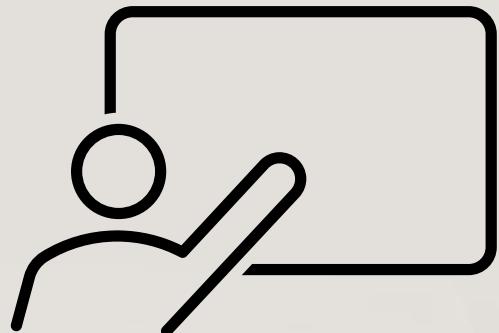


Giving an effective research talk



2025 CMS Winter meeting
Toronto

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Plan



Overview: different kinds of talks



Some guiding principles



Preparing your research talk



Delivery: the culmination of your efforts

Some different kinds of math talks



- **Elevator pitch** : who are you, as a researcher?
- ***Research talk** : promote your mathematical result
- **Colloquium** :

A colloquium is a talk in which:

- the first 20 minutes are understandable to any mathematical audience,
- the next 20 minutes are understandable to the specialists in the field, and
- the last 20 minutes are not even understandable to the speaker. -Kumar Murty

- **Teaching** : student-focussed, detailed, well-paced
- **Public lecture** : engage a general audience and share a mathematical concept

From your experience...



What makes a talk effective?

What makes a talk bad?





Tell 'em what you're going to tell 'em;
then tell 'em;
then tell 'em what you told 'em.

SOME GUIDING PRINCIPLES

1. You are telling a **story** :

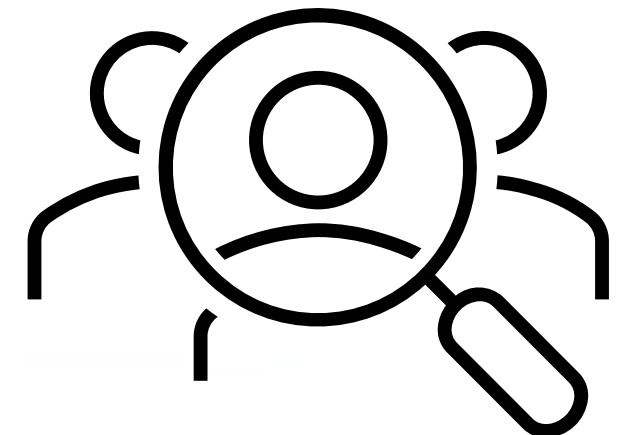


- Hook motivation
- Introduction background, literature review
- Main plot } your results and applications
- Climax
- Dénouement your future work



2. You are telling a story to your **audience** :

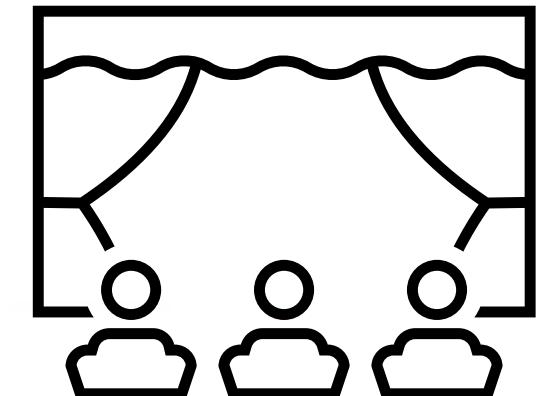
- Who are they?
- Why are they there?
- What will interest them?
- How can I be more inclusive?
- How do I show the audience my respect?



3. You are **telling** a story to your audience :



- It **is** a performance
- Face your audience and be responsive
- Planning is everything
- Practice your lines!
- Practice for **time**





SPECIFICS: PREPARATION

What is the value of a research talk?



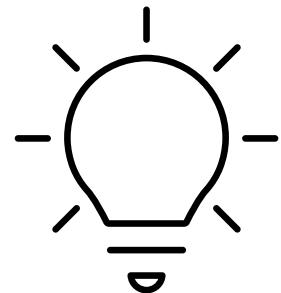
The expected value of **giving** the talk:

- Promoting your research
- Getting feedback and suggestions on your work
- Connecting with potential new collaborators (or employers!)



The side benefits of **preparing** your talk:

- Discovering the narrative structure of your work
- Asking yourself questions “from the outside”
- Motivating you to get the best results



Overview: stages of preparation



1. Stand up, pretend you are there, and start talking
2. Submit your title and abstract
3. Write out your draft from start to finish (missing details?)
4. Practice: find out what you need to cut
5. Create your slides / plan your blackboard layout
6. Practice!

Slide talks



- **Plan** slides by sketching boxes and filling them in :
 - One main idea per slide (new topic = new slide); ~7 lines
 - Minimize what audience needs to memorize
 - Points, not paragraphs; can an image help?
- **Cut** it down to fit the time. For me: 10 slides : ~ 20 minutes
- **Create** your slides (Beamer is great! Timing with \uncover, \only, \pause)
 - Write careful statements, check for precision (proofread!!)
 - Write out abbreviations first time used
 - Put slide numbers / progress bars

Chalk and tablet talks



□ Plan your chalk/tablet talk by talking while writing!

□ Visualize using the space:

(Final)
Draft E

On unicity of types for tame total supercuspidal representations
It w/ Peter Latham

Previous project: Looked at even tame at the expense
of not being completely over \mathbb{R}

80) ~~Is there an integral type occurring in \mathbb{R} ?~~ Is it unique?

Q: Is there a unique type occurring in \mathbb{R} ?
Quick: If $\mathbb{R} = \mathbb{R}^+$ it is unique. Can conjugate to supercuspidal we can reduce to a larger compact open subgroup.

"Unicity" \Leftrightarrow at most one type on each conjugacy class
of maximal compact subgroups.

Notation by which

A. Poles (from \mathbb{R} to \mathbb{R}^+)
B. Null \Leftrightarrow GL(n) 2005 Paskunas supercuspidal P. Latham 2011 p. 2
C. Nonnull \Leftrightarrow GL(n) 2005 Paskunas supercuspidal P. Latham 2011 p. 2
D. Null & nonnull \Leftrightarrow GL(n) 2005 Henrard (appendix to Brumley-Moyard) p. 2
E. Unital \Leftrightarrow GL(n) 2005 Paskunas supercuspidal P. Latham 2011 p. 2

For nonnull types \rightarrow asl about typical type & max compact

1) Narendrapali 2015 many cases GL(n)
Narendrapali-Mondal 2016 in progress classically.
2) SL(2) 2005
Kannanapandi 2016 in field cases 2016.

3) B4 4/5
Ge 6/7

We want supercuspidals

SL(2) N 2013, reported by P. Latham 2011 p. 2
SL(n) essentially tame? P. Latham 2016
G. depth zero? \Leftrightarrow only one max compact occurs for each ref mod k, \mathbb{R} is stable & rich

In all these cases unicity of types

Branching laws 3

Q: Prof Prasad
We want to know about restriction
of G to a maximal compact subgroup.

(1) \Rightarrow maximal compact subgroups are G_y , for y a vertex in $B(G, F)$
up to conjugacy. May assume $y \in \mathbb{C}^n$.

Nakayama theory

$\text{Rep}_{\mathbb{C}}(G) = \bigoplus_{G_y \backslash G / K} \text{Ind}_{G_y K}^G \text{ etc}$

$G_y \backslash G / K$ is complicated, but $K \subset G_y$ and

$G_y \backslash G / G_x \cong W_y / W_x$ $\stackrel{?}{\cong}$ generated by reflection
in walls coming from W .

eg: y hyperplane \Rightarrow coset space is correct lattice \Leftrightarrow process \Leftrightarrow W .

Point: each $g \in G_y \backslash G / G_x$ acts on \mathfrak{g} we take the
usual weight acting in \mathfrak{g}

For such a g

$\text{Rep}_{\mathbb{C}}(G_x) \underset{\text{action}}{\longrightarrow} \text{Rep}_{\mathbb{C}}(G_y \backslash G / K) \leftarrow$ create components to equivalent
definition. Up.

So ~~maximal~~ components can work with \mathfrak{g} up to equivalence in G_x ,
we consider the Nakayama component (long by g)

$\text{Rep}_{\mathbb{C}}(G_y \backslash G / K) \underset{\text{action}}{\longrightarrow} \text{Ind}_{G_y K}^G$

Now for the building:

$\text{Sp}(4)$ $K \cap G_y \equiv G_x \cap G_y$
 $= G_x \cap g \mathfrak{g}^{-1} =$
 $\mathfrak{g} \cap G_x$ for $g \in \mathbb{Z}^2$

4 Three Cases

- 1) $G_x \in G_{yy}$: then $g=1$ ($y, x \in C$) any y is a vertex of C
 $G_y G_x = G_y \Rightarrow C_y K = G_y$ so 1 const.
- Mackey component $\text{Ind}^F K$ is a type

NB: G_y is affinely related to G_x :
 $\text{Ind}^F G_x G_y$ is not a singleton unless x is a vertex

By 

2) $T \in G_{\mathbb{C}^n}$:

Lemma $[N 2011]$ $S \supseteq 0$
 $\text{Let } S \subseteq \mathbb{C}^n : \exists z \in \mathbb{C}^n \text{ s.t. } \forall x \in S \text{ } d(z-x) \leq \varepsilon$

$\text{S} = \{z-x \mid x \in S\}$

Consequence: If $z \in \sum_{i \in \mathbb{N}} x_i$ then $Tz \subseteq Gx_i \subseteq Gz$
 From (1) and (2) $Tz \subseteq Gx_i$ and $Gx_i \subseteq Gz$ so $Tz \subseteq Gz$.

$$\begin{aligned}
 \underline{f_1: K \cap C_{G_\delta}} &\leq TG_{x, \text{so}} \cap G_x \cap C_{G_\delta} \\
 &\leq TG_{x, \text{so}} \cap G_x \\
 &= (TG_{x, \text{so}})_{G_{x, \text{so}}} \\
 &\quad \text{U} \\
 &\quad T_{x, \text{so}}
 \end{aligned}$$

Rem: If $T \models \text{Cgy } \mathcal{B}$ so is "too small": need a deeper argument, otherwise as address Herbrand construction (part 1 for \mathcal{B})

Then (Nickau 2013)

If T stabilizes only the fact $\mathcal{F} \models \mathcal{B}$, then $\exists C \supseteq \mathcal{B}$, depending on $x \in \mathcal{B}$, s.t. $\mathcal{S} \supseteq C \Rightarrow \mathcal{T}(\mathcal{F})$ contains exactly one maximal type for each vertex of \mathcal{F} , and none otherwise. ("unicyclic")

Case 3 $T \subseteq \text{G}_m$ but $G_m \not\subseteq \text{G}_m$. "pathological".

- Freudenthal, 2001 then Rudolphy, Wenzlauer
 - fixed point of certain ramified automorphic form.
 - truly pathological examples in F_4 .

Example (Tiff Adler's talk):

$$\text{Sp}(4) \cong \frac{\text{Sp}(2) \times \text{Sp}(2)}{\text{Sp}(2) \times \text{Sp}(2)}$$

$\xrightarrow{\text{higher ind. plane}}$

$\text{Sp}(4) \cong T_1 \times T_2 = T$ not a Levi subgp

$\xrightarrow{\text{T}_1 \text{ ramified torus } \text{Sp}(2) \times \text{Sp}(2)}$

$\xrightarrow{\text{ind. spec.}}$

$\text{TS}_G, \text{viz. } \text{PGL}(2) \times \text{PGL}(2) \cong \text{G}_2$ $\xrightarrow{\text{WEGL}}$ reflection on \mathbb{P}^1 w/ G_2 .

$\text{WEGL} \cong \text{G}_2$ $\xrightarrow{\text{WEGL} = \text{G}_2 \subseteq \text{G}_2}$

$\text{TS}_G \cong \text{G}_2 \subseteq \text{G}_2$

$T \subseteq \text{G}_m \Rightarrow \text{WT} \subseteq \text{G}_m$.

$\xrightarrow{\text{WT} \subseteq \text{G}_m}$ $\text{WT} \subseteq \text{G}_m$ also ablp.

$\xrightarrow{\text{ind. } \text{WT} \subseteq \text{G}_m}$ $\text{ind. } \text{WT} \subseteq \text{G}_m$ more by



SPECIFICS: DELIVERY

From your experience...



What's a good (bad) start?

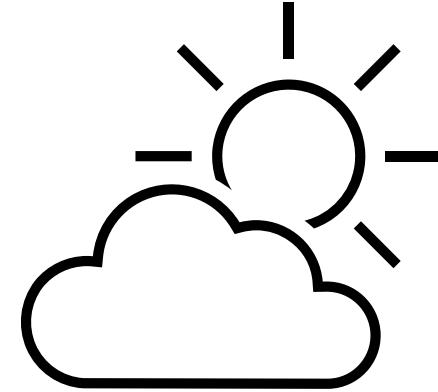
Tip: memorize your introduction
– it gets you rolling!

What's a good (bad) finish?

Finish on time!

It's the big day!

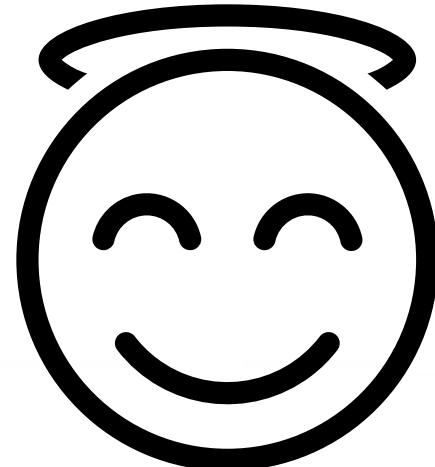
- Dress well!
- Be tidy, clean your glasses
- Think through the logistics (USB key? Zoom set-up?)
- Know what time your talk has to end, or set a timer
- Face the audience
- Start with your memorized introduction... and then off you go!



Delivery tips

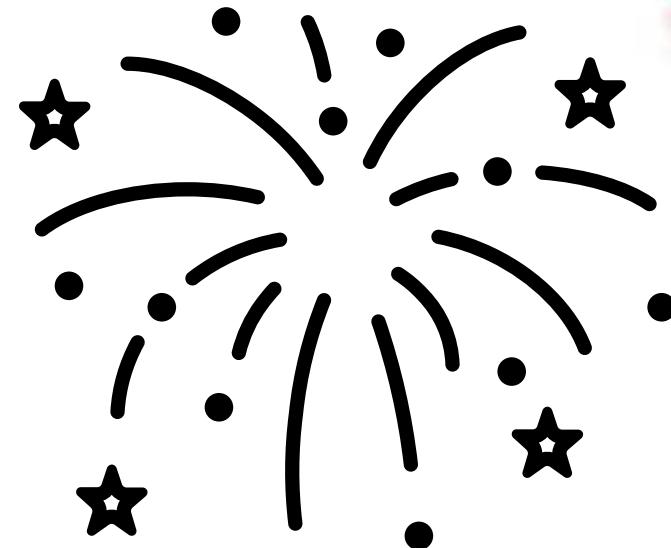


- Speak clearly, and loudly enough
- Be professional and courteous
- Pause at the end of each slide; look around for questions
- Keep your toes pointed front!
- Validate questions
- Enjoy yourself!



After the talk

- Make notes!
 - Questions that were asked
 - What was the length?
 - What would you change next time?
- Follow up with interested people in your audience



And most important:

- Write your paper!

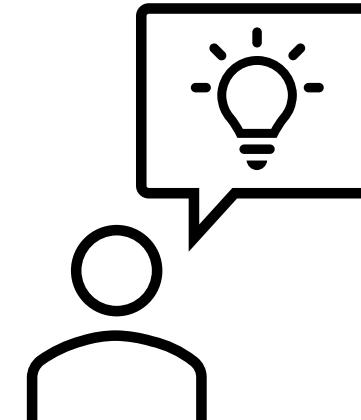


SOME CONCLUSIONS

An effective presentation...



- Is well-organized
- Is targeted to the right audience
- Has been prepared well and practiced
- Is interesting to the speaker
- Shares a good story
- Leaves the audience with something to think about



More tips to share? mnevins@uottawa.ca