

How to present like a rockstar

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Your Talk Is Not About You*

* Except in interviews and your PhD defense where you are part of the evaluation.

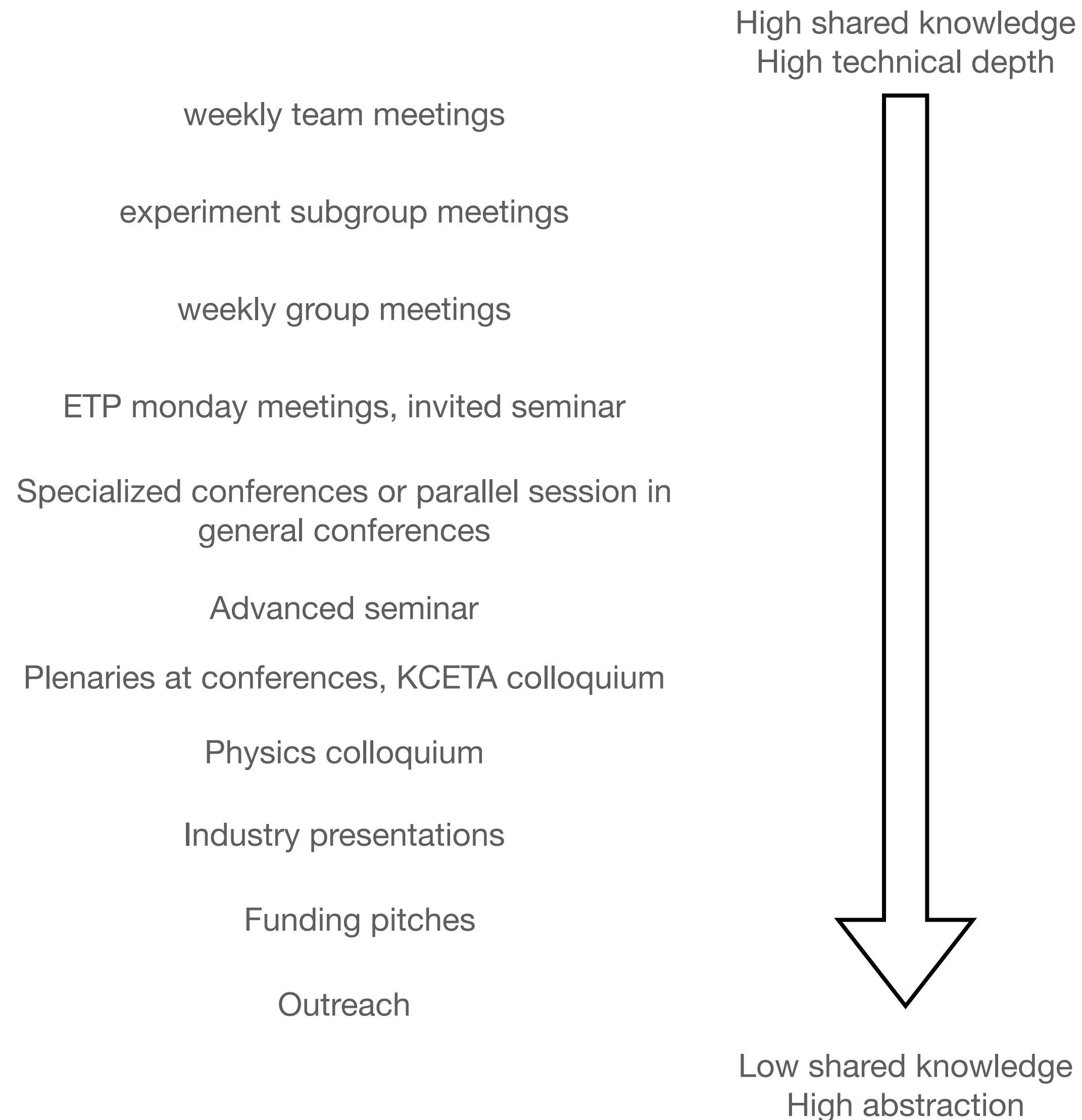
- Showing what you know is easy
- Making others understand is hard

Outline

- Part 1: Cognitive Constraints of Learning
- Part 2: Slide Design
- Part 3: Presentation

Part 1: Cognitive Constraints of Learning: How does the human brain process information?

Know your audience



- **Your own research group**
 - High shared background knowledge
 - Expects technical depth and details
- **Same field, different subfield/specialisation**
 - Knows the fundamentals
 - Does not know your specific methods
 - Needs context
- **Broad physics audience**
 - (Very) limited jargon tolerance
 - Limited patience for detail
 - Strong need for intuitive framing
- **Non-physics audience**
 - No jargon
 - No equations
 - Cares about impact and meaning

How we misjudge the audience

The most common mistake:

Overestimating shared knowledge and underestimating cognitive load.

*“Just read
the plot.”*

*“This equation is
common knowledge”*

*“Everyone
knows this.”*

*“This
abbreviation is
standard.”*

*“I do not need to
define that.”*

Shared knowledge and cognitive load

During the talk:

- Working memory is on average limited to about **4 meaningful units** of information at a time [1]
 - Cognitive interference (e.g. dense text, background noise, simultaneous input from text and voice) reduces this to below 4 units
- **Attention** fluctuates and **lapses can occur within the first minute** [2]
 - The commonly cited “10–15 minute limit” is an oversimplification

After the talk:

- Retention of unreinforced information declines without retrieval practice [3]

[1] N. Cowan. “The magical number 4 in short-term memory: a reconsideration of mental storage capacity”. Behav Brain Sci. 2001 (1):87-114

[2] D. M. Bunce et al. “How Long Can Students Pay Attention in Class? A Study of Student Attention Decline Using Clickers”. Chem. Educ. 2010, 87, 12, 1438–1443

[3] H. L. Roediger, J. D. Karpicke. “Test-enhanced learning: taking memory tests improves long-term retention”. Psychol Sci. 2006 Mar;17(3):249-55.

Scientific evidence for 4 meaningful units

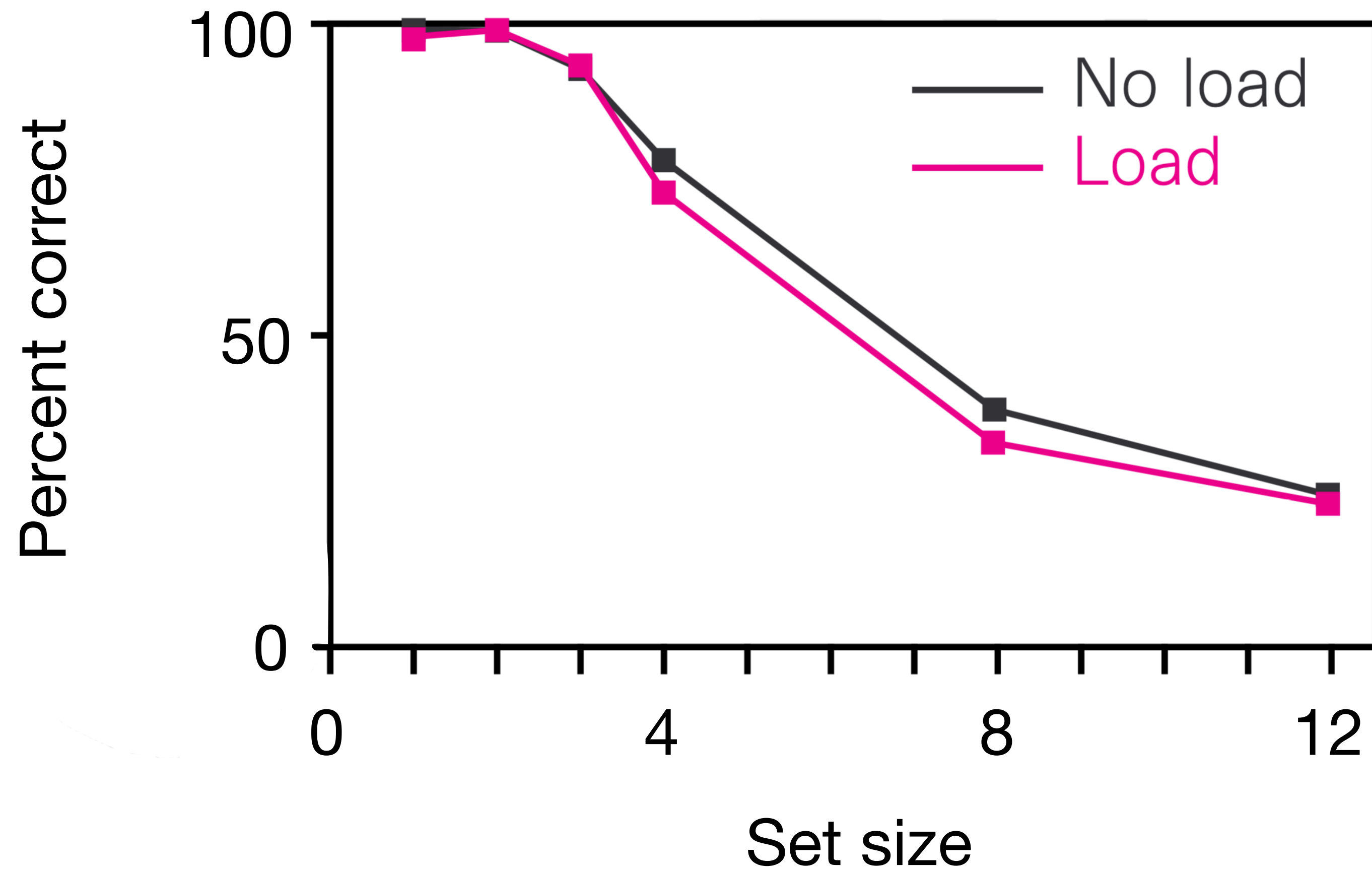


Figure 1a, adjusted labels from Luck, S., Vogel, E. The capacity of visual working memory for features and conjunctions. Nature 390, 279–281 (1997). <https://doi.org/10.1038/36846>

Managing the ≈ 4 meaningful units

- One unit = one meaningful concept
- It is not about four bullets per slide, but up to four meaningful units
- What is meaningful depends on individual prior knowledge
 - The same content can be one unit or ten
- Mixed audiences process the same material differently
 - In mixed audiences, different listeners have different knowledges in the same talk
 - It is often hard to judge the audience exactly, so sometimes you think its four, but it actually is six
- Using the same slides for different audiences is lazy and rarely optimal

Calibrating to the audience

- State your assumptions explicitly
 - example: *“I will assume familiarity with Kalman filtering.”*
- Define key terms before using them repeatedly, especially acronyms and symbols
- Start from common ground before adding complexity. Identify what everyone in the room likely knows.
 - examples: define the performance metric before showing optimization results, recall the baseline method before presenting improvements
- Signal increasing technical depth explicitly
 - examples: *“The next part becomes more technical.”*, *“For this slide I will assume familiarity with ...”*, *“This section is mainly for the trigger experts.”*
- Signal intentional omission of detail
 - examples: *“I will not go into the full derivation here.”*, *“Details are in the backup slides.”*, *“The main point is ...”*
- For experienced speakers: adjust depth if overload becomes visible
 - slow down, summarise more, or temporarily simplify

Example of meaningful units

$$\left(i\gamma^\mu \partial_\mu - m \right) \psi = 0$$

PhD in theoretical particle physics

- “the Dirac equation”

MSc student

- Gamma matrices γ
- Spinor field ψ
- Lorentz index μ
- Mass term
- Relativistic covariance

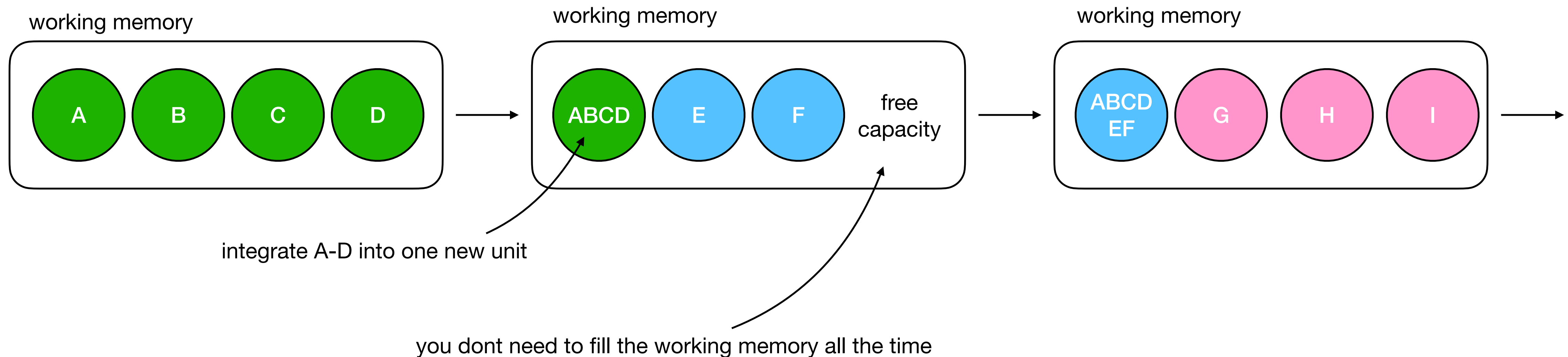
BSc student

- Imaginary unit i
- Matrices γ
- Derivative ∂
- Index notation μ
- Wavefunction ψ
- What makes it relativistic?
- Index contraction

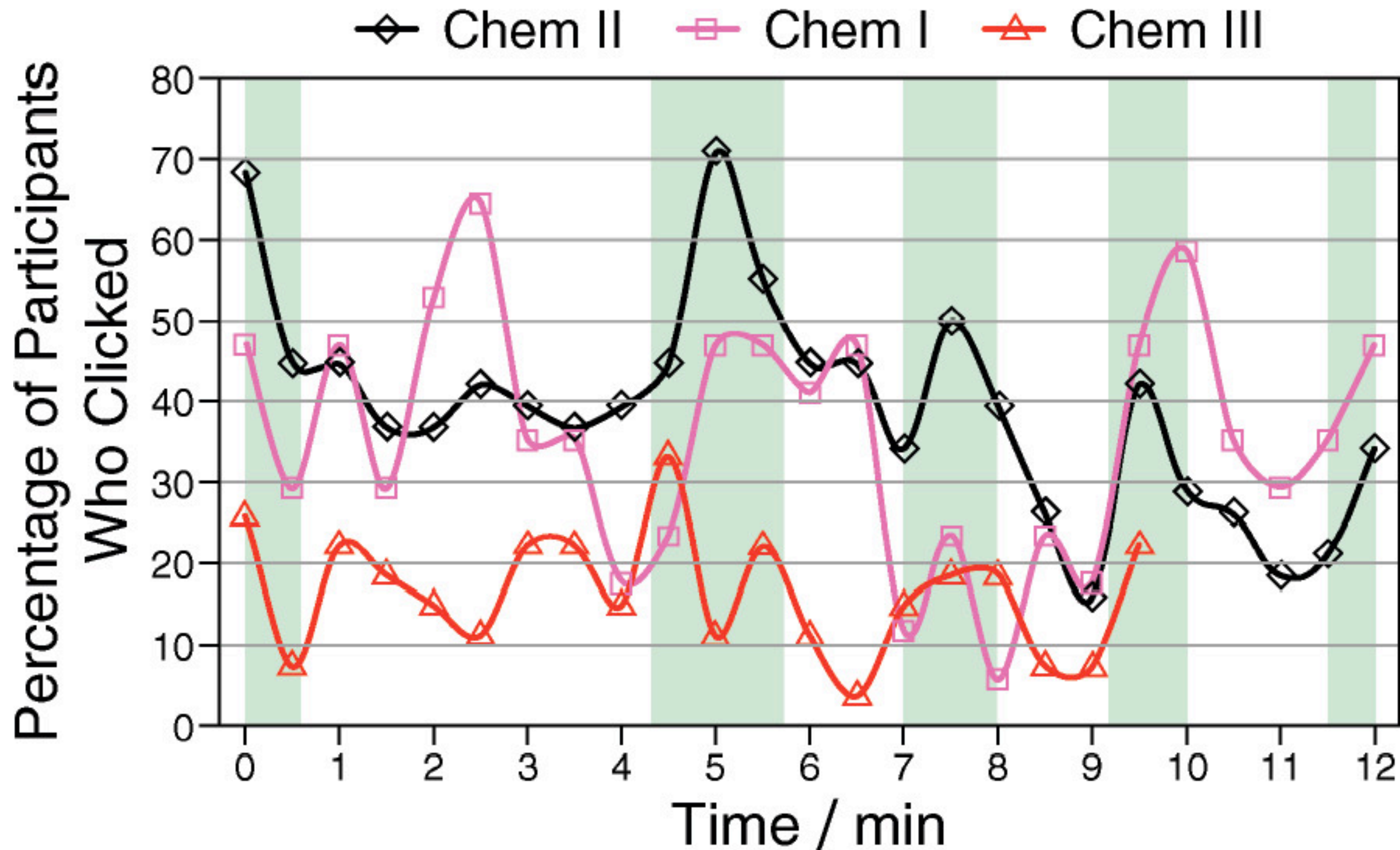
- The equation is identical, the cognitive load is not

From Overload to Understanding

- Introduce one new unit at a time (“isolate”)
 - Establish meaning before adding the next unit (“stabilize”)
 - Recombine units into a higher-level concept before moving on (“integrate”)
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- Integration frees working memory for the next units



Scientific evidence for attention lapses

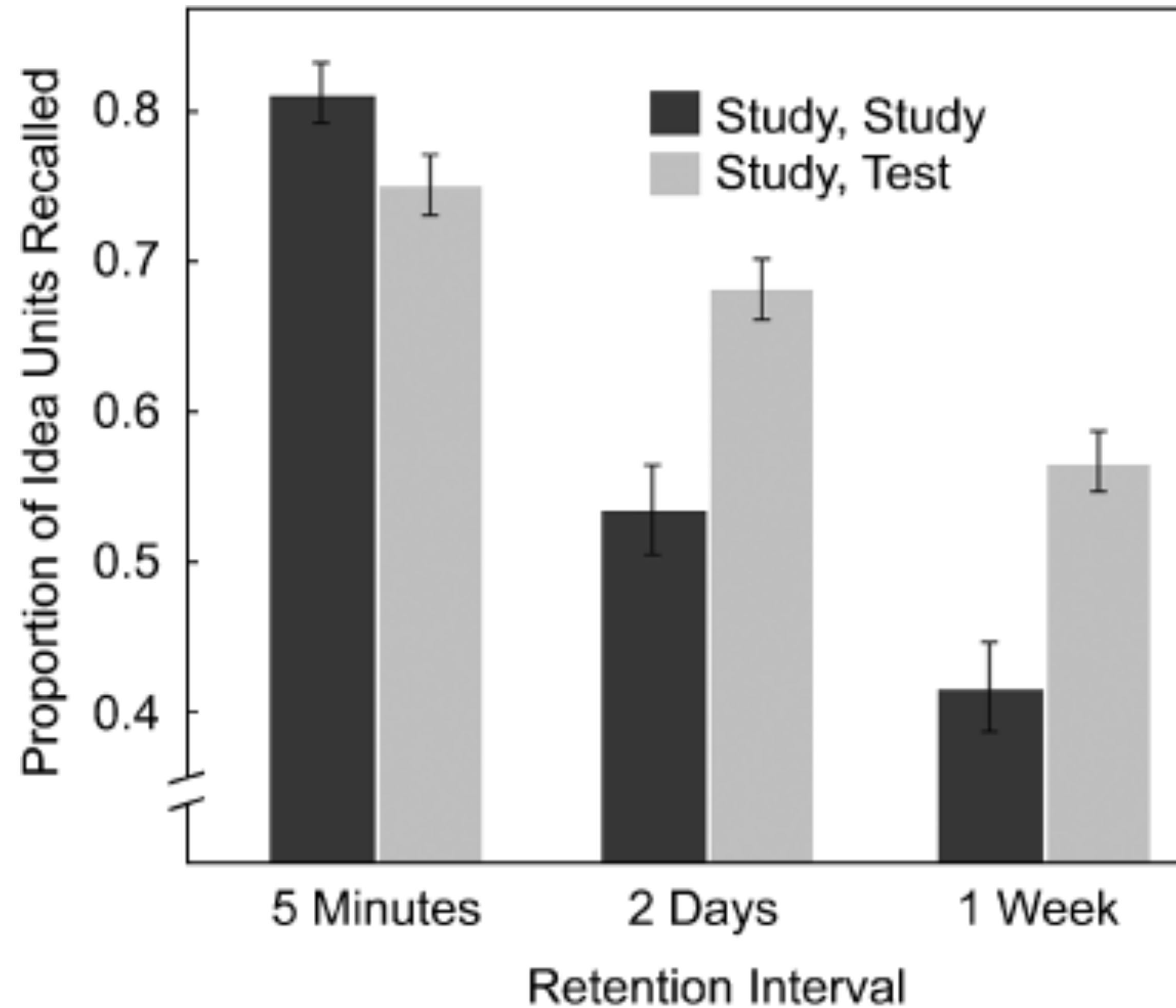


D. M. Bunce et al. "How Long Can Students Pay Attention in Class? A Study of Student Attention Decline Using Clickers". Chem. Educ. 2010, 87, 12, 1438–1443

Countering attention lapses

- Do not assume continuous attention, even in motivated audiences
- Introduce and repeat structure explicitly
 - Tell the audience where they are
 - Tell the audience what comes next
- Use cognitive resets and re-entry points
 - Insert short summaries
 - Reconnect details to the main idea before moving on
- Avoid simultaneous inputs, favour varying inputs
 - Competing input channels reduce overall comprehension
 - Individual tolerance varies, always design for the average listener (*you may be fine with reading and listening simultaneously, but is the average listener?*)
 - Varying input channels (text, pictures, videos, ...) on the other hand can counter attention lapses

Scientific evidence for retention decline



H. L. Roediger, J. D. Karpicke. "Test-enhanced learning: taking memory tests improves long-term retention". Psychol Sci. 2006 Mar;17(3):249-55.

Active retrieval strengthens retention

- Passive listening is not sufficient for long term retention
- Simply repeating a result is still passive exposure
- Information that is not actively brought back is quickly forgotten
- Actively retrieving information strengthens memory
- Testing (e.g. exams, quiz, ...) improves long-term retention more than restudying

Strategies to increase recall

- Pause and let the audience mentally summarize the point
“Take five seconds and restate the conclusion to yourself.”
- Before adding new material, ask for recall of a key earlier point
“What was the main limitation we identified?”
- End with a summary that requires reconstruction of the argument
“If you had to explain this in one sentence, what would you say?”

Part 2: Design your slides

Close PowerPoint

- Close PowerPoint (or Keynote*). We'll get back to it.

* My unpopular opinion: If you use Linux, this is one thing where it really sucks does not perform well.

Your story comes first

- Before you even open any slide editor, answer these three questions:

1. What is the **one** thing I want my audience to remember?

- If you have two results, ask yourself: is there a single higher-level claim that connects them? If yes, that is your one thing.
If not, your talk should be split into two logical blocks or two talks.

2. What is the **logical path** that gets them to the one thing?

3. Where does a **visual** (a plot, a table, a drawing, ...) actually help and where is it just decoration?

A logical path of ideas

- Write one idea per sticky note. No sentences, just the core thought of the idea.
 - While the tactile feedback of real sticky notes often helps, you can also use computer tools.
- Arrange them until the story becomes a logical path.
- The one note that all others point to, that is your **one** thing.
 - Some people write the **one** thing first and build backwards
 - Others discover it after arranging everything
- Each note that survives becomes a slide. Each one that does not wasn't a slide to begin with.



Anatomy of a talk: Your audience doesn't know what you know

- They don't know why they should care about your topic
 - They can't see the structure in your head
 - They don't know when (and how) it ends
 - Your job: make all three obvious
-
- The talk structure that does this:
 - A beginning that tells the audience where you're going
 - A middle that builds the argument
 - An end that lands the **one** thing

Anatomy of a good main title slide

Title

Belle II Upgrade working group: L1 Trigger

Where?

When?

Name*

Email

Affiliation

Image

Logo(s)

Belle II Trigger Upgrade Workshop
24.09.2025

Torben Ferber (torben.ferber@kit.edu)
Institute of Experimental Particle Physics

KIT

ETP

*Avoid line breaks in names. If you have coauthors, they go in a second line under your name or a separate slide.

Main title slide design rules

- Content

- State the central message or question
- Establish speaker identity
- Provide minimal context of the talk (event, date)

- Hierarchy

- **Title must dominate** (i.e. title font significantly larger than name font, high colours contrast, generous spacing around title)
- Speaker identity is secondary
- All other information (coauthors, your affiliation, event and date) is tertiary

- Visual Discipline

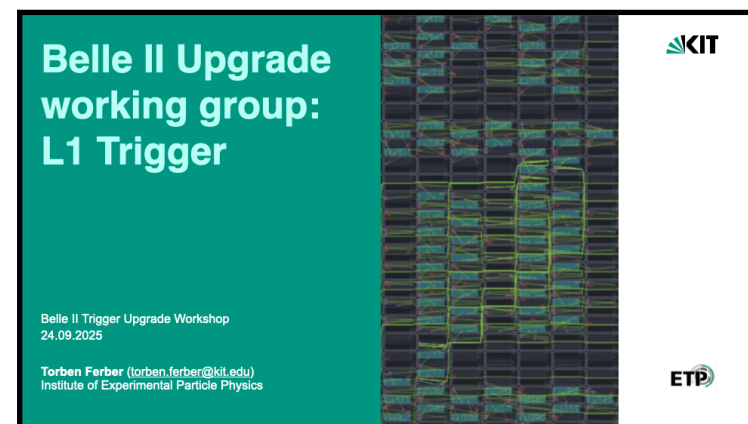
- Background image(s) may provide context but must not compete with the title
- Logos must be small and aligned to not distract visually

Is your talk title a topic or claim?

- The title must **create orientation** for the presentation
- Use claims for presentations that show results or conclusions
 - e.g. *“L1 Trigger Upgrade Reduces Latency and Improves Efficiency at Belle II”*
- Use directional titles (often using *“Towards...”, “Development of...”, “Options for...”*) for exploratory work
 - e.g. *“Design Options for the Belle II L1 Trigger Upgrade”*
- Avoid labels as titles
 - e.g. *“Belle II Upgrade Working Group: L1 Trigger”*
- Tip: Titles of abstracts you submitted to a conference can remain descriptive, slide titles of the actual talk given at a conference can be more message-driven

Anatomy of even better main title slide

Claim instead
of topic



The main title slide is divided into three vertical sections. The left section is a solid teal color with the title 'Proposed L1 Trigger Upgrade for Belle II' in large white font. Below the title, it says 'Belle II Trigger Upgrade Workshop 24.09.2025' and 'Torben FERBER (torben.ferber@kit.edu, he/him) Institute of Experimental Particle Physics'. A pink arrow points from the text 'Capitalized family name and pronouns are optional' to the name 'Torben FERBER'. The middle section is a dark background with a grid of colorful, abstract patterns resembling particle tracks or data. The right section is white and contains the KIT logo at the top and the ETP logo at the bottom.

Capitalized family name
and pronouns are optional

Slide titles are important and should add value

- Every slide needs a message-driven title
 - e.g. “GNN outperforms the baseline at low transverse momentum”
- Titles should be statements, not just a noun
 - example bad (noun): “Results”
 - example good (statement): “Tracking efficiency improves by 20%”
- The title should summarise the takeaway of the slide
 - “Latency is reduced without increasing the trigger rate”
- Good rule of thumb: The audience should understand the presentation path by reading only the titles
 - e.g. “Current L1 Trigger Latency Is a Limitation” → “Proposed Upgrade Reduces Latency by 30%” → “Upgrade Maintains Trigger Efficiency” → “Recommendation: Adopt the Proposed Architecture”



One main idea (i.e. one sticky note) per slide

- Each slide supports one idea or question
- If you need an “and” on a slide, you should probably split the slide into two
- **Remove anything that doesn't directly support the slide's one idea**

Every slide has a footer

Slide number

(so the audience can refer back ("I have a question on slide 35...")
and so you can navigate under pressure)

Your name and talk title
(any slide can end up out of context)

Logo
(adds credibility)

Outline slides

- If your transitions are good (see next slide), you generally don't need an outline
- Exception: long or complex talks (45+ min, multiple parts)
 - Show once at the start
 - Revisit briefly between major sections
 - Only when the audience genuinely needs to know where they are (like a map)

Transitions between slides

- Signal clearly when you change topic
 - short verbal transition (“Now we move to the interpretation of the results.”)
 - put a transition sentence in the title (“From problem to solution”)
 - use dedicated section slide (for major changes)
- State why the next slide matters
 - e.g. “Given this limitation ...”, “To address this ...”, “This leads to ...”
- Reconnect to the main message
 - e.g. “Remember our goal: reduce trigger latency by 30%. This next result shows we’re already halfway there.”
- Avoid abrupt jumps in abstraction to avoid *cognitive shocks*
 - bad: problem (e.g. “Trigger latency is 30% too high”) → implementation (show hardware language details)
 - good: problem (e.g. “Trigger latency is 30% too high”) → conceptual bridge (“Where does the latency originate?” (show block-level view)) → implementation (show actual implementation details) → hint towards hardware language details

A summary slide is mandatory!

- Your audience remembers the beginning and the end best (*serial position effect*)
- The summary slide is your last chance to make the **one** thing stick
- Re-exposing key points strengthens retention (*retrieval practice effect*)
- Possible strategy:
 - Pause before the summary slide
 - Ask: “What is the one thing you are taking away from this?”
 - Let the audience sit with it (>30 seconds in a lecture, a breath or two at a conference), silence is very powerful to get attention
 - Then show the summary as confirmation of what they just worked out themselves

Your slides are not your script

- No full sentences
 - Slides are anchors for your argument, not a written version of what you say
- Never read your slides aloud
 - Your audience reads faster than you speak and you will lose them in seconds
- Font size minimum (48 for main bullets)
 - If someone in the back cannot read it because you have too much text: **cut the text, not the font**
- Define every abbreviation the first time you use it, on the slide, not just verbally
 - If you use it only once, spell it out and skip the abbreviation entirely
 - Know your audience: if half the room is outside your field, spell it out every time

Figures are excellent. Use them.

- Maximally one figure per slide
- Make them large. If it is small, it is invisible.
- Always explain your axis labels: it orients the audience and slows you down
- A figure from a paper is complex by design and you cannot always simplify it. Your job is to guide attention explicitly (remember: 4 meaningful units at a time!)
 - e.g. “Look at the red curve. Ignore everything else for now.”
 - Walk the audience through one element at a time
- Never use a figure and expect the audience to read it alone
- Never use a figure just because there is white space left on a slide

Equations and tables are dangerous. Use them carefully.

- Equations:

- Maximally one equation per slide if you really must (a very theory/math-oriented audience may tolerate two)
- Define every symbol and never assume the audience knows your notation
- Derive only what is necessary. If the derivation is not the point, show the result only

- Tables:

- Rarely work in presentations (they are for papers designed to be read slowly, in your own time, with full context)
- If you must use one, highlight the cell(s) that matter and ignore the rest

Color is a signal, not decoration

- Choose **one accent color** and use it consistently throughout your talk
- Color should carry meaning, never just be decoration
- Never rely on color alone: ~10% of all males are red/green colorblind
- Never rely on implicit color cues
 - e.g. if you make text green because it mimics a linecolor in a plot, say it
- Avoid possible unwanted color cues
 - e.g. if a figure uses one color dominantly, do not use the same color on the same slide for something else

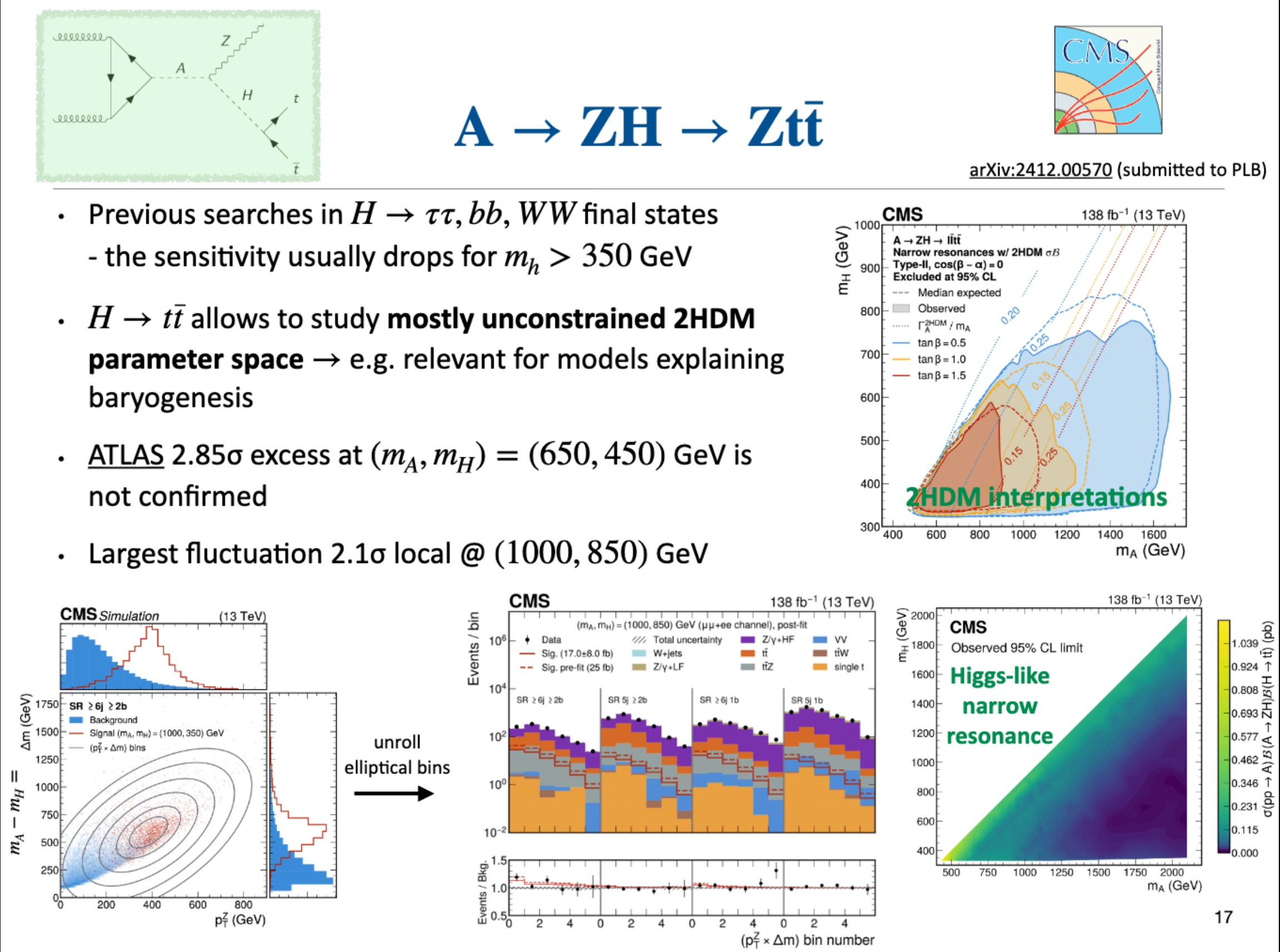
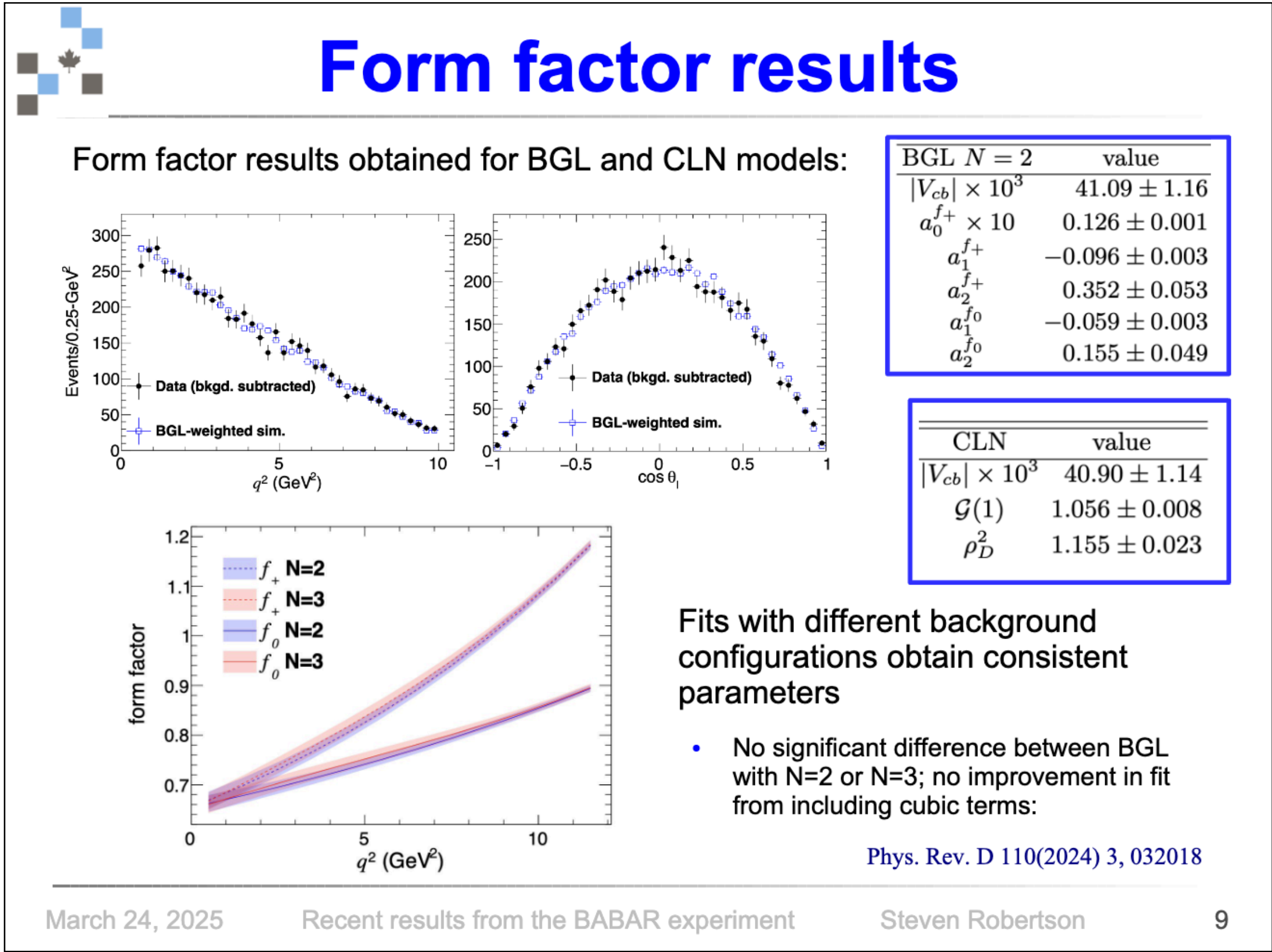
Build-up slides: use with caution

- Revealing bullets one by one fragments your argument
- The audience spends energy wondering what is coming next, not listening to you
- If something changes between two slides, make it impossible to miss: highlight it, point to it, say it aloud
- When to use them: only when the sequence of revelation is itself the point
 - e.g. showing a process step by step where seeing all steps at once would overwhelm

Backup Slides

- A backup slide is a slide you prepare but do not present
 - It lives at the end of your deck, hidden from the main flow
 - You jump to it only if a specific question comes up
 - Warning: if you upload or share your deck, backup slides are visible to everyone
 - If the argument matters, it belongs in the main talk
-
- In my opinion: In practice, backup slides create more problems than they solve.
Consider whether you need them at all

Is there anything wrong with these slides?



Part 3: Presentation

Your body speaks without words

- Stand still. Do not rock on your feet back and forth without purpose
- Do not walk around without purpose
- Own the room: plant your feet, face the audience, not the screen
- Hands out of pockets
 - one hand in a pocket can look relaxed, two always looks closed off and nervous
 - Use them to gesture, then let them rest
- **Never** turn your back to the audience to read your slides

Your clothes are part of your argument

- The audience should remember what you said, not what you wore
- Dress one level above your audience to signal you take the occasion seriously
 - For most academic and professional presentations, business casual is a safe default
- A dark blazer over a light shirt frames your main communication tools, your hands and face
- Avoid anything that moves, shines, or makes noise when you gesture
 - When in doubt: fewer patterns, fewer accessories, fewer distractions

Exceptional speakers with different styles



Barack Obama

also: Steve Jobs, Angela Merkel, Richard Feynman,
Oprah Winfrey

Malala Yousafzai



Your voice is your instrument

- Slow down. Most presenters speak too fast when nervous
- Breathe. It slows you down, and it sounds like confidence
- Vary your pace: speed up to build energy, slow down to signal importance
- Volume: project to the back of the room, not to your slides
- Silence is powerful. A pause before a key point tells the audience: this matters.
 - Barack Obama is famous for uncomfortably long pauses before every key point
- Never fill silence with "um", "so", or "you know", pause instead

Look at people! Speak to people!

- Before I start, I try to find 3-4 friendly faces spread across the front rows of the room
 - I rotate between them so it looks like I am addressing the whole room
- Pick one person, finish a thought, then move to another
- Do not scan the room randomly (appears nervous)
- Do not stare at one person (appears aggressive)
- Never speak to your slides. If you are reading them, so is your audience, and they read faster than you speak

Nervousness is not your enemy

- Even great presenters or artists get nervous. The goal is not to eliminate it but to use it.
 - If I am too relaxed for a talk I may have given many times, or a lecture I am very comfortable with, my performance is not optimal.
- Adrenaline sharpens focus, raises your voice, and makes you present
- The classic trick: Reframe “I am nervous” to “I am excited”
- Channel it: take a breath, plant your feet, and let the energy come out through your voice and gestures

The first and last 30 seconds should be scripted

- Script your opening exactly and memorize it
- Do **not** start with your name and title, you have already been introduced
- Start with a hook instead:
 - A question (e.g. “How many of you have run a blind analysis and genuinely had no idea what you would find?”)
 - A bold claim (e.g. “The Standard Model is almost certainly wrong. Today I will show you where.”)
 - A one-sentence story (e.g. “Three years ago, we saw a 3-sigma excess in our dark photon search. It kept us up for months.”)
- Do not script the middle part of the talk, do not read text from cards: know your arguments and line of thought, but do **not** memorize words.

The summary: Land the one thing

- Your summary and closing is as important as your opening, memorize it too
- Return to your opening: answer the question, resolve the story, confirm the claim
- State your one thing explicitly: "What I want you to remember is..."
- Then stop. **Do not add "so yeah, that's it", do not say "thank you", do not invite questions yourself**
- Pause
- The chair will take it from there

Answering questions

- Listen to the full question before you start answering, do not interrupt
- If you did not understand, ask them to repeat it. If you still did not, say so
- It is fine to say "I don't know", it is not fine to bluff or give a wrong answer
- Do not let one person dominate the discussion (the chair should help, but you can too)
- If a question is hostile, do not get defensive but answer the science, not the tone
- If a question would take 10 minutes to answer properly, say so and offer to discuss afterwards
- When you get a question: Stop. Think. Answer with words first. A slide is a last resort, not a reflex.

Laserpointers are for cats

- If you feel the need for a laser pointer, your slides need better verbal guidance or less content
- "Look at the blue curve" beats a shaky red dot (or smartpointer or whatever tool) every time
- If you must use one: point, then put it down. Never circle, never wave.



Technology will fail

- Prepare your slides as pdf and have them ready in two places (e.g. uploaded and USB stick)
- Arrive early and test everything: your laptop, projector, ~~cat-toy~~ laser pointer
- If something breaks mid-talk: acknowledge it briefly (!), stay calm, keep going, no long apologies
- Know your slides well enough that if the screen goes dark, you can keep going

Respect the time limit

- Know your time limit and design your talk to fit it
- **Rough guide:** 1.5 minutes per content slide, but let the argument dictate the pace, not the slide count
- Practice out loud, with a timer (reading in your head is always faster than speaking)
- Build in a 10% buffer: if you have 20 minutes, design for 18 minutes
- If you allow questions during the talk, time becomes unpredictable, factor that in or set clear rules upfront (this is a much harder format and only for experienced speakers)
- If you are running long, cut content: **Never cut the summary, never speed up**
- **Never run over.** It is disrespectful to the audience, the chair, and the speakers after you.

How to present like a rockstar

- You know your material so well you could give the talk without slides
- You own the room: you stand still, you speak slowly, you look at people
- You are excited and you use it
- You start with a hook and end with the **one** thing
- You respect the clock, the chair, and the audience
- When things go wrong, you keep going

