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Commentary

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Suggestions for Slides at Scientific Meetings

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The spoken message in a scientific talk is enhanced by well-prepared slides that are simple, clear, legible, and pleasing to the eye. Good slides can create visual images that endure in the audience's mind long after the speaker has finished.

Poorly prepared slides, however, detract from both the speaker and the intended message. Poor slides have features that hinder communication, such as small letters, too much text, dark images on dark backgrounds, outlandish colors, complex figures, or large tables. Poor slides create lasting images, too, but of an undesirable kind.

In an effort to encourage scientists to reconsider the effectiveness of their slides, we provide some guidelines for slide preparation. We hope that our opinions will stimulate speakers to prepare slides that enhance, rather than detract from, the spoken words (see Smith 1957, Toft 1998). First, we present our top 10 recommendations, in decreasing order of importance. Then, we offer six additional ideas that also should aid in preparing effective slides and talks.

TOP 10 RECOMMENDATIONS

1. Use sufficiently large letters.—We are convinced that attention to this one factor would solve most difficulties with slide legibility. Effective slides should ensure that each person in the meeting room, including the standing-room-only crowd in the back, is able to read the slide. This visibility goal must typically be achieved in a meeting room in which the width of the projection screen is about 1/9th the depth of the room. Conditions in meeting rooms vary considerably, of course; at the 1999 meeting of the American Ornithologists' Union in Ithaca, for example, ratios for four rooms that the AOU used were 1/7, 1/9, 1/9, and 1/11. The plenary session at the 1998 AOU meeting in St. Louis was held in an auditorium with a 1/11 ratio. The worst ratio that we have encountered at an AOU meeting was 1/15, in the 1994 Systematics session at Missoula. In this commentary, we accept 1/9 as an average room, but speakers will, at some time, encounter worse conditions; preparing for those worst-case scenarios would require even larger letter sizes than we recommend below.

Given the goal of reaching the audience in the back of an average meeting room, we determined preferred letter sizes empirically by surveying attendees of the poster session at the 1999 AOU meeting in Ithaca. We first prepared a figure in the standard 2×3 landscape format; on this figure were different letter sizes, with the smallest lowercase letters ranging from 1/15th to 1/50th of the height of the slide (Fig. 1). We next asked viewers to step back to a distance nine times the width of the figure, as if viewing the slide from the back of the room, and choose the letter size that they would prefer to see in slides at a meeting. Our survey revealed that the majority of viewers (71 of 138) preferred the largest letter size that we offered, and that 99% of viewers (136 of 138) preferred lowercase letter sizes that were at least 1/25th of the height of the slide (Fig. 2).

A previous survey, at the 1991 Northeastern Regional meeting of the Animal Behavior Society, revealed similar results. At that meeting, however, we had asked viewers not what their ''preferred'' letter size would be, but rather what would be the ''minimum'' letter size that they would be willing to read. Of 66 viewers, 86% chose letter sizes of 1/25th or larger, and 12% were willing to read letter sizes as small as 1/30th.

These preferred letter sizes are much larger than those that we observed in slides at the 1999 AOU meeting (Fig. 2). To measure letter sizes in slides, we placed reference markers beside the projection screen in several meeting rooms. Using our binoculars, we then estimated the size of the smallest letters (excluding obviously unimportant text) on the fifth slide in each of 55 talks. If the fifth slide contained no text, we made our measurement on the next slide that did contain lettering. Observed letter sizes were much smaller than preferred sizes; 55% were 1/55th of the height of the slide or smaller and no measured letter was larger that 1/30th of slide height. The distributions of preferred and observed letter sizes were essentially nonoverlapping, with lettering in many talks so small that reading it from even the front of the room was difficult (Fig. 2). Put another way, if the

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FIG. 1. A simulated slide, projected horizontally in 2 × 3 format, for choosing preferred letter sizes in slides. Letter size (in parentheses) is the height of the smallest lowercase letter divided by the height of the slide. To simulate viewing this slide from the back of an average meeting room in which the room depth is nine times the width of the projection screen, hold the slide 61 cm (24 inches) from your eyes. Then choose the letter size that you would prefer to read in slides.

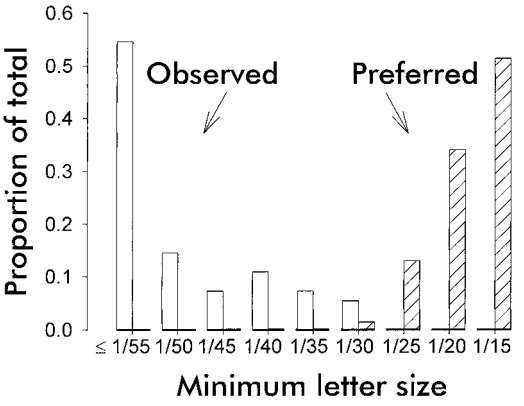


FIG. 2. When reading slides, viewers prefer much larger letter sizes than typically are observed at scientific meetings. Preferred data were collected in a survey of 138 participants of the 1999 American Ornithologists' Union meeting in Ithaca, New York (see Fig. 1); observed data were from estimating letter sizes from one slide in each of 55 talks at the same meeting.

138 viewers of our poster had each evaluated the 55 projected slides, 99.9% of their 7,590 viewing opportunities would have been unsatisfactory.

Given viewers' strong, unequivocal preference for large letters, we are mystified by speakers' insistence on using slides with unreadably small letters. Clearly, a speaker who wishes to communicate with his or her audience should use slides with letters that are large enough to be legible to all viewers.

Suppose that one wanted to make a slide in which the smallest letter was 1/20th of the height of the slide (realizing, however, that many members of the audience actually prefer even larger letters). On original artwork in 2 × 3 format (to be projected horizontally; see item 6), one would measure the height of the figure, and divide by 20; the resulting value represents the height of the smallest lowercase letters. On a 20 × 30 cm figure, for example, the smallest lowercase letters should be 20 cm/20 = 1 cm high. Realize, however, that original artwork in other than 2 × 3 format will still be projected in 2 × 3 format, and letter size must be calculated accordingly. If the artwork is 10 cm high and 30 cm wide, for example, or 20 cm high and 10 cm wide, the minimum letter size is still 1 cm.

Implementing a "1/20th rule" is also simple if one prepares slides with a program such as Microsoft PowerPoint. If the "page setup" is 5 inches high by 7.5 inches wide, a standard 2 × 3 format, then 30-point type is appropriate, because lowercase letters at this type size are about 5 mm high, which is roughly 1/20th of 5 inches. One clearly should not blindly accept the default font size suggested by PowerPoint or other software.

Following a 1/20th rule means, of course, that artwork prepared for paper publication is rarely adequate for projection. Minimum recommended letter sizes for published figures are about 1.5 mm, regardless of figure size. Hence, a 3.0 × 4.5 cm figure would have good letter sizes for both publishing and projecting (figure is in 2 × 3 format, and 1/20 × 3.7 cm = 1.5 mm). Most published figures are far larger than 3.0 × 4.5 cm, however, and the letter sizes are therefore far too small to use in a slide. (Published artwork is also undesirable for a few other reasons; see item 17.)

Most of the speakers we talked to at the AOU meeting were surprised at how small the lettering was on their slides. As a test of your own slides that you have used in a talk, we urge you to project them and measure the letter sizes directly on the projected image. If they fall outside viewers' preferred sizes (Fig. 2), adjust future slides accordingly.

2. Use an appropriate background for slides.—On this topic opinions of speakers run strong: "A blue background is important, because blue is the most friendly color." "White is boring; color of some kind must be used, because the younger generation demands glitz." And so on.

When deciding on a background color, remember that the slide should be legible in the variety of imperfect conditions under which it is likely to be projected during its useful lifetime. Will it be legible, for example, when projected either in a darkened room or in a well-lit room without curtains? Will projectors with dim bulbs beam a legible image to the screen? Will the slide be legible to those standing in the back of a huge auditorium in which a small im-

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promptu screen has been placed on stage? A speaker who wants to communicate with an audience prepares as well as he or she can for the full range of possible conditions.

All things considered, we believe that dark lettering on an off-white background, such as that generated by color film exposed to a white background, maximizes the usefulness of the slide under the greatest variety of conditions (see Smith 1957, Toft 1998). Light backgrounds on slides also enable room lights to be only dimmed, so that you can see your audience and the audience can see you. Such conditions enable eye-to-eye contact, which enhances communication.

We have additional reasons for making this simple recommendation. First, we choose to avoid the popular gradient backgrounds, because the gradient is decorative information (i.e. non-data ink; Tufte 1983) that detracts from whatever should be the focus of the slide, and because most gradients also provide a gradient of good to poor contrast with the essential information on the slide. Second, slight differences in background colors and room conditions can create unpredictable results. In a darkened room, for example, light letters shimmer annoyingly against a dark blue background, but contrast is greatly improved with some room lighting. Knowing that speakers rarely have control over room conditions, we recommend what we consider to be a fail-safe approach. Third, we see some truth in Toft's (1998) conclusion that an inverse relationship exists between the gaudiness of slides and the scientific merit of the talk. For other thoughts on colors, see point 3, below.

3. Use color thoughtfully.—Use of color certainly can enhance communication, and well conceived placement of one or two colors, especially when consistent from slide to slide, can help emphasize a point or illustrate a contrast. Unconsidered or indiscriminate use of color, however, can distract from communication of an idea. Gratuitous or purely decorative use of color, especially the use of many colors in one slide, will inevitably hinder viewer understanding by drawing attention from the slide's message and/or by presenting more information than the viewer can easily comprehend at one time. Also, color combinations that are attractive and readable on a computer screen do not necessarily translate to readable colors in a slide; even professional graphic designers have difficulty predicting how screen colors will be rendered on film, and professional ornithologists who are amateurish artists have even more trouble. Use of red lettering on noncontrasting backgrounds is especially difficult to read, as evidenced by the large number of complaints on this topic at our poster at the Ithaca AOU meeting. Remember, too, that as many as 1 in 20 members of the audience might be color blind and unable to see a color code.

Our main point is simple. Being creative and achieving effective contrasts between backgrounds and letters is so difficult that the only fail-safe approach is to use well-established, well-tested combinations. We recommend that speakers inform the audience with the scientific substance of the talk, not try to impress them with ''extraneous gaudy colors and fancy patterns screaming outrageously from the slide's background'' (Toft 1998:S70).

4. Strive to avoid tables of numbers.—If a table of numbers must be used, perhaps because the absolute values of the numbers are crucial, then use sufficiently large letters, such as with a $1/20^{th}$ rule. Show only the relevant numbers in a size that is legible throughout the room. Remember, however, that the human mind sees and remembers trends in figures far more readily than in tables, and that effective communication of a point is more likely to be achieved with a figure than with a table of numbers.

5. Use literal (text only) slides effectively.—Above all, use sufficiently large letters, such as with a 1/20th rule. Doing so will force you to use only a few key ''punch'' words on which you and the audience can focus. Longer passages of text on a literal slide are also undesirable because they can be read (if legible) by the audience far more quickly than the speaker can read them aloud. Whether the speaker reads the text or not, a mental conflict in the audience inevitably arises between listening and reading, with neither done effectively. Also, use upper and lowercase letters in these literal slides, not all uppercase, because a mixture of the two is more readable. Consider using progressive disclosure, too, in which more and more of a text (outline) is provided as you proceed through a topic (this approach can also be used for nonliteral slides).

6. Use 2 × 3 format, projected horizontally.—If all slides are horizontal, the projection area can be used more efficiently, because the projection area is often smaller when it must be adjusted to accommodate both horizontally and vertically projected slides. In addition, with no vertical slides, the horizontal slides can all be projected on the top part of the screen so that more members of the audience will be able to see the slides; this reason becomes especially apparent in hastily improvised meeting rooms where the screen is only slightly higher than the chairs. Also, projectionists at some meetings are given specific instructions to adjust the projector for horizontal slides and not to readjust the projected image to accommodate the few vertical slides that might be encountered. Consistent use of 2 × 3 format thus makes most efficient use of the projection screen and maximizes the probability that the audience will actually see the prepared images.

7. Use sans serif fonts.—Although readability studies show that serif fonts such as Times Roman are more legible in text printed on a page, sans serif fonts project better in slides. Sans serif fonts such as Arial or Helvetica contain bold, solid legible letters and are the most forgiving under projection conditions that

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are often less than perfect. If you doubt this conclusion, try printing two identical text paragraphs, one in a serif and one in a sans serif font, using the same point size, of course; when viewing these two paragraphs from a distance, you will undoubtedly confirm that the sans serif font is more readable.

8. Label graph elements directly.—Avoid legends or keys for labeling bars, lines, points, etc. on graphs. Using a key or legend to identify parts of a more complex, published figure may be appropriate in a journal article, but it is less so for a projected image. In a projected slide, a person in the audience must first read the legend, match the legend with the type of line or shading used to identify a particular feature, and then remember the relationship and search for that feature in the image. If bars or lines are labeled directly, the effort of the audience is minimized; the message will therefore be communicated more effortlessly and efficiently, and the audience (and speaker) will benefit accordingly.

9. Be consistent in the style of all slides.—If a talk is viewed as a coherent, continuous flow, then one wants consistent slides throughout, too. Consistency in style will include background color, style and size of lettering, choice of colors to enhance some messages, labeling of axes, use of titles, and so on. Developing a style and sticking with it also enables one to mix slides prepared for different talks, all the while maintaining a coherency and consistency within any given talk.

10. Keep the slide simple.—Each slide should contain one main idea, or two at the most. In a glance, the audience should appreciate the message of the slide; ideally, then, after only a few seconds, the focus of the audience is back on the speaker, who is orally guiding the audience through the significance of the projected image. An audience that must linger on a complex slide is not listening to the speaker. Slides can be much simpler than published figures; a slide does not have to be entirely self explanatory, because the speaker is there to explain the slide.

Six Additional Recommendations

11. Add a title to each slide.—Titles provide an immediate focus for the audience. Titles should be just a word or two, perhaps in all capital letters, that instantly guide the audience to the topic or take-home message of the slide. Unlike a legend for a published figure, this slide title does not have to be entirely self explanatory.

12. Axis labels should be short and legible.—Follow, at minimum, a 1/20th rule. To avoid twisting the heads in the audience, consider using a horizontal label on the ordinate, too, such as at the top of the y-axis. Carefully weigh readability versus use of space.

13. Organize the talk around the slides.—Just as a manuscript is often written around the already-prepared figures and tables, a good oral presentation is often prepared around the slides. One first determines the major points of the talk, then develops a slide for each of those main points, and, last, fleshes out the talk around the slides. In a short talk, try to keep a fairly constant pace, with slides and accompanying main ideas coming at the same pace throughout the talk. In longer talks, however, varying the pace could help to keep the attention of the audience (J. Hailman pers. comm.).

14. Use humor to make a point, not for humor's sake alone.—Humor in slides fails more often than it succeeds. If humor fails, the audience is more likely to laugh at you than with you.

15. Don't use published figures as slides.—Published figures usually don't project well. Besides having letter sizes that are too small (see item 1), published figures typically don't have titles, but slides could/should. Published figures are often complicated and contain more than the one idea that is desirable for slides. Also, legends for published figures are rarely legible when projected.

16. Be prepared to give your talk without slides.—Two types of speakers appear at meetings, those who have had a projector fail them and those who will experience such a failure in the future. Prepare in advance to give your talk in a professional manner without your slides; failure of the projector then becomes an opportunity, not a disaster.

Summary

We provide here a short list of opinions gleaned from our experience and a variety of sources (e.g. Smith 1957; MacGregor 1979; Tufte 1983, 1990; Woodford 1986; Council of Biology Editors 1988; Hailman and Strier 1997; Toft 1998).

1. Obey, at minimum, a 1/20th rule for letter size, without exception.
2. Use dark images and lettering on light (white, even!) backgrounds.
3. Use color only to enhance, not decorate, a message.
4. Prefer figures to tables.
5. In literal slides, use upper and lowercase letters, and use just a few key words.
6. Use all 2×3 format slides, projected horizontally.
7. Use sans serif fonts, such as Arial or Helvetica.
8. Label graph elements directly, without legends or keys.
9. Be consistent in the style of all slides.
10. Keep the slide simple.
11. Use a brief title for each slide.
12. Label axes simply and legibly.
13. Organize the talk around the slides.
14. Use humor only to make a point, not for humor's sake alone.
15. Do not project published figures (or tables).

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16. Be prepared to give your talk without your slides.

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