone you know personally). If it's a job you really want, consider emailing them to let them know you've applied. While the relatively recent appearance of MathJobs.org has been a blessing for applicants and letter writers, it has increased tenfold the number of files delivered to hiring committees. The odds of winding up on a short list may be greatly increased by personally reaching out to someone on the tenured faculty close to your work. Even if they're not themselves on the search committee, they can forward your file to the committee members. Or they can do nothing; it's not necessarily an imposition to write and say that you've applied.

The Visit

Here is a bit of game theory: if you were invited, then you were invited by somebody. That is, there is a person or group of people in the department already advocating for you; they're most likely people you already know or, at the very least, people close to your research.

The people closest to your research are not the ones you need to impress!

They're probably already impressed with you or else they wouldn't be trying to convince their colleagues to hire you to their department. The people you do need to impress: everyone else, especially those far from your research area.

A typical visit will involve meetings with the department chair, the head of the search committee (often but not always the chair), and perhaps the director(s) of the graduate/undergraduate program(s). The chair/search head will want to know whether you seem like a collegial person to have in the department; the program directors will want to get a sense of whether you can teach introductory and advanced courses in the undergrad/grad curricula. You may be asked to speak with a dean, as well as other members of the faculty interested in conversing with you one-on-one.

Our best advice here: just be yourself. Do be curious about the department and faculty life: where do people live (how are the commutes? schools?); what is the grad student to faculty ratio (how many PhD students, on average,