20 Commandments for Writing and Giving Talks
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A long, long time ago, I posted a note called "Dos and Don'ts for Giving Talks." Having organized 5 Topology Students Workshops, and experiencing another decade or so of talks, I decided that a new version was needed, and so here it is. A lot of the content is also touched upon in the two talk worksheets on the Mathematics Students Resource, which are [here](#) and [here](#). I wrote those worksheets with various other mentors from the Topology Students Workshop, in particular Katie Mann.

If you search around for advice pieces about talks, you'll see that a lot of them are angry (see, for instance, [McCarthy's well known piece](#) and [this one by Shewchuck](#)). I suppose that makes sense. We all know the feeling of having our time wasted by a terrible talk. Why can't people just give good talks? As a profession we have not done enough in educating ourselves on the practices behind good talks, and also we almost never give each other constructive feedback. Even when I give a horrible talk, I'm either told nothing or told that my talk was good. The point is, having been an angry audience member many times, you should hopefully be motivated to improve.

It takes a huge amount of time and energy to write a good talk. You need to start with high level storyboarding, organizing and reorganizing, making lots of nice pictures, researching the history, working out enlightening examples, and then throw it all away and start over a few times. There is an infinite dimensional space of talks. There's no way you're going to find the right talk on your first or second attempt.

There are 20 commandments below. The first eight are about storytelling: what is the point?, executive summary, capturing attention, context, stories, tension, tour guiding, and ending. The next seven are about pedagogy: chunking, on ramps, pictures, indicating the hard work, being precise, and aiming low). The last five are about the delivery and other aspects of your talk that reflect on you as opposed to your theorem: scholarship, stage presence, preparation, ending on time, other mechanics.

I think slide talks are generally a better choice than board talks, especially for conferences. So in some cases I assume that we have a slide talk at hand. Many of the comments apply to board talks, but might need to be adjusted.

Anyway, that's enough intro, and we're almost at the one page mark, so let's get to it.

Storytelling

1. *What is the point?* Your talk should have one main point. Usually this revolves around the statement of your main theorem. You should make it as clear as possible what that point is. For starters, have a slide that says "Main theorem," and nothing else, before the slide that has the statement of your main theorem. Then at the top of your main theorem slide, write "Main theorem." Announce to everyone out loud that you are about to state *your* main theorem. Then state it slowly and clearly, and then pause so the audience can absorb it. Try using a different tone or cadence. Finally, make sure to say how you think about the theorem, and what it means. I cannot tell you how many talks I have been to where the talk ends, and I am wondering what the point was.

2. *Executive summary.* While you often cannot state your main result on the first slide, you should start by giving the audience an idea of where the talk is going, and in particular the idea of the main result. Here is the text from one of my executive summary slides:

   We give a simple, geometric algorithm for the following decision problem:
   Given a branched cover of the plane over itself, determine whether or not it is equivalent to a polynomial.
   Our methods come from geometric group theory and the theory of mapping class groups.

   This certainly is not stating the main theorem. For that one needs to sit through the talk. But it tells the audience why they are giving up their hour. It also serves the purpose of setting up some pins to be knocked down. Or empty boxes that will get filled in during the talk. By doing this, it is much more likely that commandment 1 will get satisfied, and also makes it more likely that the audience will be able to follow the arc of the talk.

3. *Capture the audience's attention right away.* If you start your talk with "Let me start with some notation," you are immediately killing any enthusiasm that the audience might have. Similarly, recalling to the audience the last time you were at their university is unoriginal and a waste of time. (Also, I cannot tell you how many talks I have been to that start with one, or both, of these mistakes.) Why should they be excited to sit in your talk? I saw a great talk by Josh Greene where he started by reading a problem from a book of math puzzles, something about cars on a racetrack. Besides being entertaining, this made me want to know what this had to do with 3-manifolds. Do you have a picture or example or question that draws the audience in? If not, think of one!

4. *Give context.* Start your talk from the beginning. The beginning is often farther back than you think it is. For a colloquium, the beginning is not the definition of the mapping class group. Rather, it might be: this is a surface, here is where surfaces come up in life (the space of configurations of a mechanical linkage, for example), and when we have a basic object like this we want to understand its symmetries. Once you start moving towards your main result, context is equally important. What are the foundational results that your result is related to? What made you want to answer the question that you answered? The further back/out you can go the better. The audience is more likely to understand and get something out of the big picture as opposed to your specific result (sad but true; get over it).

5. *Tell a story.* People like stories. Mathematicians are no exception to this. What is the story behind your main result? Joan Birman gave a great colloquium at Tufts that started with Robert Williams sitting next to her at a conference and asking her if his knot was trivial or not, and then connected to Lorenz's study of chaos and weather patterns, and ended with a connection Ghys' ICM lecture and modular forms. Benson Farb gave a great talk at the ICM that features a battle between an idea that was too good to be wrong and a computer program that said it was wrong (the beautiful idea won).
    In your case, maybe the conventional wisdom in the field was that some folk conjecture should be true, and somehow you stumbled upon a potential counterexample. Or maybe your theorem follows a thread that can be traced back to a forgotten theorem or question of Euclid or Poincaré that you stumbled upon. Or maybe it was a dark and stormy night. All of these things will produce oxytocin in the audience, which will (quite literally) make them happy.

6. *Tension.* An unexciting, and quite typical, approach to giving a talk is to state the definitions required for the main theorem, list some prior results, state the main theorem, and then give an idea of the proof, which is the natural proof once one understands what is going on. Yawn! What's missing is the tension - the excitement. These are the critical points in the story where something unexpected happens, or where one is not sure which way things are going to turn out. Maybe there are heuristic arguments for and against your main theorem. Or maybe there is an example so complicated that it seems hopeless that there can be a general statement. Or maybe one of your lemmas contradicts a known result. Curt McMullen has a slide with the title "Long periodic trajectories are uniformly distributed… aren't they?" and a picture that suggests that the opposite might be true. These are all points of tension that require resolution. They draw the audience in. Every good math story has points of tension. Find them!

7. *Be a (good) tour guide, not a magician.* One way to give a talk is to give the big picture (or helicopter flyover), pointing out major landmarks that you will come across during the talk, before proceeding to trek through the details. Another way is to create a trail of breadcrumbs, asking the audience to repeatedly take one more step with you into the forest, so that you can reveal the big punchline at the end of the talk. Which of these talks would you rather listen to? Which method is more common?

   While it is appealing to build up to a big punchline, and while this works in an entertainment context (like a horror movie, for example), this does not work in an educational context. When you give the big picture, the audience member can create empty boxes in their mind, to be filled during the talk. They know, for example, that you are going to explain some specific classical theory, study one particular example in detail... When you don't give the big picture, the audience member will spend precious mental energy wondering where this is all going, why they are sitting there, and what they want to eat for lunch. By the time you get to your punchline, they will have lost the thread, lost interest, or both.

8. *Stick the landing.* Many (or most) math talks end with the speaker going deeper and deeper down a rabbit hole, and simply ending when time runs out. You should not do this. If you are ending your talk with "And I guess I'll stop there," you haven't thought enough about your ending. (Again, I can't tell you how many times…) Go back to the point discussed above: what is your story? What is the resolution of that story? This is a good time to reiterate the main point of the talk; it will land differently now that the audience has heard most of your talk. You can also discuss further directions.

   Pro tip that I learned from my former student, Justin Lanier: Whatever you put on the last slide is what the audience will have in front of them while they are wracking their heads for questions. If all they see is "Thank you," they might be drawing a blank. Put the statement of your theorem up, or some pictures from your talk. Finally, it is good to end your talk by saying the words, "Thank you." Besides showing your gratitude, this is a good way to indicate for sure that your talk is over. It is very awkward if there is uncertainty.

Pedagogy

9. *Chunk, chunk, chunk.* Any complicated task you do in life is more easily done in chunks. The chunks of a talk should be a few slides each, and each chunk should ideally be an individual, digestible idea. Here are some examples of what the chunks might be in a talk: Overview, A Key Example, The Main Construction, Statement of the Main Theorem, Idea of the Proof, Further Directions. Each chunk should be introduced with a slide that contains nothing but the title of that chunk. Besides telling the audience what you are about to do, this also has the effect of either waking them up, giving them a break, or letting them know that you are moving on to another of the landmarks you described at the beginning.

   As much as possible, each chunk should be separately understandable. Your construction of a space of trees can and should be understandable without remembering what the main theorem is. So while you can refer to the overarching goals and themes during each chunk, it is also helpful if each chunk stands alone as its own mini-talk. It is much more likely that an audience member can follow a 7 minute thread than a 50 minute thread.

   As a side note, I want to advocate for title slides. Good title slides help keep the audience grounded, in the same way that the titles for the chunks do. I feel like titles on slides are going out of fashion, and clarity is the victim. Titles are not clutter, but rather an effective tool for getting the most out of your slide.

10. *Make a spiral, not a line.* We've all been to a talk where we got distracted for a moment—maybe even by something relevant to the talk—and then fell off the wagon, never to get back on. That is not very fun, so you should avoid giving a talk that is linear in this way. The first part of the antidote is to clearly chunk your talk, as above. That way, the listener knows when they have a new on ramp. At the start of each chunk, you can remind the reader where you are and how this chunk fits into the big picture. Spiral math is popular in elementary education. What I'm talking about here is a version of this for a talk.

   In order to have as many on ramps as possible, the chunks should be as independent from each other as possible, repeating your main points as necessary so the listener can get back on track, and guiding the listener into the flow of the talk by giving signposts: explaining where you are and why you are doing what you are doing. If you feel like you are repeating yourself too much, that probably means you are doing it right!

11. *A picture is worth a thousand words, the latter is a stake to the heart.* Simplify each slide as much as possible. One way to do this is to explain with a picture. Even a complicated construction, like a space of trees, can often be best explained by showing a picture and walking slowly through it. Another strategy is to explain complicated mathematical statements by giving a special case. Whatever you do, don't put too many words on a slide. Humans are incapable of not reading, so they'll be doing that instead of listening. Also, your audience is less capable than you think at comprehending large volumes of complicated text, so this makes us struggle instead of listen. One of my favorite pastimes is editing slides to simplify them as much as possible; a word here, a notation there, a punctuation mark there. It is satisfying, like pruning a bonsai tree.

12. *Indicate where the hard work is, but only indicate.* Especially when you are starting out, you need to convince people that you are doing nontrivial mathematics. I was told that I lost out on a job because I made my (very difficult) theorem look too easy. (I have also been told by third parties that there is no way this could possibly be true.) The goal is not to make the audience suffer, but to show them where you suffered. A slide showing pictures of all 42 cases is one way to do this. Or showing the major stumbling block (tension!). You won't get to explain the gory details of your proof to your audience, but you should find a way to say where they are and convince the audience that they are real. What you don't want is for the audience to leave your talk thinking that your theorem is obvious. It isn't. Tell them why.

13. *Be precise, avoid TMI.* You have probably heard the advice to not overload your audience. So you leave out a hypothesis here, an adjective there, a formal definition there. Bad! Everything you say and write should be 100% correct. You cannot say that every surface is a connect sum of tori; that's only true for the closed, orientable ones. etc. If you try to skimp by not saying precisely what you mean you will confuse, lose, and annoy your audience.

On the other hand, there is a time and a place for eliding the gory details. If your theorem is technical, you might state a special case. If you are doing an induction, you might only discuss the inductive step (if that is the interesting part). In discussing a proof, you might give only an outline. If there's a technical definition or construction, find a way to leave it out of the talk completely. Be selective about what you present, and present that with precision. (Pro tip: it is not true that every talk must have a proof!) Lemma 7.2 might be your favorite thing about your paper, but you're not going to be able to explain it in your talk (which has one main point). Eschew your darlings.

14. *Examples, please!* There are many things in life that are hard to define, but you know it when you see it. (Google the last sentence for examples.) So while it is important to give precise formal definitions in your talk, it's really the examples that turn on the metaphorical light bulbs. You can read the definition of a group, and even understand it and prove things about it. But we learn what a group is by looking at specific examples. This principle applies equally well to your talk. The more examples–especially running examples–you have, the better chance your audience will be with you.

15. *Aim low.* Mathematicians love understanding things. Give them a talk they can understand. If it's a seminar, give a colloquium. If it's a colloquium, give a public lecture. Ignore the standard advice that your talk should lose more and more of the audience as you go. Why would you do that? Once I was in front of a room of high school students and their parents and was asked to give an impromptu lecture. I pulled out some slides on knot theory that I made for lower elementary students (literally kindergarteners). The audience loved the talk. They could understand it, they enjoyed the animations, and had to think pretty hard about some of the questions I asked. I even met someone who became one of my top undergraduate researchers ever. I think this episode speaks for itself.

You

16. *Be a scholar.* You have proven a theorem or two, and you are invited to give a talk. You do not feel much like an expert or someone who understands the big picture. Change that right now! The first thing you should do is read the introductions of all papers adjacent to your work. Include all of the relevant history–with dates! Besides being the scholarly thing to do, this decreases the chance that the world expert on your topic will be sitting in the front row wondering why you didn't mention their work (they will not be happy). Be generous with credit, even if (especially if) you are in competition with others.

Another way to be scholarly is to draw a connection to another field. You may find such a connection in your reading. You are not comfortable with said discipline, you say. That is okay! You are not expected to be an expert in this far flung field, but you should learn enough that you can say something.

One more scholarly move is to discuss in your talk what you think are the major open questions in your field. Or some new, possibly less major, questions that are inspired by your research. The audience will enjoy this more than Lemma 7.2. It takes a very different kind of effort than proving a lemma, but it is well worth it. Start staring at your navel!

17. *Enjoy yourself, but not too much.* I have been in many a talk where the speaker is very clearly bored with their theorem, or tired of explaining it, or they think it is easy, or they are self deprecating or scared of being in front of the room. Any of these negative emotions will translate directly to the audience. If you can't get excited about your theorem, nobody else will. That said, one should be careful not to boast. But getting excited and engaged, making eye contact, and connecting with your audience is the only way to make your audience excited about your work.

      An important point here is that your talk is not the time to practice your stand up comedy. The audience came to learn mathematics, in particular your mathematics. That is a gift and you should treat it with the respect it deserves. Your goal is to impress them with your mathematics. Slapstick humor will distract from this. I say this with as much love as possible, being a recovering seminar comedian, but save it for the dinner afterwards. A joke or two is fine if it's natural and actually funny. But a forced joke will fall flat, and create unnecessary awkwardness - as if mathematicians didn't have enough of that already.

18. *Be prepared.* First of all, I usually set aside an entire week (not one day) if I am preparing an important talk (which most of them are). The first day or two might be just storyboarding what the different slides will be about, shuffling them around, making chunks, etc. Actually making the slides might take a day or so. Making the pictures might be another day. And then the editing, pruning, etc.

      And then there's the actual practicing of the talk: actually saying out loud what you are going to say, from beginning to end. It has happened to me many times that I was confident that I knew what I would say on a slide, and then when I opened my mouth, it was a train wreck. The only way to be sure you will nail your talk is to do the whole thing out loud, preferably in front of other people.

      Also: anticipate questions. If you are going to casually mention a theorem, or a connection to another field, you should not be surprised when someone asks about it. Always know your topic a level or two better than what you are presenting. That way, if someone pokes you during the talk, you are ready. The best way to know what questions you'll get after the talk is to practice in a low stakes situation. Often you hear the same questions every time you give a talk. All this said, if you can't answer - or even understand - a question, don't panic! That's totally normal. You can say you're not sure, or that you don't know, and thank them.

19. *Other mechanics.* Dress professionally. Go to the room ahead of time to try out the equipment. Confirm the length of the talk. Start your talk by thanking your host/organizers. Depending on the situation, it could be helpful to say who you are (student at X working with Y). Name your collaborators, clearly and fully, and write their names, at the very start. Don't say anything negative about other mathematicians or their work. Make eye contact (much easier in a slide talk!). Talk clearly, enunciate, project, and use silent pauses. Let the moderator properly do their job (they ask for questions at the end, not you!). Say thank you at the end. In the question period, answer briefly (most people want to leave).

Another basic, which deserves its own paragraph, is to avoid drawing attention to yourself. While you are giving your talk, you are going to be in your head a lot, thinking of what you are screwing up, and how you did not prepare enough, and how you are going too slowly. And you are constantly making decisions about which way your talk should go. Do not ask the audience what they want to hear next.   Do not apologize.   Do not make excuses. Do not point out that you are running out of time. Just do your math. Even pulling out your phone to look at the time is a distraction. Bring an old-fashioned travel clock, or use an app that allows your phone to serve as such. Keeping your audience's attention is hard enough; don't sabotage yourself.

20. *Don't go over time.* Not one second. Ever, ever, ever. Even if you started a couple of minutes late for a 50 minute talk, end on time. Even when you think the audience is loving your talk, you are accumulating negative points, at an exponential rate, for every second you go over. People are busy, and they gave you a whole hour already. Be respectful of that.

One way to not go over time is to create escape valves in your talk. Whether you are given 5 minutes, 20 minutes, or 50 minutes, it's enough time to say what you need to say. If some time got chewed up somewhere, that's your loss, and you should have pre-planned places where you can skip or shorten what you were going to say.

Also, a mistake that I have seen a million times is to go slowly in the beginning because you feel like you have infinite amounts of time. You will regret this at the end, when you need 5 more minutes to explain your new construction. I can often predict from the first minute that the speaker is going to badly run out of time, because they are burning time on the front end. It is painful.

The last piece of advice, which I got from my advisor, is to consider this question:

WOULD YOU WANT TO LISTEN TO THIS TALK?

I went to a talk by Peter Ozsvath where he explained that there are always two talks: the one you want to give, and the one that the audience wants to hear. (He then told us he would do half of each. It was an excellent talk, but I do remember enjoying one half a little more.) Think about your audience wants to hear. It's not Lemma 7.2.

That's the end. Good luck writing your talk!