

Em-Cats for CT2024 Guidelines

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Introduction

This document is to give you:

1. some criteria I think any “good talk” should satisfy, and
2. some suggestions as to how to go about achieving a “good talk”.

As this is aimed at talks for CT2023 I will focus on that specific format and audience. This is slightly different from earlier iterations of this document, but should still be more broadly relevant to short conference talks.

I’m sure you will agree that these things are personal *to some extent*, and some aspects of giving a good talk can’t be captured by a simplistic list of guidelines. However, I believe that the general standard of talk-giving among professional mathematicians is...not that great, and I guarantee that if you follow these guidelines your talk **will** be better than the average of all the talks I have attended in my life.

Giving a good talk is difficult. It takes hard work in the form of preparation as well as the effort actually expended during the talk. For any new talk I still spend **weeks** preparing. It is much easier, and less work, to give a bad talk. However, the benefits of giving a good talk go far beyond the immediate benefit of people understanding you.

I believe that we as a research community are wasting a lot of time by giving, and sitting through, incomprehensible talks. Think of it like this: it takes a long time to prepare a good talk, but if you give a bad 25 minute talk to 100 people, you have wasted over 40 hours of human time on earth. Whereas if you give a good talk, you are contributing to the spreading of knowledge and understanding through the world.

I know that the research community doesn’t necessarily put a lot of value on giving good talks, compared with, say, publishing in prestigious journals or winning huge grants. I think that is part of the problem with what I call the *ingressive* research environment. A more *congressive* research community values the sharing of knowledge, and not just among experts. It values the ability to explain things, which is a way of bringing people in. I think we can work towards a more inclusive, congressive research community. Giving good talks, and valuing good talks, is one way we can do that.

1 Criteria

I think a good talk satisfies the following criteria, most important first:

1. It should be comprehensible.
2. It should be engaging.
3. It should be informative.
4. It should contain some interesting mathematics.

The most common error that speakers make is that they focus so much on (4) that they completely fail to achieve (1). Remember: **there is no point telling people something interesting if they don’t understand a word you’re**

saying. There's also no point if you're so soporific that they've fallen asleep before you get to the point, hence point (2). And I think of point (3) as this: I would like everyone in the audience to go away having learnt *something*.

I do think that the benchmark for comprehensibility is different for a 25 minute conference talk as opposed to a one hour colloquium-style talk. I will come back to that.

There is still an old-fashioned prejudice that being incomprehensible equates to being brilliant, and conversely that being comprehensible means you're not brilliant. I hope you agree that this is false, and is a poor excuse for being incomprehensible. I think we need to change the culture. This is harder to do for talks at an international conference as opposed to in our own seminar, but I have been giving intelligible talks at international category theory conferences since I was a PhD student myself, and I believe that this helped me get invitations to give other seminars and to go on extended research visits, so aside from its intrinsic value I think it can have good career consequences too.

2 Basic rules

Here are some basic rules I think should be applied to *every talk*. None of them is difficult, so why not apply them?

- **Always put your title up.** If you're using boards, write the title on the board. This document is about slides, so it's not really an issue.
- **Always start by thanking someone.**
 - If you are speaking at a conference, thank the organisers. Unless you are an organiser, in which case thank everyone for coming.
 - If you are a visiting speaker, thank the person who invited you.
 - If you are speaking at your home institution, thank your colleagues for coming.
 - If you are a PhD student, also acknowledge your adviser/supervisor.
- **Always put your plan up.** Your talk should be organised into numbered sections, and you should give your audience an idea of how the talk will go by telling them what these numbered sections are.
- **Always begin with an introduction**, at least a spoken one. (I often start with an informal overview which ends with me putting my plan up. Then the formal part of the talk begins.)
- **Never begin with the word “Definition”. Nor the word “So”.**

In an hour-long research seminar I would always stop and ask the audience if they have questions. In a 25 minute conference talk I don't, because I think questions should wait until the end as time is so short. If someone interrupts and asks a question in the middle that isn't just to clarify a typo or something, I think it's fine to say you will defer that question to the end.

3 Never run over time, ever

You should never, ever run over time. This sounds hard, but it is simply a case of caring, and then *planning* properly. Here's how to do it:

1. Care. Running over is an imposition on your audience. Moreover, many people will stop listening if you run over, and will start feeling negatively towards you. Whereas if they like your talk, and you indicate that there was more you wanted to say, they will ask you in the questions (see below).
2. Divide your talk into sections, and decide in advance how long each section should take. Write this down on your notes so that as you get to the end of each section you can check whether you are keeping to your schedule. This way you can make small adjustments early on, rather than having an undignified scramble at the end. When using slides I work out how many minutes I have per slide on average, so that I can check the slide numbers against the clock to see how I'm doing.
3. Plan something dispensable at the end, so that if you run out of time you can abort without missing something important. And in the unlikely event you have time left over, you can fill the time in with something. In particular this means that **your main result should not be at the end**. Get it out there earlier. One thing you can always do is have your last slide be "Future work" in point form. Then you can talk about it for as little or as much time as you have left at the end.
4. Plan your talk to be shorter than the time available, to allow for interruptions, mishaps, and errors in your timing. For CT talks are 25 minutes plus 5 for questions. I recommend planning a 22 minute talk.
5. Run through your talk in advance, to see how long it takes. When I was a PhD student I practised all my talks at a blackboard to an empty room, sometimes two or three times.
6. After your talk, observe whether it was the correct length or not. After giving a few talks you should learn what is a good rate of slides per minute for you. If your talk turned out to be too long, your next talk should have fewer slides. Please don't fit more into your talk by just talking faster.
7. My rough guide was one slide per minute when I used 4:3 slides. Now I use 16:9 slides and often divide them in two, so I go for one slide per two minutes. Note also that transitions make things take longer and give you less flexibility for speeding up if you need to, so it's useful to make a note of the number of pages of your pdf as well as the number of Beamer frames (or equivalent, if you're not using Beamer).
8. Remember that nobody ever minds if you under-run. In fact, it probably makes most of the audience happy.
9. If, even doing all this, you still run out of time, **stop talking**. It's better to say "I'm sorry I didn't have time for all I planned, but my time is up so I'll stop here" even if it's mathematically awkward. You can also say "I was going to say something about *xyz* but my time is up" and then if

the audience likes you the first question in question time will be “Could you tell us about *xyz?*” and everyone will laugh and be on your side.

4 How to prepare

1. Start by making a plan. This should include section headings and timings. Attached at the end is a document where I attempted to classify possible category theory talks into types, together with suggested structures for them. I invite you have a look to see if it helps you.

For a CT conference talk I would aim for about 4–5 sections with the following structure:

- The introduction should be completely followable by *everybody in the audience* and should tell everyone what the point is and what the main ideas are. I say “followable” because for a conference talk I think this means that they get the gist, not that they understand all the words you’re saying.
 - The first couple of sections should be mostly followable by everyone, at least broadly. It is unlikely that anything original would go here—it should be expository, going over the basic background for the talk.
 - I think it is acceptable for the last couple of sections to be harder. Some or even most people won’t *completely* understand them, but they should still have an idea of what’s going on. This is where your new work goes. The key is to try to make your new work memorable in essence, so that people are aware of it. It is unrealistic to try and get people to really understand it in a talk like this, I think. If people are interested they can read the paper, and if it’s memorable they will remember where they heard about it even if they don’t look it up right now.
 - Great world experts are going to be there. I think it’s a decent idea to have a few minutes at the end that are aimed at them. After all, it is still important to showcase your work.
2. What is the main result you want to tell people? There should usually be basically one result, or one “thing”.
 3. What is the main thing you want *non-experts* to take away from your talk? Some people will be at your talk out of general interest rather than specific research interest—make sure they get something out of it. If you become known for giving good talks then you will eventually get more people who are at your talks out of general interest.
 4. Plan your slides. Personally I plan them by hand, sketched on paper that I divide up into small-scale “slides”. This is because I use a lot of diagrams and I can’t think exposition at the same time as typesetting diagrams. More details about this follow below.
 5. Consider writing out everything you will say in your talk. This is a good idea until you are an experienced speaker, and especially if you are not

speaking in your native language. I continued to do this for at least the first ten years I was giving talks. I am still likely to write out the introduction, so that I can start smoothly and then get into my stride.

6. The best way of being sure your talk is the right length is to try it. You might feel silly giving a talk to an audience of the empty set, but nobody is watching so it doesn't matter! You can also time each section so that you know how long you should be spending on each section during the actual talk. You could even find a friend to practise for. Practising your talk is really the only way I know of getting rid of nerves as well (other than having an innate sense of your own overwhelming greatness).

5 Writing slides

There are still people who give 25 minute conference talks without using slides, but I don't recommend it.

I personally believe that slides should not necessarily make sense without the talk. If they do, there's too much information in them: that's what the paper is for. They should be an aid, not the entire talk. Looking through the slides alone should give us the *idea* of what the talk is about. I recommend not putting too much text on slides, and I also recommend reading out everything that is on every slide during the talk – the audience is going to do that anyway, and they probably won't listen to whatever you're saying while they're reading the slide to themselves.

Here are my tips for slides. Some of these tips are for virtual talks but I'll leave them here so that the document is more broadly useful. I use the word "slide" and "frame" interchangeably. I will refer to Beamer but I know a lot of people use something different to make their slides.

1. Pick your style and colour-scheme deliberately. I remove all of the extra adornments from the default, except the frame numbers, and I am often asked how to do that as people seem to like it. Also decide whether you're going to use serif or sans-serif. I resisted sans-serif for ages because I preferred reading mathematics in serif. At some point I switched to sans-serif because I found other people's sans-serif slides much cleaner to look at. I check my colour scheme for colour blindness accessibility using this site <https://davidmathlogic.com/colorblind/>
2. I think most projectors and screens are wide these days, I recommend 16:9 as your aspect ratio as you can then fit more on each slide. For projected talks I use 12pt, but for virtual talks everyone is at their own computer screen and I think 11pt or even 10pt is fine. I think there's a big advantage to being able to fit more on a slide, so that the audience can keep more of the material in front of them at once, as if there were multiple blackboards.
3. If you're using wide slides and smaller text, consider splitting your slides up into parts so they act like several slides that can be simultaneously displayed, so that the audience doesn't have to try and remember the previous slide when you move on.

4. I strongly recommend making the frame numbers *not* list the end frame number. So that they don't say things like "3/24" when you're on frame 3. This is so that you can have a slide that's padding at the end: if you run out of time you can just stop before you get there, without anyone ever needing to know.
5. Start with an enumerated list with your plan. Use those numbers as section numbers throughout, and make sure it is clear which section we're in at any given moment. My preferred way to do that is to have it in the frame title on every frame.
6. Try to make your slides have a clean and clear layout. It really helps the audience.
7. Don't put too much detail. I think it is rarely appropriate to put full details of a proof. At most, give the main idea of the proof, and then anyone who's interested can look it up in your paper.
8. Think about how each section is going to segue into the next, and then think about how each slide is going to segue into the next. The talk will be more intelligible if the audience feels naturally lead into the next step each time.
9. Every time you give a definition or a result, make sure you're clear what role it has in the narrative, so that you can tell the audience what it's doing there.
10. For virtual talks: I like to put a grey box in the top right corner for the video of me. This ensures that my face won't cover any part of my slides. In the live talk it's not really an issue as the screen share will have its own area on Zoom, but on the video recording Zoom will probably place your face at the top right (that's what it does for me anyway). You can try it yourself to figure out how big it is going to be, but it might vary depending on the Zoom version being used.

Transitions

By "transitions" I mean where you're still on the same slide, but you're making things appear or move. So in Beamer this is where you're using things like `\pause`, `\uncover`, `\only`.

1. Please do use some transitions. I think it's too much to put an entire slide up at once. But don't use too many, as it's distracting, and reduces your flexibility with timing.
2. Please don't use the kind of transition where some of your slide is "grey" and then it becomes black when you "uncover" it. I think it's really distracting.

Here's my process for making slides

1. Sketch slides by hand in pencil on paper.

2. Type up slides roughly, but mostly without diagrams.
3. Do the diagrams.
4. Fine tune the layout and add transitions.

6 The talk itself

Giving a talk is a form of performance, and it is natural to be nervous. Preparation and practice are two good ways to combat this. It is difficult to make a handy checklist of “how to give a good performance” but if there’s any aspect you’re particularly worried about feel free to ask me and I’ll do my best to help you with it.

I think virtual talks are more scary because anyone in the world could be there, and you can’t see them all. But they’re also less scary because you can be safely at home, you can have a lot of notes in front of you without anyone seeing, and it’s really a lot more like slides with a voiceover, so it’s less dependent on the “performance” aspect.

I have recently taken to making my slides available online before the talk so that people can follow along on their own device at the talk, and go backwards and forwards at a different pace from me.

Do try to anticipate the questions that people might ask at the end, so that you are ready.

7 Benefits of giving a good talk

A good talk massively benefits the audience, but it also benefits the speaker as well. Here are some of the benefits:

- It publicises you and your work, and might provoke interesting questions from the audience which will stimulate more research.
- It helps you understand your work better and can form the starting point for planning the paper you then write on your work.
- A good talk means that people in the community will feel positively towards you and are more likely to remember you. Of course, they will probably also remember you if you give a really spectacularly awful talk.
- If you give good talks you are more likely to be invited to speak at other departments. This is good for raising your profile (and for your CV).

Em-Cats: Overall Talk Templates

Start by picking one of the overall templates A-F, and a sub-classification (the numbers).

Then pick one of the motivations alpha or beta (see p.2).

See p.3-4 for suggested section structures for your chosen template.

See p.5 for general principles for making slides.

Let me know if you think your talk doesn't fit any of A-F as there might be things I didn't think of!

Any of B, C, D and F might have A embedded in it

A. one thing is equivalent to another

1. two old things
2. one old one new
3. two new

B. a generalisation of an existing thing to a broader context

1. relaxed hypotheses
2. higher dimensions
3. weakening of structure
4. same structure different context

C. abstraction [structure here is like generalisation]

1. a categorical version of an existing thing
2. a categorical framework for organising/understanding an existing thing
3. a new definition uniting several concepts

D. a special case or example of something

1. a special case of something turns out to be something else (could be thought of as E)
2. a new example of some existing structure (could be thought of as C)
3. computing a specific example of something

E. proving that something has a certain property/properties

1. universal property
2. good structure eg limits/colimits/preservation (or absence of it)
3. one structure always gives rise to another structure
4. a good totality/compositional structure (could be thought of as C)

F. new approach to existing thing (Could be thought of as A)

1. new proof of existing concept
2. new approach to existing construction

Motivations

alpha external - a specific application

a) why is the application interesting, and b) how does the work help with it

in this case start with the application, using it to motivate the theory

then present the theory

then show how to use the theory for the application

beta internal - a general principle

a) why is the general principle important in general and b) what do we get out of it in this case

in this case start with the general principle, giving some examples of it at work

give the thing to which you're applying the general principle

then apply the general principle

A. one thing is equivalent to another

1. two old things
2. one old one new
3. two new (trickier, as you have to motivate two things)

What do we get out of knowing they're the same?

different points of view on the same thing, maybe one abstract for theory and one concrete for use
sharing knowledge/theorems between the two places
an abstract sanity check that something is a good definition (A3 might be this)

Possible structure:

General motivation (internal or external?)
Explain the first old thing, and why people/you are interested in it
Explain the second old thing, and why people/you are interested in it
Show how to prove they're the same
Say what we get out of knowing they're the same

Need to decide which comes first, which will depend on the motivations.

B. a generalisation of an existing thing to a broader context

1. relaxed hypotheses
2. higher dimensions
3. weakening of structure
4. same structure different context

or

C. abstraction

1. a categorical version of an existing thing
2. a categorical framework for organising/understanding an existing thing
3. a new definition uniting several concepts

Possible structure

General motivation (internal or external)
Explain the basic thing
Explain the principle behind the generalisation/abstraction
Apply the generalisation to the thing
Say what we get out of this

D. a special case of something

Possible structure

- General motivation (internal or external)
- Explain the starting thing
- Explain why the special case is interesting in principle
- Elucidate the special case
- Say what we get out of this

E. proving that something has a certain property

1. universal property
2. good structure eg limits/colimits/preservation (or absence of it)
3. one structure always gives rise to another structure
4. a good totality/compositional structure (could be thought of as C)

Possible structure

- General motivation (internal or external)
- Explain the thing we're thinking about and why we're interested in it
- Explain the property we're interested in with some examples
- Show how to prove the thing has the property
- What do we get out of this

F. new approach to existing thing

1. new proof of existing concept
2. new approach to existing construction

Possible structure

- General motivation (internal or external)
- Say what the existing concept is
- Give some background to the new approach
- Give the new approach
- What do we get out of this

General principles

Fractal: the structure principles apply at every scale

introduction -> content -> segue

- the talk
- each section
- each slide
- each definition

Start the talk with an intro into the idea of the talk

end with an overview of future possible work

Start each section with an intro into the idea of the section

end with a segue taking us into the next section

Start each slide with the idea of the slide

end with a segue into the next slide

Start each definition with the idea

end with a segue into what we're going to do with the definition

Motivate any definition: either

- the structure it encapsulates, or
- what it does (in which case say what it does first)