

Math Talks

Like many of you, I just returned from the joint meetings where I saw many talks of varying quality. This has prompted me to write an article on giving a good math talk. Most ideas here are mine, and I would appreciate any references or suggestions others have on giving mathematical talks. While most of the suggestions are obvious, I have seen many speakers who could benefit from these suggestions.

When preparing a talk, you should first ascertain who you will be speaking to. Then you should decide what is the objective of your talk. A guiding principle is that while everyone in the audience has chosen to attend, it is your job to make it worth their while to listen.

There are three basics which go into the preparation of a good talk: research, materials, and organization. Research is what most of us are familiar with. By this I mean knowing your topic well enough that you can answer questions honestly, whatever your audience. Specifically, you should know some of the basic theory underlying the topic as well as some of the consequences of the results discussed. Ideally you should also know some of the history of the subject. Depending on the setting, your talk need not be original material. If not, then know the history well enough to give proper credit and references.

The materials for the talk are the handouts, the overhead slides, the chalkboard, or whatever else you need. You should have practice using the materials. Typically, you give handouts when conducting a series of seminar talks on a topic. Handouts will help attendees keep track of what you are doing and give them something to refer to later. If you make handouts, be sure that they are neat and clear. Remember to make large headings for topics so that people can use your handouts easily.

Exercise particular care when using overheads. Clear, concise slides can hold your audience's attention, but messy, disorganized slides may be the swiftest way to lose it. You should use 18 point (1/4") type or larger if typeset and half an inch if handwritten (neatly!). Consider your slides carefully. When a slide goes on the screen, everyone will start reading it. Thus, don't put it up until you want it read. As well, keep the slides concise and to the point. You can fill in details verbally.

Board technique is as important in talks as it is when teaching a class. This means you should write neatly and think about what will be on the board at all times. If you will want something later in the talk, write it where you can save it without too much effort. Some of these touches can turn a good talk into a great talk. Similarly, bad board technique can take a good talk and make it horrible. Steven Krantz's book *How to Teach Mathematics* has several pages on blackboard technique. Every suggestion he makes is as appropriate for a lecture or seminar as it is for a classroom.

When organizing a talk, remember that not all of your audience will be paying attention at any given time. Try to make it easy for those who have drifted to rejoin you. You will also hold more of your audience for a longer time if you sufficiently motivate the subject early in the talk. Put important comments in the beginning, as well. Every good talk I have ever attended has been well-motivated from the start. Remember that it is hard work to watch a talk. As the speaker, you must continually convince your audience that it is worth their while to pay attention.

Try to give basic examples illustrating the main points of your talk. This can be very hard as basic examples sometimes don't exist. In that case, try and come up with examples that motivate the ideas even if they are not precisely examples of what you are speaking about. (In this case, DO warn your audience what you have done). Remember, your job is to help your audience understand the subject. They will be able to do so more easily if they have examples to ponder.

Carefully consider which details to include. While details are frequently at the crux of the matter in mathematics, they may also serve to confuse. Those having little to do with the ideas of the subject are best left out. I have been told that many details are best done "in private, between consenting adults." Always keep in mind the goal of conveying the ideas behind the subject, and let that be your guide.

Another organizational issue is one of time. Do not go over. Nobody enjoys having a talk go overtime, and nobody minds when a talk is a little bit short. Ideally, have something at the end that can be omitted if necessary or lengthened if necessary. This will help you end your talk before the allotted time.

If people ask questions during your talk, give them honest, thoughtful answers. The audience usually asks questions to help them understand. If you don't know an answer, say so. If you have a conjecture, explain why you believe it. If, however, the issue brought up is subtle, then say so and mention what makes it subtle without going into too much detail. Little else annoys people more than speakers who pretend to understand more than they really do.

There are several common formats for talks. Colloquium talks are given to general audiences and should not do too much. In a colloquium talk, give some history of the field and motivate the problem. By all means state your main theorem and discuss the proof, but be sparing with the unimportant details. A colloquium audience is much more interested in understanding the field and the importance of the result than the details of the proof.

A second common format for a talk (or series of talks) is a research seminar. At your home institution, your audience is the (other) faculty, and your purpose is to keep your colleagues abreast of your work. When visiting another institution, your intended audience is the three or four specialists in attendance. They invited you to see what you are doing and to learn something of value. Make it worth their while. Having said that, this is not a carte blanche to bamboozle the rest of the people in attendance.

A third common forum for a talk is at a meeting of specialists in your area. Such talks are typically 10 to 20 minutes. These talks are often seen as "advertisements" for your research. Again you should be clear about the motivation of the question, but for an audience of experts, you can motivate the problem while assuming the audience knows a lot about the field. By their very nature, 20-minute talks skip details. As before, you need to figure out what is important in your work and explain that. The statements of the theorems are far more important than the proofs. The general idea behind the proof should be given if possible, but don't go through messy calculations if you can avoid it. Probably the best comment is that you should be willing to cut material.

A last format is the job talk. This is like a colloquium, but much harder to give. In this case, you MUST know at least a week in advance who your audience is and what they expect out of your talk. What makes this type of talk much harder to give is that members of the audience will be looking for different qualities. At a research school, many will want to see your research and they will want to know what makes it good. Some will also be interested

in seeing how well you organize a talk. Others will be interested in how well you answer questions, and some people will have other interests still. At a smaller school, you might be giving a talk to undergraduates. At some schools, you might even be teaching a class. It is extremely important to do a good job at this talk. Many members of the department will base their final decision on the talks given.

In all cases, you should practice your talk before giving it. The amount of practice depends on the type of talk, and as a realist, I know that not every talk gets practiced. The best practice comes before a live audience (if you can find one). Grab some friends and ask them to watch you practice. Then listen to their comments. Practice helps you fine tune your timing, and it also helps you discover where the rough spots are. Lastly, practice gets you used to the materials of the talk. I think a job talk should be practiced a minimum of 3 times. That way, you avoid major gaffes, know what you are going to say, and can be ready for the unexpected. For other talks, one practice run is probably enough, although if you encounter difficulties the first time, it is probably worth it to practice again.

This advice should make it sound like preparing a good talk is hard work. While it may be hard work to prepare a good talk, there are many benefits. The obvious benefits are communicating a subject you love to your peers, and gaining a reputation for being a thoughtful and considerate speaker. In addition, I find that preparing a talk is always a boon to my research. By seeking a way to express my ideas in a clear and concise manner, I am forced to rethink the basics, and this often leads to new, simplifying ideas. For this reason, talks (particularly research seminars) are good to give when you are in the midst of some research, not after you have tied up all of the loose ends. (Although in a job talk, I would rather the loose ends were tied up.)

Perhaps the best way to improve your speaking is by observing others and thinking about their presentation. When you are paying rapt attention to a speaker, consider why your attention has been captured. If you lose interest in a talk, think about what the speaker has done. If you drift back into a talk, what enabled you to do so? By emulating the good and discarding the poor, your speaking ability will surely improve.

It is also worthwhile to read about giving talks. One good reference is Paul Halmos' article on the subject, "How to Talk Mathematics," in the AMS Notices 21 (1974), pp. 155--158 (and presumably reprinted in the recent book of his collected expository articles).

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