Proving Yourself: How to Develop an Interview Lecture

John Swallow

You've applied, you've waited, and now you've been invited for a campus interview—and, no doubt, you'll be giving a lecture. Your hosts have provided a few details about the lecture format, and you've given some thought to a topic—perhaps a result from your research. At this point you wonder: have I done enough? Is the problem of the interview lecture essentially solved?

If you're in that most special of cases, when your appointment is a done deal and all that's required is a passable lecture, then yes, you needn't do any more—and congratulations!

If you're in the general case, though, then read on. Positions can be won or lost with a lecture, and the goal of this article is to help you land your desired position. If you've been working on your job talk for quite a while, then this article will help you assemble a good set of questions for your hosts so that you can maximize the effectiveness of what you have already prepared. If you're just getting started on your interview lecture, the article will help you start and plan the process efficiently. Either way, don't let what follows overwhelm you. Even the most experienced lecturers can improve, and your hosts surely understand that you're just starting out.

Boundary Conditions

When you ask your hosts the natural question—what sort of lecture you should give—you'll almost surely be told one datum: the type of lecture. That is, you're to give a colloquium, a seminar, an undergraduate lecture, or some variant. You might also be told a second datum: how much of the talk should be related to your recent research results.

John Swallow is JT Kimbrough Professor of Mathematics and Humanities at Davidson College and an associate editor of the Notices. *His email address is* joswallow@davidson.edu.

What you should realize is that these data hardly answer the question. In fact, your hosts have done no more than set boundary conditions—and they know that. You'll probably want to prepare a few more questions to ask so that you'll know how to hit the mark more closely—and we'll mention these later on. Still, the answers to even these questions will be only boundary conditions, and it will be up to you to construct a lecture meeting the boundary conditions and differentiating you, positively, as much as possible. Let's start, however, with how to interpret the two data.

Understanding the Constraints

Most often the type indicates the audience. For instance, a colloquium is usually meant to introduce an area of mathematics, or perhaps a significant theorem or counterexample, to mathematicians who are not specialists in the area. Such a lecture should certainly be accessible to the graduate students in the audience for at least n minutes—and almost surely the n you assume is too low. A seminar lecture, by contrast, is for specialists—not from your precise subfield, of course, but from a recognized subdiscipline: algebra, or differential geometry.

An undergraduate lecture could suggest one of several sorts of potential audiences: math majors, all students in math courses, or even all undergraduates. If you're asked to give an undergraduate talk, be sure to determine the audience as closely as you can. How many students will likely attend, and with what background? Will everyone in the audience have had a course in linear algebra?

After the determination of the audience, the next most important boundary condition is the topic. For positions at research universities, this will be your research, or at least something from your work that would suit the audience.

For positions at other institutions, however, potential topics can be quite variable, and it would be well worth your time to explore your options with your hosts. Some may prefer that you provide a context for your own work, instead of results from it, say by explaining fundamental ideas in your research area: an introduction to a subdiscipline. Others may ask you for a hybrid exposition-research lecture: present your own work, but only after spending the first m minutes in a manner sufficiently elementary for a certain audience.

Still others may ask you to teach a class, either on a topic of your own choosing or of theirs, something called a class lecture. Watch out for this last sort: they may be the hardest lectures to give. It is far too easy to become overconfident about presenting "trivial" material—and what, after all, could be worse than showing your potential colleagues that you have trouble preparing to teach calculus or linear algebra?

One tricky part of these boundary conditions is that the actual audience will very likely diverge from the stated audience. Your colloquium could be attended by some specialists, your undergraduate talk by many faculty. Be aware of this discrepancy, particularly when you deliberately describe a concept or a proof intuitively but not precisely: those who know what you're talking about will scrutinize that intuition closely.

Now let's move on to what should be the heart of the lecture—the mathematics.

First Principles

Of prime importance: your talk must communicate some compelling mathematics. Select a theorem or two that you can comprehensibly state and convincingly motivate. Don't be a slave to the advice that all good mathematics talks contain at least one proof; many wonderfully fine lectures don't even give a sketch. If you do plan to explain the result, be sure that the proof or sketch can be clearly broken into a few significant and accessible ideas.

Having made these choices, then lay out the pieces of the mathematics: definitions, possible examples, equivalent statements of the theorem, ideas in the proof, applications. Once you see them, consider how you can order them to tell a compelling story.

It may be that you want an example first, in order to motivate a theorem. Or you may want an example afterwards, to illustrate the statement of the theorem—and you might work the example out in a way that prefigures the general method of the proof.

Given a choice between greater clarity or greater completeness in presenting a proof, always choose clarity. It is for this reason that many excellent lecturers give sketches in place of proofs. Your audience can always ask how some details would be filled in, and if they do so they'll be giving you just the sort of question you'd like to answer. Remember that the objective is not to show that you can work out all of the details of a hard problem—surely your hosts assume this, since they brought you to campus—but to show that you can share some compelling mathematics with others, generating excitement and enthusiasm in the process. (Beware confusing clarity with teaching to the least knowledgeable person in the audience. It serves no purpose for your lecture to be too vague.)

In general, less is more. It is far better to end a bit early, with the possibility of answering some great questions, than to finish in a rush, running roughshod over your conclusion. Similarly, a couple of well-explained ideas will be far more valuable to your audience than a fully-detailed proof.

If you're to give a class lecture, take extra care in preparation. Especially if you're to introduce an elementary concept, be sure you know exactly what definition you will state, exactly what diagram you will draw, exactly what example will illustrate the precise point you want to make. We're all harsh critics of things we've taught many times.

Conventions and Convolutions

Now that you've got the pieces of the talk set out and organized, consider the means at your disposal. Will you have a blackboard or a whiteboard, colored markers, or an overhead projector? A projection system driven by a desktop or laptop, with or without sound? A podium, with a microphone at the podium or a lapel mike? What will be available—and what most people tend to use—should be among the information you find out from your hosts. Once these are known, you can consider your options, and decide whether to follow the local conventions of that particular department.

If you can give your talk in the traditional way, writing on the board using chalk or colored markers, legibly and in straight lines, then you probably should. In this way you'll be able to show off your experience managing the challenge of delivering a lecture while choosing, as judiciously as possible, what to write on the board.

You've seen the mistakes of inexperienced lecturers: beginning to write a sentence, only to break off because it's taken too long; writing that sentence in a line—but not a line of slope zero; spelling words using a script of size proportional to the distance from the edge. Your hosts will want to know, for their students' sake, that you've worked to avoid these mistakes, and the best way to allay their fears is to demonstrate your competence during the interview lecture.

You may feel a temptation to give a PowerPoint-style lecture, by, for instance, using the beamer LaTeX package to prepare a pdf file that you can click your way through. Be very careful, however, before deciding to do so. First and foremost, you'll be passing up the opportunity to demonstrate your

ability to give a traditional lecture, and so you'll place yourself at an initial disadvantage, something you'll need to compensate for by crafting an especially rhetorical presentation.

Moreover, for every mistake of a beginning lecturer at the board, there is a mistake of a beginning lecturer stepping through a prepared file. These mistakes include reading the lecture directly off the slides, thereby revealing a dependence on the script; cramming too much text or technical material on a slide; and clicking too quickly from one slide to another, without regard for whether the audience is assimilating the material. For all the faults of blackboards and whiteboards, they have one great benefit: they force you to make hard decisions about what to write. If you do decide to give a PowerPoint-style presentation, be sure to see the "Rhetoric and Taste" section below.

If your work involves computing, then your lecture may require a computer demonstration, and you'll need to work to make this portion of your presentation as seamless as possible. You'll want to be able to recover from errant key presses or button clicks, so know your software intimately—and be sure to find out whether you'll be able to use your computer or instead an unfamiliar one at the institution. It's wise to ask your hosts to schedule sufficient time for you to run through the technological portion at least a half-day before the talk. If it turns out that something's amiss—you can't connect your laptop to their secured Internet network, their projection system, or their sound system; or you finally realize that you'll have to use their computer, which doesn't have the software you need installed—the likelihood of finding a remedy will be much greater if there's a half-day to find someone to troubleshoot the situation.

You can certainly consider combining two or more ways of delivering your talk—board work, beamer presentation, computer simulations, something yet unnamed. But be prepared to handle the transitions well. If all you genuinely need is a diagram or section of a proof that requires a lot of time to write, you could ask if the lecture room has movable boards. Writing on a board before the lecture and covering it up may be a better strategy than depending on technology.

Finally, if possible, avoid being tied to a podium. Doing so restricts your ability to move around, to engage the audience, and perhaps even to get up close to a student and ask a question. If a microphone is necessary, try to use a wireless one. If you need to click through your presentation, procure a wireless clicker as well.

Great Expectations

Having chosen and organized the mathematics well, now it's time to think about how you'll be presenting yourself. You want to appear confident and relaxed, both friendly and engaging: show your best self—and smile.

The folks in the audience will be asking themselves who you are: who you are as a teacher, who you are as a mathematician, and who you would be as a colleague.

Don't be overly modest or self-deprecating. The interview lecture is not the time to express eternal gratitude to your advisor, or to admit that your work hasn't been all that impressive. Show what you've got and stand by it. At the other extreme, don't try to impress with your mathematical ennui—this trivially follows from that, which obviously implies the following result. If you're not excited about the mathematics, your audience won't be either—not to mention that you'll likely be making them feel inferior.

Engage the audience, yes, but don't go overboard by asking every two minutes if everyone's with you, or by too-earnestly soliciting questions. Don't be surprised that some faculty simply don't intend to be with you. They've heard it all before, and they're simply watching how you go about the task.

Choose what you will highlight in the talk based on your audience. If you're speaking to mathematicians, bring out an interesting subtlety, emphasizing that you're a mathematician's mathematician. If you're speaking to undergraduates, bring out a detail of the discovery or the surprise of a generalization, emphasizing that you're a student's teacher.

Whatever you do, don't become defensive in taking and fielding questions. Instead, prepare for lots of possible questions, viewing the opportunity of answering them as an opportunity to introduce material in a different way.

Theory and Practice

With all of this planning behind you, now practice! Rehearse the beginning especially, figuring out how you'll start off with the right expressions and tone of voice. Give the talk to some friends or family members. If you're reluctant, at least deliver it a couple of times to an empty room and then see if you can ask others to observe and evaluate.

Either way, find a way to time the different portions of the talk. It's a great help to see how long each portion takes, particularly if you find that the talk is a bit short or a bit long; you'll be able to spend more time with a proof, or eliminate an unnecessary remark.

Once you feel ready for prime time, see if you can give the talk as a regularly scheduled seminar at your current institution, or even as a lecture in some course, finding an audience somewhat like the audience you plan to encounter. (Of course, this requires starting the process of lecture development far in advance of your actual interviews!)

Rhetoric and Taste

If you've gotten this far, you have a fairly complete recipe for developing an interview lecture that should be entirely satisfactory. However, particularly if the competition is stiff, you may need a lecture that reaches beyond satisfactory—all the way to memorable. At one level, lectures are about making meaning, to be sure. But making that meaning truly memorable is what will cause that search committee to keep thinking about you.

To make your lecture memorable, you must do something different and do it well. The novelty might certainly be using the latest technology (audio, video from film, or flash presentations you developed yourself), but it needn't be. In our society of mathematicians, it can sometimes be considered novel to engage the audience by making eye contact with each person. The ways of breaking the mold are limited only by your creativity and your diligence in perfecting a technique, making your personality work for you—and your sense of mathematical taste.

One especially effective approach is to use a rhetorical strategy in your talk. That is, consciously present the mathematics in a way that elicits some emotional reaction: laughter, surprise, or even a bit of anxiety. You could choose among the following:

- Produce a surprise: show how an example or result generalizes, but not in the expected fashion.
- Explore—or manufacture—a paradox.
- Make visible some concepts or phenomena that were previously invisible even though the objects are well-known.
- Add a joke or two to lighten up some tough technical moments.
- Deliberately omit a case, or tumble over a subtle point, and get the audience to ferret it out.

Of course, some of these are riskier than others, and the more you have a sense of the faculty at the host institution—who may be quite different from those whom you met earlier—the better. Note that the last strategy requires special care to carry off: your audience must believe by the end that the strategy was your plan all along!

Other methods for making meaning memorable are matters more of style than of rhetoric, and they might be used together with a strategy:

- Provide historical details or motivation about the mathematical results you give.
- Use the available division of the boards carefully, cleverly hiding certain results behind some boards and bringing them out just in time. (No doubt you'll need to take a few moments before the talk to figure out how to do this.)
- Get some members of your audience to stand up and somehow represent a mathematical concept or technique.

Whichever rhetorical strategies or stylistic components you use, the very fact that you'll have decided upon them means that you'll have crafted a truly individual—and distinguished—lecture.

Quod Erat Faciendum

Don't forget: when you're done, smile and say "Thank you." The interview won't be over, but it will feel different. Your hosts will have experienced first-hand how you can communicate mathematics—and the better you've prepared for that moment, the more they'll want you to join them.

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