Creating effective poster presentations

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PART 1: INTRODUCTION

Poster presentations have become an important part of professional meetings and are recognized as valuable tools for teaching and assessment. An effective poster is a visual communication tool that will help you engage colleagues in conversation, convey your main point to large numbers of people, and advertise your work. An effective poster is a highly condensed version of a research paper constructed primarily of visual displays of data with just enough supporting text to provide context, interpretation, and conclusions. This AMEE Guide provides guidance and is illustrated with annotated examples.

A new look at scientific meetings

Maugh (1974) declared the poster session “a new look at scientific meetings” and its first use at a major meeting in the United States as a smashing success. More than 20% of the 2,200 papers at the joint meeting in 1974 of the American Society of Biophysical Chemists and the Biophysical Society were presented as posters. Poster presenters and viewers alike appreciated the two-way exchange, and the potential for more in-depth discussion and personal interaction than oral presentations afford.

Since then, poster sessions have become common at scientific meetings, in part through necessity as the number of scientists vying for presentation slots met limitations of time and space at meetings. For example, the 2008 meeting of the Ecological Society of America hosted approximately 1150 contributed oral presentations and 700 posters (38% of total) during a 5-day period (ESA 2008). At the annual meetings of the Association for Medical Education in Europe (AMEE), posters have increased in both number and proportion of presentations. The 2001 meeting in Berlin saw 283 short communications and 117 poster presentations (30% of total; AMEE 2001). The posters were presented in 12 themed groups on a single day. During the 2008 meeting in Prague, some 450 short communications and 600 posters (57% of total) were offered; posters were presented in 31 themed groups over three days (AMEE 2008).

Posters have also been recognized as valuable tools for teaching and assessment. In the classroom, they can provide a mechanism to promote teamwork, develop presentation and communication skills, and enhance critical thinking and analysis skills (e.g., Moneyhan et al., 1996; Hess & Brooks, 1998; Bracher et al., 1998; Costa 2001). They also offer an alternative to essays and written papers for the assessment of student work (e.g., Pelletier, 1993; Moule et al., 1998; Akister et al., 2000). Chute and Bank (1986) suggest a class poster session as a time-saving alternative to spending “…half of the course listening to nervous undergraduates awkwardly drone on in the usual seminar fashion.” Poster competitions for graduate students are also held at some professional meetings, garnering prestige, recognition, and even monetary rewards for up-and-coming scientists.

Although the importance of posters as a tool for communication, teaching, and assessment seems clear, we have noticed that presenters often do not take full advantage of the medium. In our personal experience, we have found that many posters are hard to read, poorly organized, overloaded with text, and lacking in effective visual displays of data. In 1999, one of us (Hess, unpublished data) evaluated all 142 posters at the national meeting of a professional society. The main criteria in his “60-second poster evaluation” were overall appearance and the ease with which key pieces of information could be located (Hess, undated). Many of the posters were cluttered or sloppy (33%) and had fonts that were too small to read comfortably (22%), especially in the figures (44%). Research objectives (38%) and main points (42%) could not be found on many posters within the one-minute review period. Smith et al. (2004) demonstrated that such quick-scoring techniques are a good indication of
overall quality. They found that a 15-second quick-scoring technique, focused largely on visual and organizational elements, was highly correlated ($r=0.75$) with more detailed scoring of the same posters.

The problems identified in many posters diminish their communication value for all but the most determined readers. Once authors are made aware of them, these problems are easily fixed. Medical and nursing educators have long dominated the literature examining the use and preparation of posters, both for professional meetings and as teaching and learning tools. Indeed, the overwhelming majority (nearly 75%) of the ca. 125 peer-reviewed articles in Brownlie’s (2007) comprehensive annotated bibliography of the literature are from medical and nursing journals. Poster presenters should have access to straightforward guidance to help them create more effective posters. That is the purpose of the new AMEE guide and the associated web site, Creating Effective Poster Presentations (Hess et al., 2008).

Creating an effective poster presentation

A scientific poster is a relatively large (1m x 2m) visual display designed to convey research findings. An effective poster is a visual communication tool that will help you engage colleagues in conversation, convey your main point to large numbers of people, and advertise your work. Posters use ordered text and graphics to present a single message, are left unattended a day or longer for meeting participants to review at their leisure, and usually have a scheduled 1- to 2-hour period when the author(s) are to be available for discussion. In some conferences, like those of the Association for Medical Education in Europe, poster presenters are also required to deliver a 2- to 3-minute highlights speech to help generate interest in their work.

Despite the notion among some researchers that posters are “second class” when compared to oral presentations, we argue that there are many reasons to prefer poster presentations:

- You have the potential to reach a larger audience. Only those directly interested in your field may attend an oral presentation, whereas scientists in related fields are likely to stroll through a poster session. If your poster is visually interesting and graphically informative, you can capture their attention.

- It is much easier to talk with people during a poster session – even the big names in your field may stop at your poster. Thus, you can begin to develop professional contacts and networks.

- You have the opportunity to present your information in a wide variety of formats. In addition to your poster, you can also use handouts, additional photographs, and even computer simulations to deepen your conversation with interested colleagues.

- You can respond immediately to any criticism of your work, including improving your approach when the criticism is warranted.

- While an oral presentation is linear, poster presentations provide multiple points of entry for viewers. Different people will be interested in different parts of your work, so that conversations can all start differently (you should be prepared for this). You will also have the opportunity to try different explanations if the ones you rehearsed are proving unconvincing.

- Many people find the poster session format less stressful than an oral presentation.

Like an effective oral presentation, an effective poster presentation requires thoughtful and careful preparation. In today’s era of computers, digital text and graphics, and large printers, actually assembling and printing posters is not difficult. A poster, however, is not simply a manuscript hung on a board or a set of PowerPoint slides printed on a single, large sheet of paper. In fact, a
compelling case can be made for thinking of a poster as an illustrated abstract – a highly condensed version of a research paper constructed primarily of visual displays of data with just enough supporting text to provide context, interpretation, and conclusions.

There are numerous “how-to” guides available for poster presentations (see Brownlie’s 2007 bibliography for an extensive list). There are common themes that occur repeatedly, including:

- developing a short, large, results-oriented title to convey results and attract attention
- using visual elements to tell your story: photographs, graphs, drawings
- minimizing text, using just enough to provide context and explain your visual elements and conclusions
- maintaining a large, easy-to-read font throughout the poster
- using appropriate headings to organize your poster and guide viewers
- keeping your poster bright, colorful, and uncluttered
- being prepared to speak about your poster
- making sure you are with your poster during your assigned time
- preparing a summary handout that people can take with them

We have developed this new AMEE Guide to Creating Effective Poster Presentations to synthesize these key points, illustrated by example posters annotated with notes describing what works and what could be improved. For many people, the Guide will provide the information needed to markedly improve their posters. For those who want more, the Guide is actually a summary of more detailed information found on our website (Hess et al., 2008). The website is currently in its 4th edition, and has benefited from comments and requests from around the world. We expect to add video content in the near future – short modules describing how to create effective posters, all backed with real-life examples.
References


PART 1 was first published as a Commentary in Medical Teacher:
Key messages

Poster presentations are an important communication tool in the sciences and everyday living. A carefully crafted presentation will help you engage colleagues in conversation and provide information to many people.

Posters serve as:
- a conversation starter
- a source of information
- a summary of your research, and
- an advertisement of your work.

Many posters at professional meetings have problems that reduce their effectiveness:
- hard-to-find objectives and main points
- text that is too small to read
- cluttered and confusing graphics
- poor organization, and
- weak conclusions and summary statements.

You can avoid these problems by implementing three concepts:
- keep your poster focused on a single message
- use colorful graphic images to tell a story, and
- present information in a well-ordered sequence.

This booklet summarizes more detailed information available on our website, www.ncsu.edu/project/posters.
Getting started... some key considerations

Before putting fingers to keyboard, you should determine:

- **Specific size and orientation:** (horizontal vs. vertical) requirements

- **Material you will be working with:** a single, large sheet of paper from a plotter... individual elements on standard paper (A3 & A4) mounted on foam core or craft paper... laminated or not. The examples here are single, large sheets – because they are most common at professional, scientific meetings – but the concepts are universal.

- **Schedule:** It takes time to create a good poster. Allow time to focus your message... create a draft... edit the draft a few days later... get at least one round of comments from colleagues, preferably two... print the final version.

Know your MESSAGE... and don’t be shy about it

- Determine the one thing you really want everyone to know
- State that one thing succinctly - and put it in the title if you can
- All visuals and text should relate to this message - if they do not, remove them
- **Be bold** - make the strongest statements your data will support
- Use section headings or graphic captions for your key point(s)

AUDIENCE dictates your language... know who will be there

- Be sure that your audience will understand your message
- Audience categories include... specialists only... wide-ranging disciplines... and general interest
- Provide context and interpretation for each specific audience
- Adjust terminology, jargon, and acronyms to each audience

Good points...

- Title conveys the main finding
- Nice visual balance
- Appropriate mix of visuals and text
- Simple, colorful, attractive layout
- Nice visual balance and use of white space
- Font large enough, even in figures
- Graphs interpreted by their titles
- Context and objectives are clear

Potential improvements...

- Title could be even more direct: Water Temperature Determines Sex of Southern Flounder
- Font could be even larger, taking up some of the white space between columns
- Perhaps relate conclusions back to aquaculture, a theme developed in the Introduction
Southern Flounder Exhibit Temperature-Dependent Sex Determination
J. Adam Luckenbach*, John Godwin and Russell Borski
Department of Zoology, Box 7617, North Carolina State University, Raleigh, NC 27695

Introduction
Southern flounder (Paralichthys lethostigma) support valuable fisheries and show great promise for aquaculture. Female flounder are known to grow faster and reach larger adult sizes than males. Therefore, information on sex determination that might increase the ratio of female flounder is important for aquaculture.

Objective
This study was conducted to determine whether southern flounder exhibit temperature-dependent sex determination (TSD), and if growth is affected by rearing temperature.

Methods
- Southern flounder broodstock were strip spawned to collect eggs and sperm for in vitro fertilization.
- Hatched larvae were weaned from a natural diet (rotifers/Artemia) to high protein pelleted feed and fed until satiation at least twice daily.
- Upon reaching a mean total length of 40 mm, the juvenile flounder were stocked at equal densities into one of three temperatures 18, 23, or 28°C for 245 days.
- Gonads were preserved and later sectioned at 2-6 microns.
- Sex-distinguishing markers were used to distinguish males (spermatogenesis) from females (oogenesis).

Histological Analysis

Temperature Affects Sex Determination

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>% Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>04</td>
</tr>
<tr>
<td>23</td>
<td>53</td>
</tr>
<tr>
<td>28</td>
<td>42</td>
</tr>
</tbody>
</table>

(***P < 0.001 and **P < 0.01 represent significant deviations from a 1:1 male:female sex ratio)

Rearing Temperature Affects Growth

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Body Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>23</td>
</tr>
<tr>
<td>23</td>
<td>31</td>
</tr>
<tr>
<td>28</td>
<td>31</td>
</tr>
</tbody>
</table>

Growth Does Not Differ by Sex

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Body Weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>64</td>
</tr>
<tr>
<td>23</td>
<td>53</td>
</tr>
<tr>
<td>28</td>
<td>49</td>
</tr>
</tbody>
</table>

(= male, = female)

Results
- Sex was discernible in most fish greater than 1.0 mm long.
- High (28°C) temperature produced 4% females.
- Low (18°C) temperature produced 22% females.
- Mid-range (23°C) temperature produced 44% females.
- Fish raised at high or low temperatures showed reduced growth compared to those at the mid-range temperature.
- Up to 245 days, no differences in growth existed between sexes.

Conclusions
- These findings indicate that sex determination in southern flounder is temperature-sensitive and temperature has a profound effect on growth.
- A mid-range rearing temperature (23°C) appears to maximize the number of females and promote better growth in young southern flounders.
- Although adult females are known to grow larger than males, no difference in growth between sexes occurred in age-0 (< 1 year) southern flounder.

Acknowledgements
The authors acknowledge the Saltonstall-Kennedy Program of the National Marine Fisheries Service and the University of North Carolina Sea Grant College Program for funding this research. Special thanks to Lea Ware and Beth Shimps for help with the work.
Create a provocative TITLE... and keep it short

- Craft a title from your main message... deliver this message to people who only read titles
- A provocative question can garner interest
- Keep it short... direct... active

For example... use a specific, direct title...

**Substance A Inhibits Production of Protein B**

...rather than a generic, uninformative one...

**The Effect of Substance A on Protein B**

Use HEADINGS to organize your work and convey main points

- Headings help viewers find the parts of your poster they want to read
- Use headings to convey key points and take-home message(s)
- It’s fun to experiment, but stick to an organizational format that everyone knows unless a compelling reason merits something else...
  - Introduction :: Objective :: Methods :: Results :: Conclusion
- Use color, typeface, and font size that make headings stand out

MINIMIZE TEXT and keep it large

- Posters are visual – use minimal text to support images and graphics
- Keep text elements to 50 words or less
- You can minimize text by... keeping the focus on your main message... using phrases instead of full sentences... using active (first person) voice
- Use large text – at least 24 points for text, larger for headings
- Serif fonts (e.g., Times) are best for text; Sans-serif for headings

Good points...

- Title asks a question many audience members will find compelling
- Concise methods; focus on findings
- Pleasing design and color scheme
- Nice visual balance
- Blue header blocks tell the story
- Good use of high-quality images
- Font is generally large enough

Problems...

- Lacks white space – appears crowded
- Non-standard headings confuse many viewers
- Scatter plots are too small

Potential improvements...

- Increase focus: there are three stories here (breeding birds, migrant birds, mammals) - eliminate at least one
- Use standard or shorter headings to avoid confusion
- Remove methods-oriented details from center and right columns and focus on results
- Enlarge scatter plots
- Enlarge line graph in the center column

Making these changes will increase white space, reduce crowding, and improve focus.
EXAMPLE 2: Scientific poster with non-standard headings

This poster was presented at an annual meeting of the Ecological Society of America. Thousands of people attend these meetings; participants represent a broad spectrum of ecologically-focused specialties.
EXAMPLE 3: Scientific poster with positive (+) and negative (−) aspects identified

Will Manatees Still Exist in 2100?
Effect of Cold Winters and Watercraft Accidents

1. Introduction
In Florida, the populations of West Indian Manatees, listed as an "endangered species" in 1987, appear to be growing in recent years. At the same time, the total number of manatee deaths has increased rapidly. Therefore, it has become more important to evaluate the long-term viability of the populations. I hypothesized that cold stress due to cold winters and accidents with watercrafts cause additional mortality, and examined the population trends during the next 100 years.

2. Objectives
- + Results are centerpiece of poster
- + “No effect” graphic clearly separated by positional difference (on left)
- - “No effect” graphic clearly separated by positional difference (on left)
- + Author information should be larger
- + Succinct introduction of problem leading to hypotheses
- - Clear objectives
- - Bullet points too far from text
- + Succinct methods
- - Appropriate for audience
- - Nice graphic display
- - Title asks provocative question and then defines focus
- - Author information should be larger

3. Methods
- Model type: modified age based matrix model of female manatees
- Initial population size = 1600
- Mean boat collision deaths/year = 68 individuals
- Grow minimum temperatures and the number of boat collision deaths in each year randomly from normal distribution
- Simulated 100 times for each model

4. Results: Graphs of Population Trends
- Model 1: No effect (natural mortality only)
- Model 2: Temperature effect
- Even 100 years of cold winters do not cause the manatee population to decline
- Model 3: Boat effect
- A mean of 68 boat collision deaths/year causes slower population growth, but the population size still increases
- Model 4: Combined effect
- Assumming randomly occurring cold winters and a mean of 68 boat collision deaths/year, population growth became even slower, but the population size still increases

5. Discussion
- Cold winters did not cause the manatee population to decline. This result can be expected because there are thermal refuges during winter (e.g., power plant warm-water discharges). Therefore, the mortality due to cold winters was very low. Developing a model that includes the effect of winter refuge loss could be interesting in future studies.
- Current average boat collision deaths (i.e., 68 deaths/year) slowed population growth, however, did not cause the manatee population to decline.
- Population growth became even slower when the effects were combined (i.e., randomly occurring cold winters and mean boat collision deaths/year = 68) however, the population was still growing.
- Though the mean boat collision deaths (even by a smaller number) could be a serious problem. For a mean ⇒ 78, the extinction probability became 1. The records show that the deaths due to accidents increased rapidly during last 5 years, therefore understanding the current situation of boat collision deaths is important to maintain manatee populations.

Jun Yoshizaki, Biomatical Program, North Carolina State University, Raleigh, NC 27695
Email: jyoshizaki@ncsu.edu

+ Title asks provocative question and then defines focus
- Author information should be larger
- Succinct introduction of problem leading to hypotheses
- Clear objectives
- Bullet points too far from text
- Succinct methods
- Appropriate for audience
- Nice graphic display
- Image is a good attention grabber
- Low resolution image pixilated at full size
- Succinct finding
- Font too small on graph
- Main points bold and articulated clearly
- Might eliminate all but bolded text and leave room for conclusion or recommendations
- Rename Section 5 to “Conclusions”
Use **COLOR creatively... but don't go overboard**

- Use balanced color (and large graphics) to attract viewers
- Use light background and dark letters for contrast - poster sessions usually have poor overhead lighting
- Use a 2-3 color scheme - more colors than that are distracting
- Consider people who have problems differentiating colors, especially when designing graphics - inability to tell red from green is common

**Keep GRAPHICS clean and uncluttered**

- Good graphs, illustrations, photos are the visual core of your poster
- Write explanations directly on or adjacent to figures instead of referencing them from elsewhere
- Use captions to convey your message... instead of “Scatter plot of nest predators by greenway width” write “Nest predators less common in wider greenways”
- Good graphs communicate relationships quickly... keep them clean
- Use simple two-dimensional graphs whenever possible
- Use photos that support your message and enliven your presentation
- Use high-resolution images... avoid pixelated images
- Color graphics can help focus viewer attention on specific parts of a poster (e.g, images in Example 2)

**Leave WHITE SPACE... don't fill every square centimeter**

- White space helps organization by making columnar flow obvious
- Cramming in too much makes an overwhelming, crowded poster
- White space reduces crowding ... and forces you to minimize text
EXAMPLE 4: Clean up your graphics

Graphs from some software packages are filled with what Edward Tufte, an expert in the visual display of complex data, calls ‘chart junk’ – the dark backgrounds, false 3-D, shadows, and grid lines that distract the reader and hide data.

It only takes a few minutes to remove clutter so that important data patterns become apparent.
EDIT ruthlessly... less is more

- If it’s not critical to your main message, delete it
- Simplify verbiage, reduce sentence complexity, remove detail
- Print on standard (A4) paper and ask colleagues to edit
- Colleagues from a different field can identify jargon, missing context (why your work matters), and logical leaps
- Colleagues in your field can identify errors of fact and interpretation

Be prepared to PRESENT your work

- Let people read for a while before letting them know you are there for questions
- Prepare ½-, 2-, and 5-minute “tours” of your poster, focus on your results
- Some conferences require a short, oral “highlight presentation”
- Ask viewers if they want a “tour”
- For longer “tours,” include... the context of your problem and why it is important (Introduction)... your objective and what you did (Objective & Methods)... what you discovered (Results)... what your findings mean in terms of your stated context (Conclusion)
- Use the graphics on your poster to support conversations with viewers
- Use your poster as a visual aid... don’t read it to people

Develop a one-page HANDOUT

- Handouts serve several purposes... give viewers something to take with them... help viewers remember who you are, what you did, and how to contact you... provide a place for more detail than you want on your poster
- Print a scaled-down version of your poster on one side of an A4 sheet
- Use the other side for more detailed information, readings, equations, citations
- Supplement... not duplicate... information on your poster
- You can use A3 paper, folded in half, giving you four pages to work with
EXAMPLE 5: Handout designed for back of A4 sheet

The front of the sheet would contain a scaled-down version of the manatee poster (Example 3). Notice the additional detail and citations here.

Abstract

In Florida, populations of the endangered West Indian manatees (Trichechus manatus) appear to be growing slowly in recent years. At the same time, the total number of manatee deaths increased rapidly, especially the number of manatee deaths due to watercraft accidents doubled during the last 5 years. Therefore, it has become more important to evaluate long-term viability of manatee populations. Because collisions with watercrafts and cold stress due to cold winters are some major causes of manatee mortality, I hypothesized that boat collisions and cold winters cause additional mortality. Based on the hypothesis, I developed a modified age based matrix model to follow the population trends in the next 100 years. The results indicated that none of cold winters (even 100 years of consecutive cold winters), the current level of average number boat collision deaths (68 deaths / year) or combined effect (randomly occurring cold winters and the current level of boat accident deaths) cause manatee population decline. However, assuming the randomly occurring cold winters, if the average boat collision deaths / year exceeds 72 individuals, the extinction probability become 1 when the average exceeds 78 individuals.

Parameters

- The fecundity (the number of female birth / female / year) = 0.24 (Marmontel 1995).
- The survival probability (O'Shea and Heartley 1985, O'Shea and Langlînn 1985) was adjusted for cold stress and watercraft accident deaths. (SI = 0.857; S2 = 0.622; S3 = 0.353; S4 = 0.999; S5 = 0.999)
- The additional mortality due to cold stress was estimated from records of 1977, 1981, 1984; and ‘90 (Ackerman et al. 1996). These 4 years were considered as cold winter years because there were more than 30 manatee deaths due to cold stress. (age 0 & 1 = 0.0312; age 2-4 = 0.0542; adults = 0.0928)
- The mean number of boat collision deaths / year = 68 individuals (based on last 5 years of records (FWS 2000)).

Methods

- The critical temperature (≈ -5.6°C) was determined based on minimum temperature of the 4 cold winters, and the minimum temperature in each year was drawn randomly from normal distribution (with mean = -1.0 and STD = 2.7). If the minimum temperature of the year was <= -5.0, then the additional mortality due to cold stress was subtracted from the survival probability. Otherwise, no additional mortality was subtracted from the survival probability.
- The number of boat collision deaths in each year was drawn from normal distribution with mean = 68 (initial attempt, then tested up to 85) and STD = 8. The STD was obtained from last 25 years of records. The proportion of boat collision deaths in each age class with respect to the total number of watercraft accident deaths was calculated from the last 25 years of records.

Cited References

Good points...

- Title: Bold headings identify distinct sections
- “Parameters” and “Methods” supply additional details about model development
- Citations direct interested readers to key literature

Potential improvements...

- Include poster title and author at top of page
- Abstract redundant with poster; replace with brief summary and other new information
- Bullets too far from text
**Closing thoughts**

- Use creative poster presentations in
- Community stakeholder meetings to summarize the pros and cons of alternative actions
- Rotating displays in workplace hallways to keep administrative, technical, and scientific staff aware of ongoing research
- Science fairs for primary, secondary, and university students to explain projects, reports, and special interests

**Resources**

See our web site for most current list: www.ncsu.edu/project/posters.


**Acknowledgements**

We thank Adam Luckenbach and Jun Yoshizaki for use of their posters as examples, and the many viewers of our web site who have made comments to improve it.