

The Scientific Poster: Guidelines for Effective Visual Communication

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THE SCIENTIFIC POSTER SESSION IS A POPULAR MEDIUM FOR COMMUNICATING RESEARCH DATA AT national and international conferences. However, researchers and professionals have few editorial resources to help them present their research effectively in a visual form. This article provides guidelines in grammar, rhetoric, graphic design, and visual perception for producing a visually effective poster.

In this rushed-for-time age with an overabundance of information competing for attention, the poster session is becoming established as an alternate means of communication over traditional oral presentations or slide presentations of lengthy research articles at national and international conferences. The versatility and visual impact of the poster session make it a useful form of communication in scientific and technical fields, as well as in corporate advertising and marketing. However, the scientific poster session requires the integration of re-

search text and graphics in a way to facilitate quick visual comprehension. In most poster presentations, the audience sees the researcher's report in the scientific "IMRAD" format of Introduction, Methods, Results, and Discussion. The poster conveys the message by visually coordinating the typography and graphic illustrations in an enlarged version of a condensed message that stands alone (Figure 1).

The major advantage of the scientific poster is that it allows the audience to view the material at a reader-selected rate, leading to a

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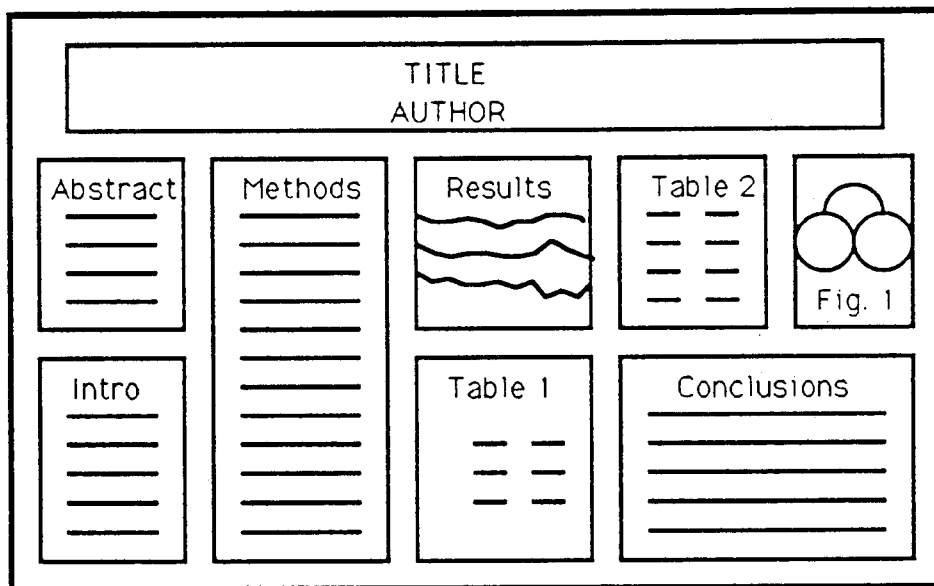


Figure 1. Example of a scientific poster session.

greater opportunity for viewer comprehension and retention, while the researcher is free to discuss issues, answer questions, distribute handouts, and reinforce highlights of the research. Such a visual and communicative interaction is not achieved through the traditional approach of "presenting a paper."

Other advantages of the poster are that it (1) attracts attention, (2) is more informal, with "no formal presenters or captive attendees" [1], and (3) can speak for itself as an active medium or stand alone as a passive medium from which readers can glean specific aspects of the information.

Because the poster functions as one large visual entity, it is, like a graph, "an excellent means of communication, because of [its] potential of concise, visual presentation of essential data and relationships" [2]. In the design or editing of a scientific poster presentation, the primary goal is to consider the editorial and rhetorical principles that must be applied to a visual display of text and graphics.

TEXTUAL CONSIDERATIONS

The creation of an effective poster is more complex and time-consuming than just pasting pages of a research article onto a poster board. Portraying a visual message involves many considerations. Most conferences issue an "Instructions for Posters" or poster guidelines with spatial limitations of a 4-ft × 6-ft or 4-ft × 8-ft poster area. Because of these limitations, poster text and graphics need to be as concise and condensed as possible, relating only the most important facts and key points. Therefore, in the planning stage, ask these questions concerning the poster presentation:

- What visual message should the poster convey to the audience? and
- What is relevant or necessary for the audience to know?

Poster material should be viewed from a conceptual standpoint. The audience will spend only minutes (not hours) reading poster material. Consider sentence length, for example—short or medium-length sentences are

visually more effective than long sentences. An effective way of eliminating unnecessary text and condensing information into a form that can be organized for visual effectiveness is to first underline only key points or words in the material, and then use only those underlined elements for the poster.

Information Grouping

Once condensed, information can be "chunked" to contribute to reading efficiency. Chunking involves grouping information in conceptual units for the reader [3] (Figure 2). The poster's text should be chunked into manageable sections, creating "a simple, coherent structure consisting of: a well-defined format, carefully edited text, and a strategic use of white space" [4]. Therefore, the reader does not have to read through long columns of text: the information is already categorized into chunked units [5]. Such an organization facilitates readability and provides a framework for greater coherence [6].

Chunking information in "digestible" bites gives a sense of categorical or divisional organization to the poster. Information must be carefully analyzed and grouped to ensure that each concept is self-contained within its chunk. One method of linking infor-

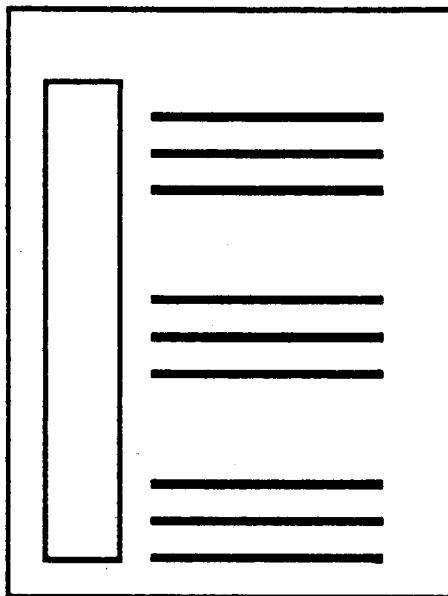


Figure 2. Chunking information into units of text.

mation into a coherent whole is by using cued headings (isolated headings that summarize or point to corresponding text) (Figure 3). Cued headings direct the audience to specific information as an index does, thereby allowing readers to scan material and quickly find the information they seek.

Lists

Although chunked paragraphs aid reader comprehension, information grouped in lists is also an efficient means of communicating selected topics or procedures. The condensed message of a list appeals to the reader's need to gather information efficiently: the information is laid out, unadorned, for quick comprehension (Figure 4). Poster-style lists written in phrase form, rather than in complete sentences in paragraph form, convey information quickly and effectively. According to Bernhardt, sentence patterns in the form of "Q/A sequences; imperatives; fragments and minor forms; [and] phrases used in isolation" are more visually informative than "complete sentences with little variation in mood [or] sentences typically declarative with full syntax" [7].

Lists can also communicate with words supported by icons. The icons in Figure 5 add a visual message and

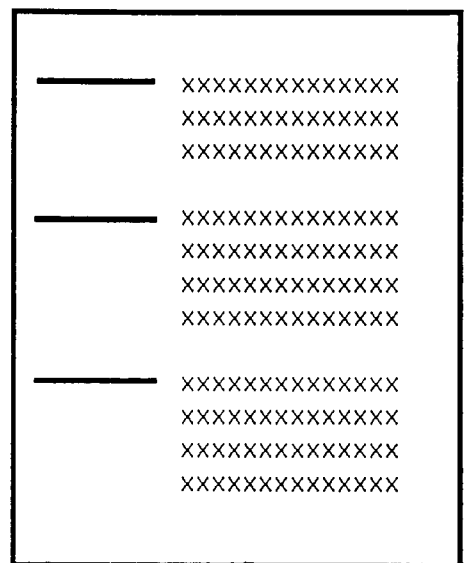


Figure 3. Bold lines on the left cue into text on the right.

EBSTEIN'S ANOMALY

Ebstein's anomaly is due to downward displacement, to varying degrees, of the septal and posterior leaflets of the tricuspid valve. The valve may also be dysplastic. It is reported to occur in approximately ten per cent of cases of maternal lithium ingestion. The tricuspid valve is usually insufficient leading to right atrial enlargement. Cardiomegaly is usually present. In the newborn, a fifty per cent incidence of congestive heart failure has been reported, presumably due to tricuspid regurgitation.

Ultrasonography demonstrates an enlarged right atrium. Downward displacement of the tricuspid valve into the right ventricle can often be seen. The resulting right ventricular cavity may be small as may the pulmonary artery. Tricuspid regurgitation can be present and demonstrated by Doppler evaluation.

EBSTEIN'S ANOMALY

- Downward displacement, to varying degrees, of tricuspid valve leaflets
 - Occurs in 10% of cases of maternal lithium ingestion
 - Insufficient tricuspid valve may lead to right atrial enlargement
 - 50% incidence of congestive heart failure in newborns
-

Figure 4. Text condensed to a bullet list for a scientific poster.



Dial 911 for any emergency



Health science occupations require
computer literacy skills

Figure 5. Icons are effective in creating visual bullet lists.

a semantic impact to the text. Icons reinforce the text and, through visual impact, leave a lasting impression with the reader. Therefore, some traditional rules for text may not necessarily be appropriate for posters [8]. For example, numbers used to begin a sentence and used throughout the text are visually more effective in a poster than the spelled-out version, just as using the percent sign (%) is more effective than using the word "percent."

Coherence

Make sure all chunks link together coherently toward one focus, not as scattered fragments or lone entities; there should be "a logical relationship between the spatial or functional layout of components" [9]. Poster elements can be linked by graphic devices, such as arrows or bold lines, or by transitional words or phrases, perhaps in a creative design or angled format. Poster design can support a

great degree of creativity, but outlandish "creativity" detracts from the professional image the poster should convey.

For a moving audience, the information must be quickly accessible. Overall, the poster presentation functions as an "illustrated abstract," addressing the main focus of each element of research [10]. Achieve this focus by condensing scientific information in the IMRAD format:

- Introduction: a few brief sentences
- Method: a list or a flow chart (we did this and this and this)
- Results: illustrations, tables, figures, or graphs, accompanied by a simple summary statement
- Discussion: a list or summary paragraph of conclusions.

These elements effectively present data in a poster format, but there are no absolutes—reasonable degrees of flexibility and creativity can enhance a scientific poster's overall effectiveness.

Stylistic Considerations

A stylistically consistent poster exudes an air of professionalism to the audience. A sloppy poster implies sloppy research, so there are many stylistic decisions to be made in poster production.

Typography. There are some definite typographical details to consider. Choosing a font is a matter of stylistic preference, yet such a choice can help "to carry a printed message purposefully" [11]. In choosing a font, keep in mind that "type helps to create a feeling or atmosphere in printed material" [11, 64]. So choose a font that attracts attention and invites the audience to read.

The type of font you choose helps create the overall effect of your poster. Serif fonts, such as Times, New York, and Palatino, are traditional forms with serif "feet" that help direct eye movement for efficient reading. The "irregular design features" of serif font "help the reader grasp word forms more rapidly in the reading process because the contrasting strokes give a rhythmic structure to words and serifs

assist horizontal eye movement." Sans serif fonts, such as Geneva and Helvetica, are more contemporary, with a straight or "clean" image, creating a "monotonous sameness" that may impair reading. However, a sans serif font is "often used . . . when the number of words is not great; its use for display is well established" [11, 165].

For short segments of text, either type of font can be effective. One common practice in design is to use sans serif font for titles and a serif font for text. However, only one font should be used consistently for text; use of a variety of fonts detracts from the effect of professional uniformity.

The typographical point size may vary according to viewing distance. Although conference guidelines should inform poster presenters of the viewing distance, most posters are viewed at a distance of 2 to 4 feet. The poster title should be at least 1 inch high, headings should be at least 36-point type, and text should be at least 24-point type.

Title. Although research points out that prose written in all capital letters (all caps) slows reading rates [3, 79, 80], such an effect can serve a purpose in the poster title. Readers may slow down their reading speed to comprehend the title's message, thereby avoiding the tendency to skip over the title or to move to another poster. Therefore, poster titles can be effective in all caps, but should be no more than eight words, if possible. According to Brown, "together with the author's by-line, a single-line title occupies about 12% of the total poster" [10, 230]. Titles any longer are unnecessary and occupy too much poster space.

Headings. Headings should be consistently styled, whether in all caps or initial caps, boldface or underlined, aligned flush left or centered. Headings should also be in a larger type-point size than the text. Choose one style and be consistent throughout the poster.

Major headings in a poster should not exceed three words, since "longer headings lose impact as they . . . occupy too much space."

More than six headings in a poster presentation "tend to compete with one another" and detract from giving prominence to major elements. Headings may be in all caps or initial caps, but the "remaining text should be in upper and lower cases as texts written entirely in capitals are difficult to read" [10, 230].

Headings (and listed items) should also be grammatically parallel. The active verb style (gerunds, imperatives) is more effective because it implies action, whereas the passive noun form (verbs converted to nouns) can indicate weak writing (Figure 6).

Text. For styling text, decisions must be made and followed throughout the poster. For example, paragraphs should be either indented or flush left, but both styles should not be used intermittently. All margins should be consistent (at top, bottom, right, and left) in all poster elements. Contributing to comfortable line length, wider margins (preferably 1 inch) are visually appealing because they frame the material with white space, making the text appear more valuable [12]; they also contribute to "optimum reading efficiency" [3, 80]. Precise and consistent margin widths help to tie poster elements "into a sequence of rhythmically related impressions" [12, 82].

In presenting text, decide whether margins will be justified or ragged right. Justified margins give a neat appearance but cause irregular spacing problems within the text. Such spacing can cause "rivers of white" within the text. Justified margins may make text appear as an impregnable block that hampers readability. Text with a ragged right margin gives a certain amount of contrast that leads to greater reading and viewing ease.

Although these considerations deal with the technicalities of a consistent textual style, such attention to detail is important to the overall effectiveness of a poster presentation. Scientific posters must meet a high professional standard, "not just for ease of reading and comprehension, but also because the poster creates an impression that, in the minds of the audience, is often extended to the quality of the research itself" [10, 229].

The text and content are key factors in this impression, yet the principles of graphical excellence and visual perception must also be addressed for the effective visual display of information in the poster format.

GRAPHIC DESIGN

The poster gives a visual message with individual components coordinated to form one large entity. The scientific poster is an effective medium for communicating research because communication and understanding are "accomplished largely through visualization" [13]. Integrating text, graphics, and other visual devices (e.g., white space, typography, design) aids audience comprehension of the portrayed topic, because "the process of thought . . . uses pictures or images as the vehicle of conceptualization [13, 13].

Text material for a poster must initially be analyzed as to how those words and concepts can be portrayed visually. Graphic design must contribute to such visualization because of the short attention span and limited viewing time of the poster-viewing audience. Therefore, in poster design, it is important to focus on how things appear to the human eye, how poster elements communicate visually, and

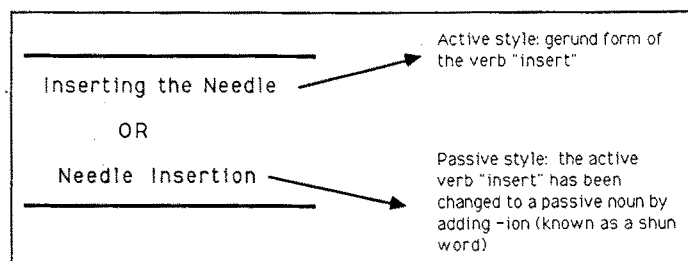


Figure 6. Active vs. passive form of a poster heading.

other visual details, as follows:

- Horizontal or vertical flow of information, not both (Figures 7 and 8)
- Use of high-impact graphics
- Design and contrast of elements
- Placement and arrangement of elements.

Graphics should increase the reading efficiency and effectiveness (enhancing audience comprehension) and the impact (strengthening audience impression) of a scientific poster [14]. According to Killingsworth and Gilbertson:

Because of their quantitative power, graphics are certainly superior to verbal statements and can be gainfully used as substitutes for words in many situations, especially where exact presentation is required. Part of the power of good graphic displays lies in their efficiency. They allow audiences to take in information at a glance [15].

The prominent use of graphics and graphic devices “influence[s] two critical functions of the mind: the gathering of information and the processing of that information” [14, 16]. The impact of graphics is summarized by Lefferts: “Graphics are tools to help give meaning to information because they go beyond the provision of information and show relationships, trends, and comparisons” [14, 6]. Lefferts explains the cognitive impact of graphics as follows:

To see is to reason. Thus, the use of visual forms of communication has great potential for influencing what a person thinks. Graphic presentation is always much more than a way to present just facts or information. Rather, it is a way to influence thought, and, as such, graphics can be a powerful mode of persuasion [14, 7].

Therefore, for the poster presenter, graphics are a powerful tool for attracting audience attention and effectively conveying important research information. To use such a tool in its highest capacity, the author, artist, or editor must evaluate what graphic design will or will not work for a particular collection of research material. An effective poster must combine and control the following attributes:

Horizontal Flow of Information

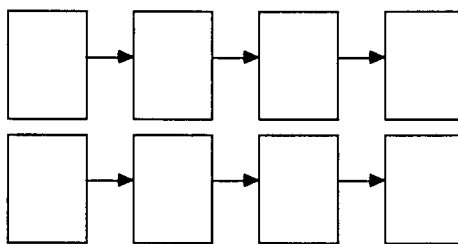


Figure 7. Poster elements that progress horizontally.

unity, balance, contrast, and meaning [14, 8], not only in each individual graphic, but also in the collective effect of all poster elements functioning as a single entity.

Simplicity and proportion are also important attributes of effective graphic design. Simplicity for visual display dictates that “each graphic must be simple in its design and confined to the main data” [16]. For effective poster display, “each graphic should be designed and proportioned to use the fullest area *as possible*, without appearing to be too crowded” [16, 76].

The following are technical guidelines for producing graphs, tables, and illustrations for a scientific poster.

Graphs

The primary purpose of graphs is “to show relationships among numerical values in clear, accurate, and effective pictorial form.” Visual shapes or curves in the form of a graph make a more lasting impression and are easier to remember than lists of tabulated material [17, 25].

- Bar graphs or histograms should have separated bars of the same width.
- Line graphs should be limited to 3 or 4 lines, each thicker than axis lines.
- Units should be defined on both x and y axes.
- Pie graphs should be limited to 6 wedges, with labeling on wedges (if possible).
- Contrasting colors or shading can be used.
- Graphical information should not be duplicated in the text.
- Graphics should each contain only one message, not a complex jumble of results.
- Graph size should relate to viewing distance.

Vertical Flow of Information

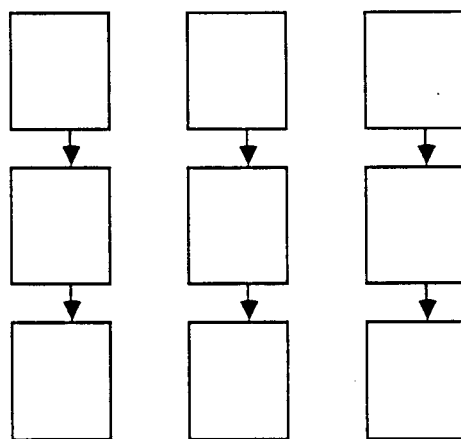


Figure 8. Poster elements that progress vertically.

Tables

Most style manuals agree on the following guidelines for tables:

- Column headings should be in singular, not plural, form.
- Rules should be horizontal, not vertical.
- Decimal points should be aligned in columnar material.

Balance

Achieving a balance between text and graphics is not always easy within a 4-ft \times 6-ft or 4-ft \times 8-ft poster area, but there must be a sense of equilibrium among the elements of a poster, so that “items in a visual field strive for balance . . . with other items in the field” [7, 71]. Such a balance is affected by “size, shape, lightness or darkness, and color” [11, 182]. On the heavy side of balance are large elements, circular or irregular shapes, and dark elements. These properties contrast with the lighter weight associated with small elements, rectangular shapes, and light-colored elements. Correct use of these elements is a matter of style, taste, and subtlety, and should not be “reduced to rigid standards,” but should create an optical balance [11, 182].

Attention must be given to the graphic design of the poster as a whole. The spatial limitations for pos-

ters can sometimes hamper creativity when it comes to mounting the elements on the poster board. It may be necessary to try several different element arrangements and to avoid letting frustrations influence the poster designer to accept just any arrangement of elements.

VISUAL PERCEPTION

In any visual display of information, the arrangement of elements, typography, design, and color all contribute to visual appeal and the effectiveness with which poster information is communicated.

Arrangement

Conventionally (in Western culture), the eye is drawn to start reading at the upper left corner and then to move from left to right, horizontally. The flow of information in a poster should be vertical or horizontal (Figures 7 and 8), but not both. Otherwise the reader may become confused about which way to go and may decide to move to another poster rather than try to figure it out. (Although it is not good practice to mix directional flows, if you must, put a large sequential number in the corner of each element.)

Some research material may be easily communicated by being placed in the "window area" or "golden rectangle" (Figure 9). According to Rubens, "both aesthetically and practically, any visual field is seen in terms of the 'Golden Rectangle,'" with visuals containing the most important information being placed in the upper left quadrant. Readers tend to lose interest between the upper left corner and the lower right area [3, 78]. However, this analysis may not apply directly to the scientific poster with condensed text and strong graphics because poster elements function individually, are separated by the mat color, and are viewed as separate entities linked together by a common focus.

Key points of research or results expressed in graphs, photos, tables, or figures can be highlighted by placing those components in the center "win-

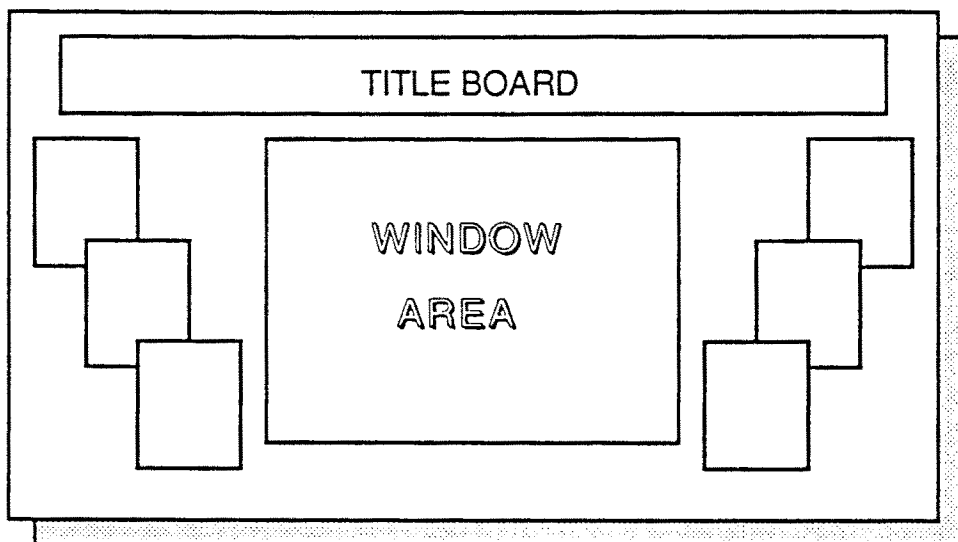


Figure 9. The poster session window area draws initial eye contact.

dow" of the poster presentation with supportive text arranged outside the window area [18]. This type of arrangement depends on the contrast material. Information placed in the audience's direct line of vision can have a high impact on audience perception [19].

Color

Color can be an effective element in scientific poster design, but overuse of color can also detract from a poster's overall effect. There are several interrelated functions of color that contribute to graphic communication. As listed by Turnbull and Baird [11, 233], color can—

- Attract attention
- Produce psychological effects
- Develop associations
- Build retention
- Create an aesthetically pleasing atmosphere.

Before poster production, the presenter should choose the poster mat color and a contrasting color for trim tape to frame each poster element (Figure 10). Color can also be used in bar graphs, flow charts, or diagrams. However, keep in mind that the "misuse of color in a message is worse, from the viewpoint of the communicator, than the use of no color at all" [11, 235]. To attract attention, ap-

ply color "to elements of greatest significance" [11, 233].

According to Turnbull and Baird, "one color plus black offers the greatest contrast, for a color is always its most intense with black." Also, they point out that warm colors (such as red, orange, and yellow) are higher in visibility than cool colors (such as predominantly blue colors). For an attractive scientific poster, however, it is better to keep the use of warm, vibrant colors to a minimum. Bright colors may detract from the significance of the scientific data being por-

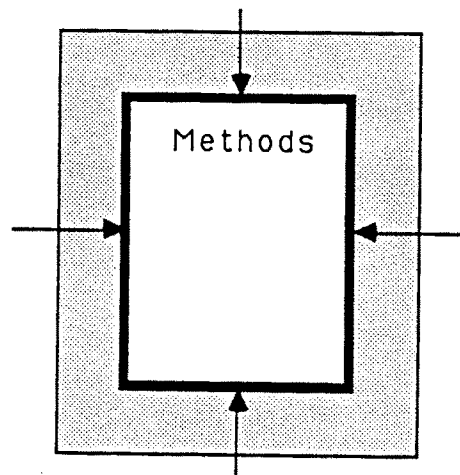


Figure 10. The poster mat board should have a consistent amount of frame around each pin-up element. Trim tape framing each poster element adds a coordinating complement and a neat appearance to the scientific poster.

trayed. Color should complement, not overpower, a poster's visual message; too much color "can create a weak communication" [11, 234].

OTHER CONSIDERATIONS

Handouts

Although producing a visually effective and informative scientific poster can be time-consuming, the task does not end there. A researcher who has spent a great amount of time completing a study and has overcome the challenge of presenting that study in a poster session should not let the audience go away empty-handed. Handouts are an important component of a successful poster session.

The presenter's handout should be just as carefully constructed as the poster itself. Handouts may present a condensed version of the poster with summary statements, tables and graphs, or a reproduction of the entire presentation in the form of a model page. As Tribe suggests, "If considerable information or background material is vital to transmit the whole story," convey that information in a handout [20]. References or a bibliography are also best reserved for a handout rather than taking up precious space on the poster.

Tribe also suggests that it is a good idea for poster presenters to "keep a notebook in which to note reviewers' names and addresses," and comments, "for later follow-ups" [20, 107].

Types of Posters

Many factors contribute to choosing a poster style: instruction from conference coordinators, available finances, means of transport, and means of production (self-produced or contracted to a professional graphic artist). The poster form itself is versatile, with four presentation styles to choose from: pin-up, tabletop, floor-standing, and roll-up.

- The pin-up poster consists of each element mounted on a separate mat board and is easy to transport. However, production time is increased

because a mat board must be cut to specification for each element, and all margins must be consistent between elements (Figure 10).

- The stand-alone tabletop poster may consist of three 2-ft × 4-ft panels that are connected at the back with special tape that will allow the poster to be folded for transport.
- Floor-standing posters require more expensive materials and require special transport.
- The roll-up poster is produced on a 4-ft × 6-ft (or × 8-ft) paper and then is laminated. It rolls up for transport and is pinned onto a cork board or other surface provided at the conference.

Other Comments

If scientific findings are presented in a poster soon after the research project is completed, the poster presenter has the advantage of seeking "immediate clarification about the research design, the instrumentation, or the analysis" [21].

A poster can be displayed several times and elements can be modified or replaced if there are extended findings or altered results and conclusions.

One final point remains: poster material should be proofread at every stage of production. Meticulous proofreading will help eliminate any potential problems and will save the presenter from much stress when production is in the final stage and when deadlines cause schedules to be rushed and hectic.

CONCLUSION

A visually effective and informative poster must be designed with regard to audience conceptualization. Integrating text and graphics within a limited space to convey a visual message requires detailed organization. Without professional assistance, the poster presenter must function as writer, editor, designer, and artist. In displaying scientific information, a poster functions "to give visual access to the subtle and the difficult—that is, the revelation of the complex" [22]; it

achieves this function through the pure form of a condensed, high-impact message integrating text and graphics. Ω

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