Certainly these seem self-evident as minimal standards for publishing any piece of nonfiction. Equally succinct and perhaps more inspiring are criteria that former AMS President G. E. Andrews has been known to mention privately (for instance, once to the second author) as his own rules-of-thumb.

**Andrews's criteria for refereeing.** Does the result satisfy at least two of the three questions:

- Is it surprising?
- Is it elegant?
- Is it useful?

These idealistic rules preserve the practical simplicity of Hardy's criteria, yet place aesthetics in the foreground. We would like to posit that if a paper satisfies even one of Andrews's criteria, it soars above almost all other instances of human activity, and is worthy of praise.

There is further advice for referees in the great article[3] by Arend Bayer in the March 2019 issue of these *Notices*. As supplementary rules-of-thumb, we suggest that referees:

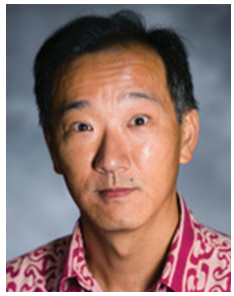
- Always first seek the beauty and importance in a paper.
- Try to really understand the author's goals—one cannot review a paper without first seeing these.
- Give every paper a fair chance.
- Remember that authors work hard to conceive and write a paper, so never write a report after a single glance.

Refereeing is usually discussed in the context of service to the mathematics community (which is very thankful to you, on that note). But in addition to giving up one's own time, we gain a lot from our refereeing work, too. Refereeing a paper shouldn't be taken on like a homework assignment. This is an *opportunity*, not just to serve your community, but to merge with the collective mind of mathematics and participate in its creative process.

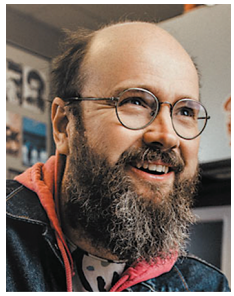
Speaking personally, the authors experience anticipation with every new paper we agree to review: we have felt the excitement of recognizing a groundbreaking result (surprisingly, not always right away), the sense of revelation, and the eventual pride of having played a nurturing role when it debuts. And along with the whole mathematics community, we are swept up in the wave of new research and enthusiasm triggered by new advances. So of course, we are on the lookout for the next potential mind-blower to show up by email!

Then like our imagined alchemist, be curious of the contents. Approach each submission in the sincere hope that it may eventually appear in print. For the sake of others in your field, you have the responsibility to see what is valuable in it, and to help revise it so its value will be readily recognized. Read carefully and comment respectfully. And if you should not recommend to accept a paper, be clear that the piece is just not appropriate for the present journal—not that it is being rejected from the literature.

It may be **through you alone** that important work will find its audience.



Ken Ono



Robert Schneider

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Ono author photo is courtesy of Ken Ono.
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[3] *Bayer, Arend. Writing, and Reading, Referee Reports.* Notices of the American Mathematical Society *66.3 (2019): 363–367.*

# Design and Construction of Mathematical Posters

*Anya Michaelsen*

When making a poster, or any kind of presentation for that matter, it's important to keep in mind that **your primary goal is to *communicate***. This one guiding principle can help inform decisions from "How do I structure it?" to "Should I include this equation?" and "What should my title be?" So with this in mind, there are three key components to creating an effective poster:

- **Structure**–appearances and organization.
- **Content**–details to include and wording.
- **Logistics**–the nitty-gritty, putting it together.

## Structure

Despite the saying, people do tend to judge books by their covers, which is why the structure of your poster, its "first impression," is one of the most important aspects of your poster. The first aspect that anyone will notice about your poster is its structure and overall appearance. If they see a wall of text or poorly formatted equations, that's an immediate turnoff. You want the first glance at your poster to invite someone to come up and read it or talk to you, not scare them off. After all, you can't communicate if no one comes to talk to you. How do you do this?

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**Organize your poster into sections.** Just like a paper or presentation, you want your poster to have clear and defined sections to guide your reader, which is usually done with boxes and titles. Typically you want the content to flow top to bottom and then left to right. Some possible sections (in order) could be:

- **Introduction or Motivation**–set up the question or problem and provide relevant history.
- **Background (general and/or specific)**–present needed terms and theorems.
- **Results and Justification**–state your results and any supporting proofs, derivations, or data.
- **Discussion or Further Research**–discuss implications or pose future questions.

**Include white space.** It may seem counterintuitive, but what you don't put on your poster can be as important as what you do. If you have text, keep it short; a long dense paragraph is daunting and unlikely to be read. Use bullet points or lists, where possible, to make the information easy to find and interpret. Use headings and subheadings if applicable. Include space between titles, text, equations, and figures so information isn't too densely packed.

**Use color, bold, italics, etc.** Use color[1] and text formatting to draw the audience to your key points. Highlight terms your reader needs to know and use visual indicators to set these apart. In a definition or construction, bold the term being defined. If you have a lot of theorems and definitions, consider color coding so a reader can quickly find the highlights.

**Include figures or pictures if possible.** If there is a diagram, plot, or other figure that can be used to communicate or illustrate some part of your work, include it in your poster. Figures are a great way to break up text and give your audience a visual framework to understand your result. You can potentially construct a flow chart or diagram to communicate some of the ideas or relationships between concepts. If you can't construct a relevant graphic, don't worry, use more equations or a photo of the researchers!

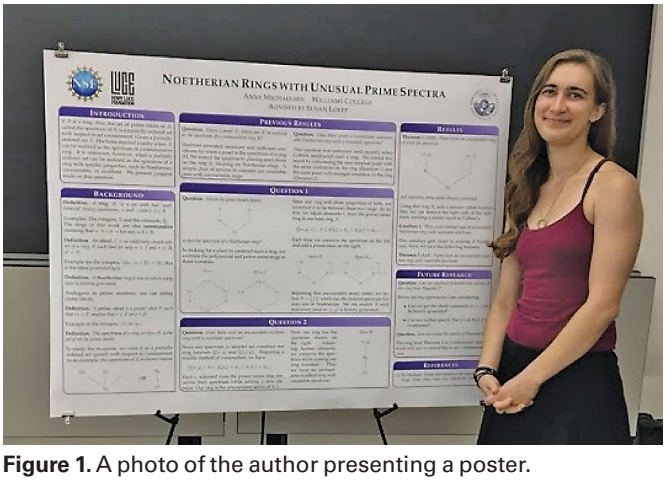


**Figure 1.** A photo of the author presenting a poster.

[1]*Preferably colorblind-safe colors and combinations.*

**Use the structure to convey content.** When you are starting out, think about any internal structure or organization of your work; the organizing boxes are a great example. You can also use structure in other ways to communicate content. Do you have two similar proofs or constructions? Consider using parallel boxes for them, lining up corresponding pieces visually on your poster. Does your proof have three major parts? Try separating them into three columns within a box, or even into three separate boxes. Do you have two big lemmas and then a theorem bringing them together? Put the lemmas into parallel boxes, with the theorem in one big box below them, mirroring the way your lemmas funnel into your main result. Using these and similar ideas to structure your poster can further guide your reader or audience's understanding.

## Content

Now that you have some general ideas for how to structure your poster, it's time to figure out what actually goes in it. Before you start sketching/typing/drawing, sit down and ask yourself:

- What are the key ideas/results I want to convey?
- What math is needed to understand my results?
- Who is my audience? What is their background?

**Know your audience.** *Who* you are talking to determines a lot of *how* you will talk to them. So it's important to know the intended audience of your poster. Who is your intended audience? What background will they have? This will inform how much background you should aim to cover.

Will your audience have any specific knowledge of your field? If so, your background section can be more tailored to your research. If you have a mixed audience or a more general audience, you could split the background into an "Advanced/Specific Background" section and a "General Background" section that could be skipped as needed. Will they be looking at your poster without you or will you always be there to explain it? If your poster needs to stand on its own, make sure it's as self-contained as possible.

**Communication is key.** At the end of the day, it's important to remember that the purpose of your poster and your presentation of it is to communicate. Using accessible language, having the appropriate background, and knowing your audience are all tools to facilitate communication.

When presenting your work it is also helpful to have several "pitches" prepared. In addition to your main poster presentation, which you should have prepared, you should have a one-minute mini-summary that you can give at any time. Having this ready means you'll always be able to share your research, whether it's in the elevator or in line for coffee.

## Logistics

**Editing**. When it comes down to actually putting your poster together, many people use LaTeX or PowerPoint. LaTeX has more functionality for typesetting mathematics

whereas PowerPoint has a more intuitive visual editor. Both PowerPoint and LaTeX have many templates available online to get you started, but you should check that these are the correct size for your presentation.

An article with links to PowerPoint templates as well as further poster design recommendations can be found at the URL in the footnote.[2] For LaTeX there are several common packages used for posters.[3] You can also browse poster templates on Overleaf[4] for other ideas.

**Printing.** For printing your poster you must first decide on the material: paper or cloth. Paper is standard, and most conferences provide a board and fasteners for mounting your poster, but you should check. Paper is likely the easiest to print and your institution may do it for you; otherwise you can print commercially. When flying, poster tubes can typically be placed in overhead bins, although may count as your carry-on.

Next there's the cloth or fabric poster, which can be easily folded and stored for travel. A fabric poster takes up less space and has comparable resolution to paper. The downsides are the cost and potential time to order online since you may not find local fabric printing.

## Concluding Remarks

A poster can feel like a big undertaking, especially under a time crunch, and just getting started is sometimes the hardest part. However, getting a first draft is also the most important part. In his *New York Times* article,[5] Tim Herrera emphasizes the importance of getting tasks done, even (or especially) if they aren't done perfectly at first. This applies equally to making posters and to writing articles about making posters. So when you are starting out, don't worry about making everything perfect and just focus on getting a draft done. Once you have a first draft, you can revise and edit to improve, but you have to start first.

It is my hope that this advice helps you in creating your own research poster or in advising others to do so. Whether specific suggestions fit your preferences and research will ultimately be up to you to use as you see fit. Ultimately, however, you should always return to the guiding principle of communication and ask yourself: *does this help me communicate my work?* If the answer is yes, then you are on the right track.

I am far from the first to offer advice on posters. For further reading on creating and presenting research posters, see the references section below. You can also find other resources online or ask mentors.

## References

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Anya Michaelsen

## Credits

Figure 1 and author photo are courtesy of the author.

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