

Office of Naval Research

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Tips for Preparing and Delivering Scientific Talks and Using Visual Aids

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INTRODUCTION

"Before I speak, I have something important to say" - Groucho Marx

From graduate school to retirement, giving and hearing oral presentations is part of the fabric of scientific professional life. Although scientific talks are accepted means of accomplishing the exchange of knowledge and information that is essential to scientific endeavor, the consensus of the community seems to be that far too many bad talks are given. If talks are not of the highest caliber, in both content and delivery, the communication is flawed; science is not properly served nor facilitated. Lack of public speaking skills can also have serious negative consequences on an individual's career.

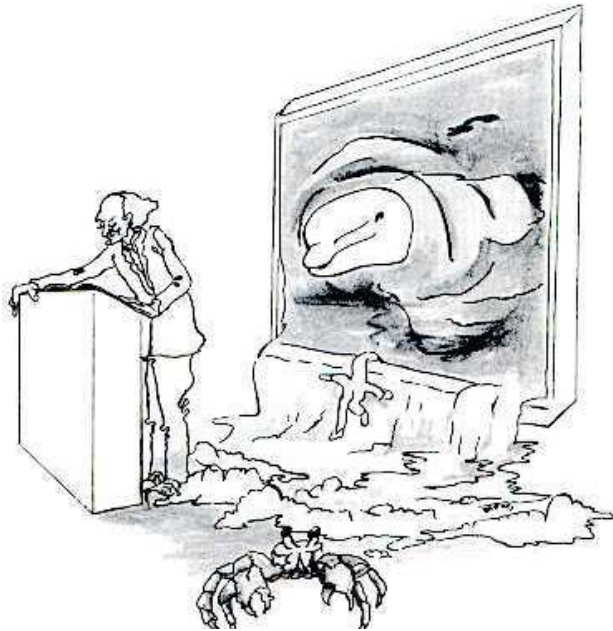
To improve the flow of information among scientists, this publication attempts to provide advice and observations on preparing and delivering a scientific talk. Many of the points apply to any public speaking situation, but many are unique to a scientific environment. The focus here is on the invited presentation, but impromptu and contributed talks could also benefit from incorporating several of the suggestions.

We hope it will be of value to the scientific community. Future talks will tell.

Studies show that we retain much more of what we see than what we hear. If so, why give oral presentations at all? Why not simply prepare handouts, distribute them to an audience, wait while the information is read and call for questions? There are several reasons besides "that's just the way it's done." We mention a few of the primary ones in this introduction. Thinking about why you give an oral presentation should help in defining how to give a good talk.

Studies further show that we retain best what we see and hear together. A scientific talk is an opportunity to show and tell. If done properly, it provides your audience with knowledge presented in a way that best enables them to absorb and retain it.

Oral presentations are interactive experiences between the audience and the speaker. The speaker presents himself or herself, as well as the talk, to the audience. The speaker and the audience exchange signals. A speaker brings the subject to life for the audience through personal involvement and familiarity with it. Good interaction with the audience helps the delivery and aids the retention of the material by the audience.



A speaker brings the subject to life for the audience ...

The audience has an opportunity to *meet* the speaker. For some members of the audience, there can be excitement in personally hearing a recognized authority in a given field. An introduction to a newcomer or lesser known individual with something innovative and relevant to discuss can also be interesting.

THE COMMITMENT

"A speech is a solemn responsibility. The man who makes a bad thirty-minute speech to two hundred people wastes only half an hour of his own time. But he wastes one hundred hours of the audience's time-more than four days-which should be a hanging offense" -Jenkin Lloyd Jones

Agreeing to give a scientific talk implies a commitment to the audience. This means making your best effort to be interesting and informative. *If you are not willing to make that commitment, you should not accept an invitation to speak.*

The commitment includes proper preparation of your talk and visual aids, as well as attention to delivering your message in the most effective way possible. It is easy to identify the speaker who is genuinely pleased to have the opportunity to share ideas and appreciates the audience's time and attention. This speaker skillfully and confidently delivers a clear, concise talk that is responsive to the audience's needs and level of understanding. An audience is entitled to expect that respect from every speaker.

We have all seen scientists who apparently believe that the science they present when speaking in a professional environment is all that is important ("the data speak for themselves" syndrome). Nothing else matters if it is "good science." They are scientists, not showpeople, right? Wrong. You have to be both for the audience to absorb and retain the most from your scientific presentation. You present yourself as well as the subject matter every time you stand in front of an audience. This is not to say that a polished delivery is more important than content, but *how well you present your material directly impacts how well it is received.* Acknowledging this fact is a large part of the commitment you make in agreeing to speak.

When addressing your peers and colleagues, it is in your best professional interest to take the commitment very seriously. Bad talks reflect poorly on your competence and/or demonstrate an enormous ego and disregard for your audience, any and all of which will not improve your standing within your professional community.

PREPARATION

"I'm rather like a mosquito in a nudist camp: I know what I ought to do, but I don't know where to begin." - Stephen Bayne

The Book of Lists tells us that public speaking is the Number One human fear (death is sixth). Of all speaking situations, professional talks can understandably be the most stressful because colleagues, peers, current and potential bosses, as well as funding agency representatives, will be judging you and your presentation. Having reminded you why any sane individual is justifiably anxious when faced with giving a scientific talk, we will also remind you that with proper preparation you can make certain that your time at the lectern will be a professional asset.

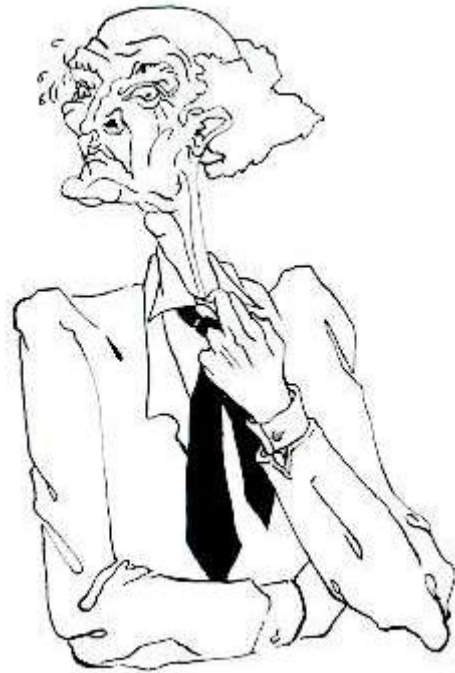
We stress and re-stress preparation here because it is an area of extreme vulnerability in scientific talks. Familiarity with your subject and confidence in your research is not enough to give a good oral presentation. Those factors can, in fact, work against giving a good talk. They can produce a false sense of security, make you careless in your preparation and let you take too much for granted with your audience.

You are invited to speak because someone believes that you have knowledge worth sharing and assumes that you are a competent enough public speaker to effectively communicate that information. The principles of good public speaking apply to scientific presentations as much as they do to political rallies or testimonial dinners. Speakers who believe their credentials and knowledge of the topic negate the need for proper preparation and the development of public speaking skills can convey only part of their messages. If your talk is not well prepared and you do not deliver it in a manner that gains and holds the attention of your audience, much of the knowledge you hope to share will be lost.

Assessing the Audience

An extremely important part of effectively communicating what you know is tailoring your presentation to your audience's needs and level of understanding. The very first step in preparing an invited oral presentation, then, is to learn as much as possible about your audience. This will often be self-evident, but if in doubt, ask questions.

- How large will the group be?
- Are they experts in your field?
- If a combination of experts (colleagues in your specific field) and nonexperts (all others), what is the anticipated ratio?
- If a group of nonexperts, what are the age range and educational level?



... public speaking is the Number One fear ...

It is easier to speak to either all experts or all nonexperts. If the entire audience is expert in your field, you speak to them as insiders and have an opportunity to dazzle and excite them with your knowledge and enthusiasm. If it is a group of nonexperts, you can still dazzle and excite them, but you must adjust the scope and level of your material, which may require a lot more thought and effort than you might anticipate.

A big problem for scientific speakers arises when addressing a combined group of experts and nonexperts. As an expert, it is insulting and a waste of time to be "talked down to;" as a nonexpert, it is frustrating and a waste of time to be subjected to a talk that is beyond one's level of comprehension.

To strike a happy medium in such a situation, try to accommodate both levels of understanding with a carefully crafted compromise from which everyone gains something. One useful suggestion is to devote half to two-thirds of your time to an introduction or overview of your subject and save the highly technical material for the remaining time. Nonexperts understand and learn from the first part and experts comprehend and are attuned to the technical information. Experts may also gain new insights on how to present the subject to nonexperts.

Another useful approach is to give the more involved technical material, then to summarize with "in other words..." or "by analogy..." when you restate the information in simplified, plain English. These brief summaries should be done throughout the course of your talk and often enough to prevent those not following the technical information from drifting off.

This publication is aimed primarily at scientists giving talks to other scientists. Please see the section entitled "[Addressing a Nonscientific Audience](#)" toward the end of this text for a few pointers on giving a scientific talk to a lay audience or the media.

Fitting Into the Program

When your topic is determined and/or agreed upon, also ascertain the date, time and place of the talk and how long you will have to speak. Mark the speaking date on your calendar when you commit to a talk, along with any other deadlines associated with the speaking engagement. That sounds completely obvious, but many can tell you of the embarrassment and irritation resulting from misunderstandings or forgotten commitments. Request a written confirmation of the details to verify what is expected.

In preparing your talk, it is important to have a clear understanding of how your talk will fit into the total program and how it should mesh with any other related presentations. It is very unnerving to hear the speaker(s) before you cover much or most of the material you intended to cover or to have prepared an introductory talk and learn only minutes before you take the podium that you are responsible for the summary and conclusion.

Ask questions about the program.

- Is the program focused on one discipline or is it designed to give a cross-disciplinary or multidisciplinary view of the topics?
- Will there be other talks on similar or related subjects?
- At what point in the program will your talk be given?
- Is a written summary of your talk or abstract required?
- What are the size and layout of the presentation room?

This is very important information when preparing visual aids.

If you are to be the first speaker in a series of talks on related subjects, your presentation can appropriately include definitions, underlying assumptions, historical background or other introductory material. If you are the final speaker in the series, summaries and conclusions are appropriate. If you are a middle speaker, it is reasonable to assume that the introductory material will have been covered before you reach the podium. To be on the safe side, however, it is wise to have a few notes to help you quickly fill any possible gaps.

Extra challenges are presented to speakers who are slotted right before lunch, right after lunch, at the end of the day and at the end of the meeting. These are times when a dash of the theatrical or some humor is helpful in capturing and holding the audience's attention; but don't overdo it.

Content

Before you can begin drafting a talk, you must define the purpose, topic and appropriate depth and scope of the information you will be presenting.

- The primary purpose of the scientific talk is to inform or instruct. You may also subtly try to persuade and even entertain your audience, but don't lose sight of the primary purpose.
- Your topic is defined within the invitation to speak and within the context of the rest of the program.
- The depth and scope of the scientific content are determined in large part by the audience profile and the time allotted you and not by the topic or the speaker.

Many scientific speakers make the mistake of overlooking the fact that effective communication requires both the sending and receiving of information. Part of the speaker's job, then, is to help put the audience in the "receive mode." A good speaker's fascination with the subject is transmitted to the audience and captures their interest to gain their full attention.

In preparing your talk, ask yourself a few questions. Incorporating the answers into your talk will help you bring your subject to life and make your talk worthwhile and memorable.

- Why would other scientists be interested?
- How can I generate excitement for my subject in someone without knowledge and involvement?
- How might other disciplines or other research areas within my own discipline use this information?
- Is there a research or teaching anecdote I could include for emphasis, added interest or humor?

The hallmark of any successful scientific talk is clarity. To achieve clarity, the talk must be well organized and logically structured. It should have an introduction, a body and a conclusion. The language must be concise. Audiences are annoyed, irritated and frustrated by talks they cannot understand. You may have something very important to say, but audiences seldom will struggle to find it.

Inexperienced speakers often make the mistake of trying to cover far too much material and providing excessive detail in one talk. They are also prone to overly long introductions and spending too much time discussing methods. It is generally wise to edit the introduction ruthlessly Give only the necessary details regarding methods (unless, of course, your talk is on methods). Narrow the focus rather than try to cover a large, complex topic with generalities in a short period. Even when the program specifically calls for an overview, pull out one or two points to discuss in as much detail as time permits. If you showcase one or two points that support or exemplify the generalities, your talk will be much more interesting and more easily retained.

Math, equations and symbols do not necessarily strengthen the science of a scientific talk but they do slow the pace, make it harder to understand (even for experts) and create an opportunity for confusion, the opposite of "clarity."

Many people, even mathematically trained scientists, tune out when math is introduced into a talk. If equations, calculations and symbols are essential for understanding your topic, consider preparing handouts for later study. You can then concentrate on explaining the *relevance* of the mathematics and symbols rather than using your allotted time at the lectern on the equations and their solutions.

If you must use mathematics in your presentation, *slow down*, and talk the audience through each equation, step by step. Do not assume each individual can find a way through it and grasp the relevance.



If you must use mathematics in your presentation, *slow down*, and talk the audience through each equation ...

Although scientific topics are serious, a little politically correct humor or an occasional light touch can vary the rhythm and significantly add to the audience's favorable reaction and memory of your talk. Don't go overboard, however, nor use this time to debut your stand-up comedy routine.

Drafting the Talk

There are mixed views on whether or not it is advisable to write out every word you plan to say.

Those opposed to a complete written draft offer the following argument. In some nonscientific environments it is quite acceptable to read a prepared talk verbatim. The accepted style in scientific meetings, however, is to convey that you are completely familiar and comfortable with your material and that you are able to speak more or less extemporaneously on your subject. A few notes or an outline and some visual aids should suffice for those who know what they are talking about. A word-for-word draft may inhibit that conversational style. This approach probably does work for some, but it is quite risky for most of us asked to speak clearly and concisely on a specific topic for a specified time.

Proponents of a complete written draft maintain that the exercise can greatly improve the effectiveness of any speaker. The primary objective of a scientific talk is clarity, which is achieved through concise language, logical sequence and careful organization. A rich vocabulary facilitates the painting of vivid, attention-grabbing word pictures. Such precision, order and verbal vibrancy can be accomplished far better with written language than with informal speech. But don't be overly constrained by the strict rules of written English or the formal academic style of scientific papers because the next step in the drafting process is to translate the written science into spoken science. The two are quite different. It is difficult to captivate an audience with a talk given in *scientific journalese*. With a well-prepared written draft you can fine-tune and rehearse your talk into a dynamic, vital presentation, complete with the desired conversational style.

If the latter method of preparation appeals to you more than the casual approach of the first method, write out your complete talk, practice it, then whittle it down to outline form or notes to take to the lectern. Your visual aids can also serve as notes, but be very careful not to fall into the trap of merely reading your visual material to the audience in lieu of giving the talk.

Consider the following guidelines in drafting and editing your talk.

- A good talk has an introduction, a body and a conclusion.
- Make every word count.
- Remember you are writing for the ear, not the eye. People do not speak the way they write.
- Use simple, direct, active words.

- Strive to keep the non-technical language as straightforward and uncomplicated as possible.
- Simplify your phrases.
- Tighten your sentences.
- Never use a long word when a short one will do.
- If it is possible to delete a word without losing meaning, delete it.
- Use equations, math and symbols sparingly and carefully.
- Almost by definition, scientific talks contain many facts and data, so it is a good idea to summarize. Summaries can be done as you progress through your talk or at the end, when visual summaries are particularly effective.

Death (or Worse) to Those Who Run Overtime

"Be sincere; be brief; be seated." - *Franklin D. Roosevelt*

It is rude and egotistical to exceed your allotted time. Running overtime also suggests a lack of preparation and experience. A good chairperson can justifiably be quite abrupt with a speaker who exceeds the allotted time.

Defining the scope and roughly organizing your material to fit within the specified time are among the first steps in preparing your talk. Granted, it is difficult to edit what might represent a life's work into 20 to 30 minutes, but, remember, other speakers face the same dilemma and most somehow manage it. Conversely, many inexperienced speakers wonder, "How on earth can I possibly have enough to say to fill 20 to 30 minutes?" To avoid the humiliation of appearing to have little worthwhile to contribute, they prepare overly long talks and do not rehearse enough to get the timing right.

Never try to squeeze your 30-minute talk into a 20-minute speaking slot. Speaking as fast as you can and flashing through your visual material at the speed of light is not the way to condense your talk into the specified time. Your audience will be annoyed and will absorb little of your presentation. Preparing a short talk can be a very constructive exercise for the scientific speaker. The short time allocated will force you to assemble your talk very carefully, to be a severe editor of your words and to be an exacting critic of your visual aids. Every word must count. Every table, equation or figure must specifically and significantly contribute to the points you are covering. Good editing skills and objective scrutiny of your visual aids are essential to preparing a good short talk. They are talents that also will serve you well in preparing all your oral presentations.

Many public speaking authorities recommend preparing a talk that is a few minutes shorter than your allotted time. When you reach the podium, you will need the extra time to adjust the microphone, respond to the person who introduced you, position your visual materials or make an ad hoc comment about a preceding talk. It is better to conclude with a little time left over than to rush at the end (when you are making your final points or summarizing) or, heaven help you, to run overtime.

One very useful technique to help stay within your allotted time is to have one visual piece that can be shown at any time and used to deliver your closing message or summary. It should take no more than three minutes to get through. When you are three minutes from your time limit, show this piece. Introduce it by saying something to the effect of, "If you continue with the details or data as I have been describing them, you finally arrive at this clear set of conclusions."

Even if you find that you have run out of time, never, never close your talk by saying, "I think I'll stop here." It sends a loud and clear message that you have not adequately prepared. A few, brief words of conclusion or summary are far better than leaving your audience thinking that you just ran out of steam or lost interest in your subject.

Practice, Practice, Practice

Accomplished public speakers advise that rehearsals are almost as important to a good oral presentation as the actual text of the talk.

It is not enough to read through your talk a couple of times. Things that read very well can sound very awkward. Speaking aloud, while standing in front of some type of audience (spouse, friend or colleague) who will give you honest, constructive feedback, will help you find the rough spots so you can smooth them out before you are on the podium. Rehearsals, with visual aids, are also essential to timing your talk properly and achieving the comfortable, confident, conversational style considered good form in scientific circles. Another valuable rehearsal technique is to tape-record your talk. Listen to the entire presentation without your notes. Do your thoughts flow logically? Are the transitions smooth? Do you vary your voice and your pace for emphasis, to avoid monotony, and as you transition to new thoughts? Do you hear any "ers," "ahs," "ums?"

Videotaping a practice session is the Rolls Royce of rehearsal techniques. Many people loathe seeing (or hearing) themselves on tape, and it does take more time and effort, but it is a guaranteed method for polishing your presentation to award-winning quality. Run the tape first and just listen, as though to a voice tape (above). Run it again and watch for these things: Do you make eye contact? What are your hands doing? Do you smile occasionally? How is your posture? Do you notice any distracting mannerisms? This method of critiquing your presentation, while somewhat painful, is brutally honest and, therefore, extremely valuable.

Practice with your visual aids. Many speakers undermine their own talks through clumsy handling of visual materials. Practice pointing to the image on the screen and turning back to the audience. If using transparencies, practice positioning the sheet, then stepping out of the way so your body does not obstruct the audience's view. If possible, practice in a room that is close to the size of the room in which you will deliver your talk.

It is very important to rehearse a talk that you have given before, especially if it has been some time since you last gave it. Concentrate on making it sound fresh and new,

for your sake and that of anyone in the audience who may have heard it before. Check information in the text and in your visual aids that may need updating.

If a speaker ready room is provided, use it! Practicing in the actual presentation room is best. You may have practiced your talk fifty times at home or in the office, but you can benefit enormously from one last run-through in the actual presentation room or one similar to it. Such a rehearsal will provide several benefits:

- You will have an opportunity to view your visual aids from the rear of the room to determine if they will be clearly visible to the entire audience. If any are dim, blurred or illegible, and if time permits, redo them. If there is not time to redo them and if you can do without them, discard them. If you feel you absolutely must include visually deficient materials, know that you will need to expand your comments on those particular pieces to make up for the poor graphic quality.
- You will have one more opportunity to check the order of your visual figures.
- Familiarity with the speaking environment will increase your confidence.

Transforming a talk into a good or outstanding talk takes time. There is no way around it. A lack of practice will be very clear to your audience and will be interpreted as a lack of commitment, professionalism and/or competence.

Dress

Scientific meetings and gatherings generally permit more latitude in what is considered appropriate attire than do bankers' or lawyers' conferences. Like it or not, however, we are all judged in part on our appearance. Extremes, either too casual or too overdone, are not good ideas if you have a speaking role at a gathering.

Play it safe, use your common sense and, remember, neatness always counts. If you err, it's wiser to err on the side of being slightly overdressed rather than underdressed.

Special Requirements

As a matter of courtesy and to minimize on-site aggravation and inconvenience, it is wise to inform those responsible for your speaking engagement of any special needs you may have. If, for example, you use a wheelchair and need assistance to be lifted to a stage, extra maneuvering room on the stage, projection equipment positioned at a particular height or a lapel microphone instead of a lectern mike, let someone know in advance. It is generally quite simple to accommodate such requirements in advance whereas last minute adjustments can be awkward.

Handouts

Handouts are often advisable due to the complexity of many scientific topics or the time allotted for the talk. They can reinforce important information, provide summaries and reading lists, and supply supporting data such as math, detailed relational or

organizational information, etc., that would be difficult or unnecessary to present within your talk.

You can distribute handouts before, during or after your talk. There are advantages and disadvantages to all three so you must consider what you hope to accomplish with the information provided to determine when to give it out.

If there is material in your talk that does not lend itself to visual display on the screen but that is important to follow while you speak, distribute the handouts before you begin speaking. If possible, have them in place when the audience enters the room. This will allow them to read the information before you begin speaking. People who are reading are not fully listening, so if your printed materials cannot be distributed until you take the podium, wait a couple of minutes while the audience looks over the information before you start to talk.

Distributing handouts during your presentation is tricky. Pass them out quickly and make certain they are relevant to the point you are discussing. No matter how quickly the distribution is accomplished, the audience will be distracted and you will lose some of your momentum. This is the least favorable time to distribute materials, but occasionally it is the only appropriate time to do so. Just be aware that you will have to recapture your audience's attention and get yourself back on track.

If you decide to distribute the printed materials after your talk, let your audience know during your presentation. Tell them what information is covered in the handouts, which will encourage them to listen instead of dividing their attention by taking unnecessary notes.

Visual Aids

Many public speaking experts contend that visual aids ruin more speeches than they improve. In the introduction, we noted that human beings retain best what they see and hear simultaneously, so how is it that visual aids often fail to improve a talk?

The answer lies in the fact that there is a right way and a wrong way to prepare and present visual materials. Visual aids are vehicles for enhancing or facilitating the understanding of your spoken words. If they do not fulfill that purpose, they are misused. Visual material if properly used will give clear visual insights that would require many words or columns of numbers.

The more prevalent the use of visual aids has become, the more they are overused and misused. Improper use seems, unfortunately, to have become almost the accepted standard. Complex scientific topics often are improved by or require visual aids, but some speakers appear to mistakenly believe it is impossible to give a scientific talk without them - lots and lots of them jam-packed with barely legible data, graphs, figures, mathematics, acronyms and fragmented verbiage - which is not the way to use the vehicle. Some speakers even prepare a visual piece for the title of their presentation!

A visual aid becomes the focal point for the time it is in view. An audience's attention is quite naturally drawn from the speaker to anything that is put on a screen, blackboard or flipchart. Since they automatically assume center stage, it is vitally important that all visual aids clarify and support your talk in an attractive, comprehensible manner or they will detract from it and compete with it. Another thing to keep in mind is that, for many, a darkened room is an invitation to doze. It is much easier to lose your audience when the lights are low, so be sure your visual material is compelling.

In all but impromptu talks, poorly designed, haphazardly rendered and badly edited visual aids suggest a lack of professionalism, preparation and commitment to the audience. Poor visuals are rude and degrade the communication.

If you make your own 35mm slides by photographing printed matter, you should be careful in using a camera with automatic exposure. Most such cameras assume the picture has light and dark elements, such that the overall scene is, on average, about 18% reflective. But printed matter, such as a drawing from a computer, is much brighter than this. The automatic exposure camera will underexpose it, thus giving a dark picture where the white parts of the picture are gray. The solution is to purposely overexpose by about two f-stops, or to use an " 18% gray card" (available from camera shops) in place of the actual scene to let the camera determine how bright the lighting is, and then replace the gray card with the computer output, or whatever you are trying to photograph.

Computer-based visual presentation technology is here and is expanding rapidly, offering more and improved options almost weekly. Computer-generated graphics that produce dramatic on-screen projection of computer images, animation and simulations will very shortly be the accepted standards for most visual presentations. These technological advances provide exciting ways to present visual material, but with them comes the temptation to over-dramatize a presentation. The "rules" on when and how to best use visual material will still apply when everyone is using computer-based graphics. You want your audience to absorb and retain the substance of your talk rather than be mesmerized by your whiz-bang special effects. The more dazzling your electronic visuals are, the less important or memorable you, the speaker, are in the presentation.

It is reasonable to assume that scientists will be in the vanguard of implementing and furthering the use of electronic presentation technology. While slides (35mm slides) and transparencies (overheads) may be heading toward obsolescence, we discuss them here for two reasons: (1) in a world of tight budgets, it may be a while yet before electronic presentations are universal, and (2) the guidelines for low-tech visual aids also apply to the design and use of their high-tech cousins.

The Ten Commandments of Visual Aids

"Everything should be made as simple as possible, but not simpler." - A. Einstein

I. Each visual aid shown must enhance, support, exemplify and/or facilitate understanding of material covered in your talk.

For each visual piece, ask three questions. If the answer is not a definite yes to all three, redo or discard the piece.

- Will it add to my presentation?
- Does it relate to material covered in my talk?
- Is the graphic quality acceptable?

It is not necessary to produce a visual aid for every point in your talk. On the other hand, it may be difficult to discuss some points without them, as with figures or graphs that are key elements of your talk. Despite the common practice of presenting a visual piece for every point of a talk, a scientific speaker should not feel compelled to present visual material unless it adds *significantly* to the spoken words.

Many speakers include visual aids that have little or no apparent bearing on their talks. There may be some relevance but by failing to explain the connection, the speaker leaves the audience confused or expects them to figure it out on their own. Visual material is not meant to stand alone without indicating its relevance when presented in the context of a talk.

II. All information presented visually should be brief and concise. It should be presented in the most comprehensible format and edited to the minimum number of words possible.

Editing visual materials to achieve the most illustrative, effective presentation requires walking a fine line between too much and too little. Do not use complete sentences but also avoid editing the material to lists of meaningless verbal scraps. Make certain to provide all necessary references, such as labeling axes and data points. A title for each visual piece gives the audience a clear idea of what they are seeing and what you will explain to them.

Use the graphic tool that makes the information the most easily understood. Consider the following recommendations:

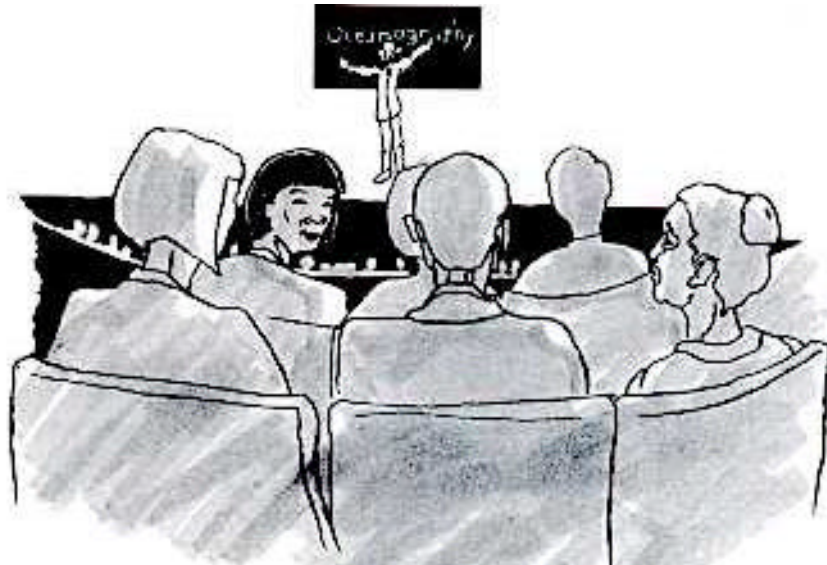
- Word charts (lists) of no more than 36 words per visual piece (maximum of six lines with six words each).
- Pie charts for percentages.
- Bar graphs (horizontal) or column charts (vertical) for comparisons and rankings.
- Column or line charts for changes over time and frequency.
- Bar graphs and dot charts for correlation.

III. Visual aids must be legible and clearly visible to the entire audience.

An audience gnashes its collective teeth when it hears a speaker utter the words, "I know you can't see (read) this, but it doesn't really matter. I'll show it anyway and explain."

The words that follow are generally a complete waste of the audience's time. Although the speaker acknowledges that the audience cannot make out the visual material,

it is explained and discussed as though it were perfectly visible and legible. *If a visual aid isn't visible and legible, it isn't an aid!*



Visual aids must be legible and clearly visible to the entire audience ...

Every member of the audience must have an unobstructed view of the visual material if it is to be effective. Use of the upper half to three quarters of the screen permits people seated at the rear of the room to see easily without sighting around heads in front of them. Using the upper portion of the screen for transparencies is even more important because the projector, projector stand and your body, will obstruct part of the lower screen.

Use readable lettering. The rule of thumb with slides is that you should be able to easily read the words when holding the slide up to the light. The recommended font size for both slides and transparencies is 24 points.

Slides generally make better visual aids than transparencies in auditorium-sized rooms. Computer technology has greatly reduced the costs and simplified the job of producing them. Slides, however, must be of the greatest possible clarity and brightness to stand up well in large rooms. Magnification and distance dim the projected image and cause it to lose clarity. The further the projector is from the screen, the greater the order of magnification, thus the greater the loss of clarity and brightness of slides. The larger the room the greater the need for bright, clear slides. Computer-generated graphics generally hold their quality very well with magnification and can exhibit much greater brilliance.



... you should be able to easily read the words when holding the slide up to the light.

If you must use handwritten transparencies, use block letters, not script (cursive). And, please, use your very best penmanship. If your handwriting is difficult to read, it will not be any more legible magnified many times. Again, anything with which the audience must struggle is distracting and annoying, so you might consider having someone else write them for you, or have them typed.

In today's high-tech world, flipcharts and black (white) boards are used most frequently in the classroom, but occasionally they are all that is available for small groups or impromptu talks. The following chart provides a quick reference for the lettering size to use for distances from the board or chart to the last row of the audience:

- 1-inch (2.5 cm) letters for 30 feet (9 meters) or less,
- 2-inch (5 cm) letters for 30-50 feet (9-15 meters), and
- 3-inch (7.5 cm) letters for over 50 feet (15 meters).

Experts also offer these formatting tips to increase the legibility of your visual aids:

- Left justify the copy leaving the right margins ragged. Fully justified (equal right and left margins) text makes it more difficult to distinguish each line and to differentiate between points.
- Use a uniform, bold typeface.
- Sans-serif and computer-generated bold, serif typefaces enlarge well, whereas serif typewriter copy (generally "Courier" in the U.S.) does not.
- A combination of upper and lower case is more easily read from a distance than all upper case.
- Use larger type for headings and smaller type for subheads to show relative importance.

All you can hope to inspire in your audience with illegible, confusing visuals is annoyance, skepticism and questions about your competence and professionalism.

IV. Two or three facts or information points per image are best; six are considered the absolute maximum.

The more complex the points, the fewer that should appear on a single visual piece.

At times it may be necessary to use a complicated image. Instead of presenting the audience with a complex visual all at once, build it up, layer by layer. To keep the audience with you, add information incrementally by using a succession of slides or overlays (successive layers of transparencies). Creative use of color as information is added assists audience comprehension as you build to the final image.

V. Do not load too much visual material into a talk.

Depending on the complexity of the material, use of three to six images per 10 minutes is usually optimum. More complex information takes more time to absorb, so reduce the number of visual pieces presented accordingly.

VI. Use color for emphasis, distinction and clarity.

Use of color in visual aids dramatically improves retention of information. Highlighting headings and key points, graphs and charts is good, functional use of color. Using color for aesthetic value is acceptable unless it interferes with or detracts from absorption of the visually presented information, as happens when visual aids become too colorful or colors are too randomly placed. Use color for effective visual impact, but resist the temptation to over-colorize.

Be careful with colored backgrounds because some colors can make black figures or text less distinct. Yellow and bright blue are good background colors; dark blue and red usually are not, unless the figure or text is reversed to white.

In using color, it is very important to remember that magnification reduces brightness and clarity. Colors grow muddier the more a visual piece is magnified. Since slides and transparencies are all magnified to some degree, use the most vibrant colors possible. One of the best ways to brighten a color is to place it next to or surround it by its complementary color.

- Blue with orange,
- Blue-violet with yellow-orange, and
- Violet with yellow

Approximately 10 % of the male population is color blind and red-green is the most common type of color blindness. Please notice that the above list omits the red with green combinations of the color wheel. If possible, avoid those complementary color sets in your visual material to accommodate as many in your audience as possible.

VII. Do not read your visual aids to the audience instead of giving a talk.

First, the audience can read faster than they can hear you read. Second, if you are reading the screen, your back will be to the audience and part of a speaker's job is to face the audience. Third, if your visual aids contain most or all of your talk, you should probably have prepared a handout and relinquished your time at the lectern.

The desired style in scientific talks is to speak conversationally and confidently. It is perfectly fine to use your visual aids as notes for your talk, but reading a talk, whether from sheets of paper at the lectern or from images on a screen, is not the preferred presentation style in scientific circles.

VIII. Be aware of the "life span" of each visual piece.

The moment a visual piece is presented, the audience's attention is drawn to it. Display a piece of visual material only when you are ready to talk about it and do not leave an image to "die" on the screen.

The two factors that determine the life span of a visual aid are the time necessary for the speaker to discuss it and the time needed by the audience to absorb the information. More complex concepts and mathematics take longer for both parties, so be sure to allow extra time for them. It is frustrating to an audience to get only a brief glimpse of a visual piece before the next image is flashed on the screen. On the other hand, the audience's attention drifts if an image is left on the screen and the talk has moved on to new information. Remove each visual piece when your talk has progressed past that material; as long as an image is before them, at least part of the audience's attention will be on the screen.

If you present a new image for your next point while you are still speaking about the previous point, the audience will move ahead of you to the new material. Covering part of the information on a transparency until you reach that point in your talk is extremely annoying to an audience. If you need more than a minute between portions of a single transparency, break the information into separate transparencies to keep the audience with you and focused on what you are saying. Another solution is to prepare transparency overlays, successive layers of transparencies that, when laid on top of one another, add information to a list or graph.

You should not leave the overhead projector empty between transparencies because this produces a blinding white light on the screen. Newer slide projectors make the screen go dark when there is no figure being shown, but older slide projectors produce the same blinding white light as do empty overhead projectors. Turning a machine on and off is distracting for the speaker and the audience. To avoid the distraction of the glaring white light, insert black or opaque slides or transparencies in the carousel or transparency stacks for the times in your talk when you have no visual material.

IX. Rehearse your talk with your visual aids.

The smooth, effective use of visual materials requires practice and a bit of choreography. Bumpy verbal transitions and awkward handling of slides and transparencies will grab part of the audience's attention, thus lessening the impact of your talk. Rehearsing with your visual material will help keep you from getting sidetracked and losing your place in your talk.

Unless you are going for high drama, do not open or close your talk with a visual aid. After taking the podium, establish yourself with the audience and settle yourself down, then dim the lights and show your first visual piece. Practice talking while changing visual materials to avoid losing momentum, your own train of thought and the audience's attention. Make certain that the correct visual piece is on the screen after each change before you continue.

Perhaps the most difficult steps to remember in using transparencies are to 1) move aside after the image is projected so the audience can see the entire screen, 2) point to the information on the screen (not to the transparency on the projector!), then 3) turn back to the audience to speak.

It is important to explicitly point to the information on the screen that you are discussing. Do not assume the audience will find it on their own. Point to it and tell why it is important. Rehearsing will enable you to maintain your train of thought as you turn from the audience to the screen and back again.

Although transparencies often seem bent on rearranging themselves and not cooperating, they can be tamed. Several experts offer the following technique as a virtually foolproof means to prevent reshuffling, omitting, and showing upside-down transparencies, assuming they are in the proper order to start with.

- Position the Feed Stack on one end of the projector and the Shown Stack on the other.
- Use both hands; position the new sheet with one hand and remove the shown one with the other hand in a fluid movement.
- Raise the two stacks of transparencies to the same height as the projector so you don't bob up and down as you make the changes.
- Step aside after the new image is on the screen.



Although transparencies often seem bent on rearranging themselves and not cooperating, they can be tamed.

For this method to work, you obviously need space around the projector for the two stacks. Since most overhead projector stands don't allow space on both sides of the projector, it's advisable to request a small table. A 4- or 6-foot table works well, with the long sides placed perpendicular to the screen. Placing the long side of the table perpendicular to the screen reduces the portion of the screen that is obscured from the audience. It is extremely difficult to manage transparencies in a talk if the projector is placed on a cart with no additional surface space, so it is entirely reasonable to request a table when you request the transparency projector.

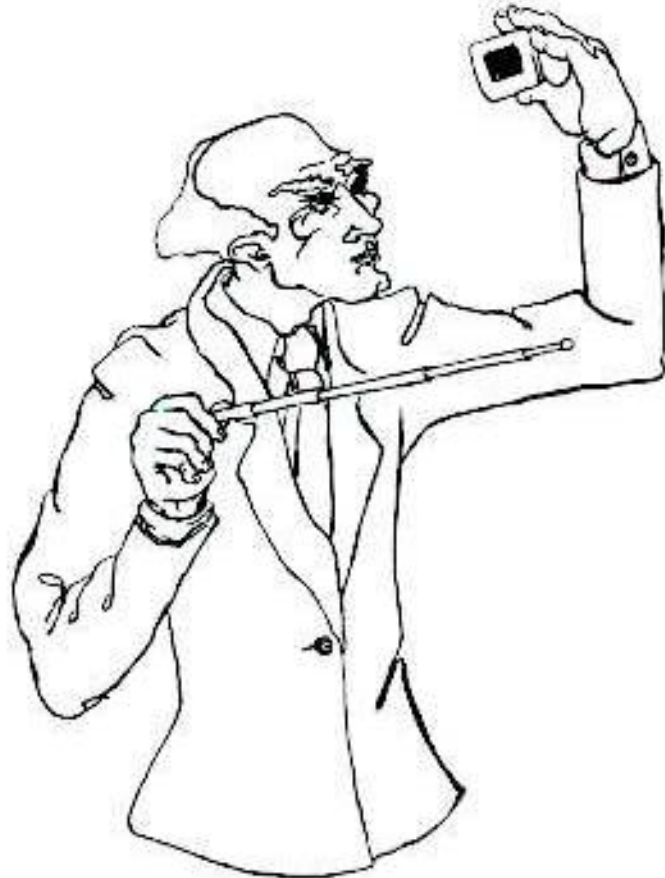
There are eight different ways to position a transparency on the projector or a slide in a carousel slot and only one is right. When preparing your visuals, order your figures, making certain they are all oriented properly, then number them in the lower left corner. "Thumb marks" in this location enable you or the projectionist to see the number when

holding the piece in the right hand. Framing transparencies makes them much easier to handle and provides a place for numbers and notes. If possible, load your own slide carousel, preview it while you rehearse your talk and take it with you. If you load the carousel after you arrive at the talk site, numbering the slides beforehand will help get the order and orientation right, but do check them again as you insert them.

X. Prepare visual aids that can be accommodated by the technology on hand and the speaking environment.

You, as the speaker, have the ultimate responsibility for learning what audiovisual equipment will be available and/or to request the equipment you will need. Ordinarily, after you accept an invitation to speak, you can expect to be informed of the pertinent details, but if they are not forthcoming, ask questions:

- What equipment will be available? Will you need to specially request or order anything? (if showing a videotape, make sure the tape size and the equipment are compatible.)
- How many screens and how large?
- What is the size of the room and how will it be arranged?
- Where will the lectern be placed?
- Does the lectern have a light? It's difficult to read your notes without a lectern light in a room darkened for visual presentations.
- How many and what type of microphones?
- Will an audiovisual technician be on hand during your presentation? If not, who will handle emergencies? Are there extra projector bulbs on hand and where are they?
- Will a technician operate the slide projector or will there be a remote control for the speaker to use?
- Who will monitor and adjust the lights?
- What type of pointer will be provided?



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All these factors together determine how you prepare and present your visual aids. Failure to learn those details in advance can lead to unpleasant surprises, if not outright disasters. Never assume that all the equipment you plan to use will be waiting for you unless you have discussed it (and even better, verified it in writing) with the organizers of the meeting, the person responsible for your invitation or the venue's audiovisual staff. Even if your requirements have been confirmed in writing, it is up to you to check that everything is actually there when you arrive at the site.

Delivery

"The human brain starts working the moment you are born and never stops until you stand up to speak in public." - George Jessel

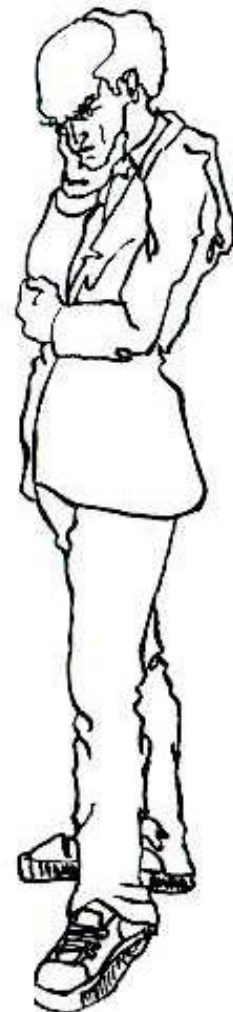
Studies of communication show that:

- 55% of interpersonal communication comes from facial expressions and other body language.
- 38% comes from vocal quality or tone of voice.
- 7% comes from the content, the actual meaning of the words.

Scientifically trained audiences will probably absorb somewhat more than the general population from content and a little less from the other two factors. Even considering a more sophisticated audience, however, the numbers clearly show that nonverbal signals speak volumes and are very important in getting your message across. To be most effective, the scientific speaker needs to develop a delivery style that incorporates good body language, pleasant facial expressions and a confident, yet relaxed, tone of voice.

Use a well-modulated speaking voice and a conversational tone. Practice using a microphone with someone in the room to help you find your best public speaking volume. Speaking either too softly or too loudly conveys inexperience. Speak clearly and distinctly. Speaking too quickly portrays nervousness (if not terror) and a lack of self-confidence.

Make eye contact with members of the audience. Use the visual feedback you get from them to assess how your talk is being received. If they seem to be drifting off, pick up the pace. If they seem confused or unsure, slow down and repeat important points. Try to have your eyes on the audience 90 % of the time you are speaking, particularly at the opening, the closing, and at the end of each emphasized statement.



... nonverbal signals speak volumes ...

Smile. A smile at the opening and here and there in your presentation sends a powerful nonverbal signal to the audience that you are comfortable, self-assured and in control. An occasional smile will help you to relax and will increase your rapport with the audience. But the smiles must be genuine and at appropriate times in your talk.

Vary the pace of your words. Pauses are essential to a strong delivery. Pause after the introduction of a new key point and after displaying a new visual to give the audience a chance to make the transition.

Watch your posture. Standing rigidly, gripping the sides of the lectern, tells your audience that you are far from relaxed and confident. Draping yourself over the lectern is too informal and conveys indifference.

Gestures add emphasis to your words and can even provide an outlet for nervousness, but use them judiciously. Too many and too flamboyant gestures ultimately detract from what you are saying. The thing to remember is that, while you are speaking, you are in charge of the gathering. You control the pace and the tone. You must gain the audience's confidence and capture its attention. It is up to you to interact with the audience and assess its reaction to your presentation. You are responsible for staying on schedule. You are presiding.

Q & A Pointers

It's not enough that you made it through your talk. Now you must subject yourself to cross-examination and do so while thinking on your feet. Q & A sessions can definitely be tricky but, remember, while you are at the podium you are in charge. You can and must control the exchanges. Experienced speakers offer the following thoughts to help you avoid or defuse awkward situations, keep the questions on track and enable you to maintain your poise, dignity and control of the session.

1. To encourage your audience to ask questions, call for them in a way that suggests you expect and want them. "What questions do you have?" is an active solicitation whereas "Any questions?" is rather unconvincing. If you have a lapel or corded microphone, come from behind the lectern for the Q & A session. This is the most interactive part of your presentation, so eliminate the barrier of the lectern. The audience needs a moment or two to make the transition from listening to speaking, to formulate their questions and, in some cases, to get up the courage to ask a question before the audience. Wait a minute or so and if no one asks a question, ask one yourself. That will generally get things rolling.
2. Always repeat or restate a question from the floor. Even in small groups, a question from the front row may not be heard at the rear of the room. In large rooms, it is essential even when floor microphones are provided for questions.
 - Repeat all positive questions. This makes certain everyone heard the question and buys you a moment or two to compose your response.

- If necessary rephrase the question for clarity.
- Paraphrase negative questions. By changing the slant or tone of the question, you can respond positively.

3. Respond simply and directly

Don't allow yourself to get sidetracked or to ramble. That consumes the time for other questions and gives the impression that you are not entirely sure of the question or the answer. If short, simple answers are not adequate, tell the audience you will make yourself available after your talk to answer in more detail.

4. Don't bluff.

If you don't have the answer, say so. Then amplify: "That data won't be available for several months" or "Sorry, that's outside my area of expertise." Then offer a helpful solution: "I'll find out and get back to you" or "That's Joe Smith's field. See me later and I'll tell you how to contact him." Virtually no one has all the answers all the time. It's helpful, therefore, to compose a short mental list of responses that say "I don't know" so you won't get flustered and lose your composure.

5. Don't lose your cool.

Never respond defensively, with irritation or with anger. Such responses show that you have lost control of yourself and your presentation. Train yourself to resist the impulse to fight back or put down the questioner with a snappy reply when a hostile, negative or belligerent question comes from the floor. If the question can be restated positively, do so, answer it and move on. If not, firmly, yet diplomatically, state that this is not the time or place for that debate. but offer to discuss it after your presentation. Then move on.

6. If someone asks about something explicitly covered in your talk, answer anyway. Perhaps you did not make the point clearly enough. This time, try another approach. If, for example, you covered the point in your talk with graphs and charts, respond to the question with a summary of the most important data covered in the visual material. If your talk progressed step-by-step to a conclusion, in response to a question you might begin with the conclusion and work backwards.

7. If someone repeats a question that's already been asked, the general guidance is don't answer it again.

"I believe we've already covered that" usually works. On the other hand, if the second question indicates that your first response was inadequate or confused the audience, do take another stab at it.

8. If someone tries to turn a question into a long-winded speech, politely, but firmly, stop him or her.

First, raise your hand. Most people will respond to this nonverbal signal to stop speaking. Then, you might say: "To have time for the other questions and so the audience will be clear on what you're asking, would you please give us your question now" The audience will appreciate this indication that you are responsibly controlling the session and that you value their time.

If someone asks a totally irrelevant question, respond by saying that really is not part of your topic.

However, (if you're feeling generous) you could say: "It sounds like an interesting subject."

9. The speaker can give permission for short interruptions, "for the purpose of clarifying a point or figure," especially with a smaller audience.

Carefully prepared talks and good visuals, however, will lessen the need for such interruptions from the audience. If an interruption is for more than a quick point of clarification, ask the individual to please hold the question for the Q & A session.

10. If you run out of time, apologize for being unable to take every question.

Offer to make yourself available after your presentation.

11. Give a short statement to close your Q & A session, then thank your audience for their questions and interest.

Impromptu Talks

"It takes three weeks to prepare a good ad-lib speech." - Mark Twain

Many impressions and decisions are made based upon impromptu talks at meetings and conferences, in the classroom and in daily conversations. You can learn to think on your feet and become at least an adequate extemporaneous speaker. If you are frequently or even occasionally called on for impromptu remarks, the exercises necessary to develop the skill are worth the effort.

As mentioned in the introduction, this publication focuses on the invited talk for which you have time to prepare. Clearly much of the advice is not applicable or must be substantially abbreviated for impromptu talks. Some of the suggestions, however, can be used on the spur of the moment, especially if you have become familiar with them in the context of preparing and delivering invited talks. You can do a quick assessment of the audience by simply looking around the room. You can organize your remarks by making a quick mental outline or, if time permits, jotting down a few notes. You can

incorporate many of the elements of good delivery And it is possible, with practice, to train yourself to do a commendable job of ad-libbing with less than Mr. Twain's recommended three weeks preparation time.

There are two types of extemporaneous speaking situations: times when you choose or feel compelled to contribute and times when, out of the blue, you are called on to contribute. The latter is, by far, more difficult, but there are a few tricks to help you with both situations.

The problems with impromptu talks for most people are their inability to organize their thoughts quickly and coherently, and to know when to stop talking. There are several patterns to keep in mind that will help you formulate fast mental outline.

- A chronology: past, present and future.
- Don't lose your cool
- By topics 1, 2, and 3 (it's recommended that you limit yourself to three unless you have had time to make a few notes).
- A discussion of the pros and cons.

Your mental outline should include your conclusion, the primary message you want to leave with the audience, presented as a strong, positive statement. Inexperienced extemporaneous speakers often simply forget a closing statement and just stop speaking. Resist the temptation to ramble; say what you have to say and either sit down or call for questions.

If called on unexpectedly to *say a few words*, stall for a moment or two to collect your thoughts by thanking the chair or speaker for giving you time to speak and possibly reiterating something said previously. Asking a rhetorical, yet relevant, question is also a way to buy a little time and can serve as your opening.

Practice in spare moments by picking a topic, taking a minute to prepare a mental outline or make a few notes, then standing and speaking for a couple of minutes. Increase the speaking time as you become more comfortable with the exercise. A practice shortcut is to make quick mental outlines of topics while reading the newspaper or watching the evening news. In training yourself to speak extemporaneously, the thought-gathering process and the speedy organization of those thoughts are the keys; the topic is almost incidental.

Addressing a Nonscientific Audience

"Many attempts to communicate are nullified by saying too much."

- *Robert Greenleaf*

As with addressing a scientific audience, when speaking to a lay audience or the media, the point is to clearly and concisely communicate your information on a level they will

understand. The point is not to overwhelm or snow the audience, nor to impress them with your vast knowledge and lofty credentials.

Effectively communicating with such a group usually means greatly simplifying a complex topic. There are some important guidelines that will help you with that task.

- Be sure to give at least thumbnail sketches of any essential underlying assumptions or principles, then straightforwardly explain or demonstrate how they relate to your subject.
- If possible, frame your talk in the context of everyday life or the binding focus of the group you are addressing.
- Math is rarely, if ever, appropriate for this type of audience.
- Talks given to other scientists usually include caveats, "on the other hands" and manipulation of variables because they indicate thorough and multidimensional research. Try to avoid those mechanisms when addressing a nonscientific audience because they tend to obscure your point(s) and confuse your listeners.

Confusing a lay audience is bad enough because it essentially wastes their time by failing to provide new, comprehensible knowledge. Confusing media representatives, however, can have farther-reaching consequences, including being misquoted and made to sound foolish. Keep your remarks simple, direct and well grounded in scientific fact.

Practicing your talk before a rehearsal audience of approximately the same age and educational level as your real audience is an excellent means of testing whether you will get your message across clearly. Does she understand everything? Does he need more background information? Does she have questions? Does he understand why the topic is important? Add to and subtract from your talk according to the responses.

Conclusion

The intent here has been to present positive suggestions to help scientists develop or fine-tune their public speaking skills. Where "thou shall nots" appear, they are important because they reflect complaints heard repeatedly about public addresses in general and scientific talks in particular. Each "don't do this" is supported by a rationale and, in most cases, followed by recommendations on how to do it better.

Capturing, focusing and maintaining an audience's attention are the keys to giving a good talk in any situation. There are many references here to things that annoy, confuse and distract audiences because a room full of annoyed, confused or distracted people will not be receptive to or retain what you have to say. There are, of course, external factors that can affect the audience's concentration such as faulty audiovisual equipment or noise from outside the presentation room. The message here, however, is to point out some of the many things speakers do themselves, through inexperience or carelessness, that undermine their own talks and to offer insights on how to avoid those pitfalls.

Common sense plays an important role in preparing and giving a good scientific talk. Scientists have ample opportunities for comparison of good and bad talks. It is a serious matter to complain about the rambling, disjointed talk of a colleague and then give one yourself. The same is true of hastily prepared, illegible visual aids. You recognize what makes a talk good when you are in an audience, just as you recognize what makes a bad one. Take the time to develop the skills necessary to emulate the good ones and avoid duplicating the mistakes of the bad ones.

We hope this publication will assist with both efforts.

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