Dazzle 'em with STYLE

THE ART of ORAL SCIENTIFIC PRESENTATION

SECOND EDITION

ROBERT R. H. ANHOLT

Dazzle 'Em with Style: The Art of Oral Scientific Presentation

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Robert R.H. Anholt

Second Edition

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To my wife Trudy Mackay

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PREFACE

For the last 10 years *Dazzle 'Em with Style* has been used as a textbook by thousands of graduate students and young professionals to help them master the art of oral scientific presentation. Much has changed, however, in scientific presentation during the last decade. When the first edition of *Dazzle 'Em with Style* was published in 1994, computer-assisted projection was still in its infancy. For many of us, e-mail was still a novelty. Most speakers used overhead transparencies or conventional slides and only few lecture halls were equipped with computer-controlled projectors. Today, it is almost inconceivable to be invited to speak in a conference room or lecture hall that is not equipped with a computerized projection system. "PowerPoint" has become a household term for scientists, and PowerPoint software has contributed significantly to the art of oral scientific presentation.

Science has also changed. New integrative scientific fields have sprung up, such as genomics, systems biology, and bioinformatics, which were nonexistent in the early 1990s. With the emergence of more powerful scientific technologies, there has

been an explosion of information. Many new journals are established each year, and online publishing is gaining in popularity. "I cannot keep up with the literature and I have stopped reading papers," one of my colleagues said recently. "If I want to know what is going on, I benefit more from going to conferences and listening to seminars," he added. I believe this viewpoint is a bit cynical. Being familiar with the scientific literature is as important as ever. Yet it is also true that exchange of scientific information through verbal communication is becoming increasingly more important as an effective way of finding out "what is going on." There is an inescapable reality that for young scientists the skills to deliver a polished, well-articulated scientific presentation have become more critical than ever.

The importance of oral scientific presentation skills is now widely recognized as the cornerstone of a young scientist's successful career. Ten years ago, courses that taught presentation skills were considered innovative. Today, virtually every college and university in the nation offers at least one (if not multiple) course in professional development, with a strong emphasis on scientific presentation skills. The ability to communicate effectively is also a highly prized attribute in companies and is often used as an important criterion for hiring.

The scientific world of 2005 is different from that of 1994, and I realized that it was time for a second edition of *Dazzle 'Em with Style*. Whereas fundamental principles of scientific presentation per se have not changed, the use of visual aids and new advances in science have changed the way in which we will approach scientific communication in the 21st century. The second edition discusses the use of PowerPoint and incorporates examples from emerging scientific fields.

As always, I am indebted to the many students and postdoctoral fellows with whom I have interacted and who have

provided critical comments and valuable feedback on my efforts to teach them the art of oral scientific presentation. I am also grateful to my editor, Luna Han, for her extensive help with the preparation of the second edition, to Tristin Starkey for secretarial assistance, and to Greg Miller for preparing the illustrations. Above all, I wish to thank my wife and colleague, Trudy Mackay, for her unabated encouragement and unwavering support. I fondly dedicate this book to her.

INTRODUCTION

> If you can't baffle 'em with brilliance, dazzle 'em with style.

Like most scientists, I vividly remember my first scientific presentation. I was a graduate student and had never spoken in public. As if it were yesterday, I recall the empty room—the place of execution—where I dropped my slides into the carousel with trembling hands. Suddenly, the room was full of people, about 30 of them. I had not even noticed them coming in. There was an ominous murmur and the monotonous sound of the air-conditioning system. It was time. My host introduced me; his 2-minute speech seemed to last a century. As he beckoned for me to get up and start my presentation, my heart stopped beating, my feet felt heavy, my hands were sweating. I looked at the dimly lit array of pale, inquisitive faces in the audience, and I managed to extrude the first trembling words in a strange, high-pitched voice that seemed to emanate from a different person. Then the words flowed. However, my conscious reality had left the room, and

I daydreamed about a host of unrelated topics while I delivered my lecture mechanically. I remember the applause; the next moment the room was empty, and I was collecting my slides from the carousel. It was over.

For many of us, giving a scientific presentation can be stressful. Yet the ability to deliver a polished oral presentation in front of an audience of peers is an essential skill for a successful scientist. Oral communication remains one of the most effective ways by which we exchange information and are introduced to new vistas of knowledge. The skill of presenting an engaging and well-structured seminar often determines our professional reputation and future success—especially when the seminar is part of a job interview. The perception of a thesis defense or a research seminar depends largely on the oratory of the speaker. We are all familiar with the droning genius, offering in a monotonous voice an uninspired monologue directed at the projection screen; potentially brilliant work passes us by as we close our eyes and doze off into the arms of Morpheus. We all recognize the annoying speaker flashing hundreds of images on the screen one after the other, who is still going on 20 minutes past the allotted time, while the audience sneaks out of the room, leaving behind only the host and the speaker. We all remember those seminars that seemed such a waste of time because "it wasn't even clear what it was about."

Truly memorable presentations occur rarely, but they seem to make up for all the boring, soporific, rambling speeches inflicted on us during our weekly seminar sessions. An engaging, articulate, and entertaining scholar who challenges our interest and projects enthusiasm to the audience opens up a world of intellectual pleasure. The speaker's tantalizing story keeps us spellbound, like children who listen for the first time to the tale of Rumpelstiltskin as he makes the poor miller's

daughter guess his name. A talented scientist who at the same time is a skilled lecturer is like Mark Antony telling the people of Rome about the great insights of Aristotle. I am truly grateful to those speakers from whose lectures I have learned so much and benefited so greatly.

Some people have a gift for lecturing and enjoy public speaking; others dread it. For many years, I have trained graduate students to deliver seminars, first at Duke University and during the last decade at North Carolina State University. For all beginning graduate students, at least a two-semester course in the art of oral scientific presentation should be required. In my experience, a weekly seminar, in which one student delivers a presentation in front of his fellow students and the faculty, works well. The student chooses a topic and studies it in great detail through library research and conversations with members of the faculty. The presentation is rehearsed several times in anticipation of the appointed date. During the actual presentation, the student's seminar is evaluated by the audience on forms that rate the presentation not only in terms of its coherence and logic, but also in terms of delivery and use of visual aids. These evaluations are discussed with the class at the end of each presentation, and the speaker is expected to improve his or her performance in the next semester by learning from constructive critical comments.

Oral scientific presentation is not only an art, but also an acquired skill. Few individuals are born brilliant speakers. However, most students can dramatically improve their lecturing skills with experience and proper guidance. I have worked closely with scores of students to help them develop lecturing skills, and although few are Mark Antonys, many have become good, if not excellent, lecturers. As with every other skill, general principles underlie the art of oral scientific

presentation. In this book, I have collected insights and guidelines that have crystallized over years of teaching students and scientists to improve their lecturing skills. I have illustrated my guidelines for oral scientific presentation with real-life examples. Although I have attempted to choose examples that will appeal to a diverse scientific audience, the reader may find some unavoidable bias toward my own areas of expertise, molecular neurobiology, genetics, and cell biology. I have made every attempt to keep these examples relatively simple without compromising their authenticity, because this book is intended for an audience of young scientists. Essential take-home messages are provided at the end of each chapter. I hope that this book will help many students and young scientists, as well as established investigators, become confident, engaging, and frequently invited speakers.

chapter

1

Preparing a Scientific Presentation

Identify Your Audience

During an election year, it is not uncommon for a presidential candidate, dressed in jeans and a safety helmet, to spend the morning addressing construction workers in a Michigan suburb and then later, dressed in formal attire, to spend the afternoon discussing the state of the economy with a group of investment bankers. It would be difficult to imagine the politician wearing the construction helmet during the meeting with the bankers. However unlikely it is that a brick would drop on the candidate's head in the union headquarters during the meeting with the construction workers, the candidate's attire enables the audience to identify and feel comfortable with him or her. Politicians are very conscious of the audience they are scheduled to address and do their homework before their scheduled arrangements.

Although scientists do not experience the same pressures, it is nonetheless a good idea, when planning a scientific presentation, to investigate what type of audience is expected. It

makes a difference whether the audience consists of specialists who all share a common interest with the speaker—as is often the case at specialized symposia—or whether the audience shares only a peripheral interest with the speaker—common in presenting departmental seminars at academic institutions, where it is often only the host who is interested in the details of the speaker's work. Does the audience consist of scientifically active Ph.D.s or educated laymen? Does the audience consist primarily of professionals interested in a focused account of accomplished work or of students interested in learning about the speaker's achievements within a wider context? A scientific presentation should always be prepared with the audience in mind. To blindly offer a showcase of your own accomplishments, reflecting only your interests, is a sure recipe for miscommunication and results in a poor performance from the perspective of the audience.

Communication is the key. Look upon your presentation as a dialogue with the audience not a monologue. Be sensitive to the needs and interests of your audience, and reflect on the questions: What do they expect to learn from my presentation? How can my presentation be useful to them? A presentation prepared with these questions in mind is more likely to succeed with the audience than a presentation intended to impress the listeners by glorifying the speaker's self-perceived accomplishments.

A key concept in the art of oral scientific presentation is acceptance of the speaker by the audience. The speaker's attitude with respect to the audience often determines whether the presentation will be clouded by an atmosphere of skepticism or received in a welcoming ambiance of motivated interest. Establishing comfortable contact with the audience should be the first concern of any speaker. Starting off with an anecdote, a good-humored reference to the local football team, or

a witty comment that draws smiles from the audience often sets the mood for the remainder of the presentation. Although it may seem a cliché, there is absolutely nothing wrong with the speaker thanking the host for the invitation and the opportunity to present a seminar "in front of such a distinguished audience at this prestigious institution." Flattery works. Most students and professionals identify strongly and proudly with their institution, and a display of respect by a visiting speaker immediately forges a bond with the audience. A gracious expression of appreciation to the host and the institution, followed by a brief anecdote or joke (in good taste), hardly ever fails to break the ice.

Try to find out beforehand who might be in attendance during the presentation. Often it is possible to give credit to a specific member of the audience during the talk. Always greatly appreciated are statements such as "After we learned about the elegant experiments of Dr. Smith [in the audience], we decided to . . ." or "Since the approach developed by Dr. Jones worked so well in her system, we adopted a similar strategy," or "Our results agree closely with previous observations by Dr. Doe, who showed. . . ."

I remember two incidents in which speakers presented a cartoon published in several of my review articles. In one case, the speaker, unaware that I was in the audience, did not give any credit at all. In the other case, the speaker suddenly realized, while looking at his slide, which credited "Anholt et al.," that I was the Anholt in question. I once heard a speaker present data on calcium influx in synaptic terminals; he was unfamiliar with the most recent publications of one of the pioneers of his field, who happened to be in the audience! Such embarrassing instances can do irreparable damage to an otherwise excellent presentation and are entirely preventable. In these examples, speakers had simply not taken the time to find

out who belonged to the departments where they would be speaking and thus were likely to attend their seminars. Invited speakers should always browse through the departmental website to learn a little about the organization and history of the host institution before arriving on the scene.

Knowing your audience facilitates communication and helps create a comfortable and favorable relationship. In preparing for a scientific presentation, always be concerned with uninformed members of the audience and consider these questions: What do I seek to *communicate?* Will they be able to follow me? What will they learn and retain from my presentation?

SCHEDULING YOUR PRESENTATION

In most cases, the exact day and time of the seminar are not under the speaker's control, but are determined by the organizer. Given a choice, offer your presentation at the normal day and time set aside for seminars at the host institution; scheduling a presentation outside the routine of the regular audience usually results in lower attendance. When given options about a seminar date at an academic institution, choose to be scheduled neither at the beginning nor at the end of a semester. The audience needs a few weeks to establish its routine at the beginning of each semester; and near the end of the semester, especially when the winter or summer recess is approaching, many people start to suffer from seminar burn-out.

The largest and most attentive audiences can be expected in the middle of the semester, when academic life is in full swing. Avoid dates that conflict with student breaks or major professional conventions. Immediately following the national neuroscience meeting, for example, few members of neurobiology or pharmacology departments are interested in listen-

ing to yet another seminar. When a regular weekly day for seminars has not been set aside by the host institution, it is wise to choose the middle of the week rather than Monday (when members of the audience are struggling to get back in the mood for work) or Friday (when they are preoccupied with the forthcoming weekend).

When given an option regarding the time of day, schedule your presentation in the late morning or at noon, if possible. Unfortunately, institutions often schedule seminars at the end of the working day to avoid disrupting other activities. However, many people in their daily cycle experience a natural dip in attentiveness around that time, and it is not surprising to see people fall asleep at afternoon seminars. Personally, I have to struggle to stay awake at 4:00 PM. No matter how interesting the topic, I find myself dozing off around 4:20 and waking up again about 15 minutes later. In contrast, most people are at the peak of their alertness at around 11:00 AM; noon seminars are therefore preferable, and because lunch constitutes a routine, daily break from work, noon seminars usually do not interfere with other activities at the host institution. (When speaking at lunch time, I always make sure to have a snack before so I will not be distracted by hunger during my presentation.)

Structure Your Material

After having obtained as much information as possible about the audience and its interests, the next step in preparing the presentation is outlining the talk. A presentation is usually preceded by a brief introduction by the host and is followed by a discussion period. Normally, there is a predetermined time allotted for the event. It is crucial for the speaker to stay within the boundaries of this time. Nothing is more

destructive to a presentation than exceeding the allocated time. Like hikers who go into the wilderness with a food supply just sufficient for the intended duration of the trip, people who attend a seminar anticipate the predetermined period and come equipped with an amount of listener energy just sufficient to cover this period. As soon as the speaker goes over time, the audience becomes impatient and restless. They feel as if they are stuck in a traffic jam, not able to reach their destination on time. The speaker will sense their anxiousness and mounting impatience. As a result, the speaker will be forced to rush through the most important part of the presentation, namely the conclusion and take-home message.

When the presentation is part of a symposium, the chairperson and subsequent speakers will be greatly irritated if a speaker exceeds the allotted time, because this interferes with the next speaker and delays the entire schedule of the symposium. It is also essential to leave enough time for questions. By doing so, you provide yourself the opportunity to engage in a direct discussion with the audience, which is essential when trying to communicate information effectively. If a 60-minute presentation is scheduled, prepare a 45- to 50-minute talk, thereby leaving ample time for the introduction and to answer questions at the end. A good rule of thumb is to keep the presentation at a length that is 80 percent of the allotted time.

The graduate students I taught were required to prepare carefully written abstracts of two or three sentences to be printed below the titles on their seminar announcements. Each abstract had to be concise and adequately cover the contents of the talk. The first sentence of the abstract usually introduced the basic question and the perspective of the presentation; the last sentence stated the overall conclusion. Sometimes a sentence in the middle briefly summarized the major experimental findings.

Every speaker, before preparing a scientific presentation, should be able to summarize its content in no more than two or three well-constructed sentences. This is important for two reasons. First, it ensures that you are clearly focused on the major issue and the take-home message of your presentation. If the main issue cannot be explained clearly in a few sentences, a presentation will be most likely diffuse and incoherent. Second, it often happens that one important faculty or group member at a host institution is unable to attend the seminar. Often the speaker has the opportunity to meet with this person individually before or after the lecture, but often only for a short time. During this brief period you should be able to summarize your presentation in a few concise sentences.

I visited once a multinational flavor and fragrance company that had expressed a potential interest in sponsoring olfactory research in my laboratory. The most influential person was the director of research, whose busy schedule did not allow him to attend my seminar. I was scheduled to meet with him for only 15 minutes later that afternoon. When the time came, he was running behind schedule, and in a few minutes he would have to drive to the airport. My total meeting with him was cut to barely 5 minutes, in which he asked me to summarize my major research findings and the future direction of work in my laboratory. Hardly prepared for this situation, I gave a rushed and incomplete overview of my research endeavor. Ever since this embarrassing and unsuccessful experience, I have made sure that I can summarize my seminar on the spur of the moment in two or three sentences.

In designing the structure of the presentation, remember the interests and expectations of the audience and put the presentation into context accordingly. Using the same set of data, for example, you can often shift the focus of a

presentation from molecular aspects to cellular or behavioral aspects or from the nature and generation of a stimulus to the response of the target tissue. A strong presentation on the effects of bronchodilators delivered via inhalation as aerosols would not be structured identically for a group of physiologists interested in the effects of the drug on pulmonary function as for an audience of biomedical engineers concerned mainly with the design of the inhaler and its mechanism of drug delivery.

Imagine that you present a seminar on the discovery of a new gene that predisposes to hypertension. When talking to a group of geneticists, the presentation would focus on the methodology of how the gene was discovered with a detailed discussion of phenotyping, choice of molecular markers, and statistical details of association analysis. However, an audience of clinicians could not care less how the gene was found. They would like to know how it affects hypertension and how it would help them diagnose, prevent, or treat the condition. Similarly, the focus of a presentation on the preservation of tropical rain forests should differ for an audience of zoologists, one of foresters, one of geographers, and one of meteorologists.

Whereas it is important to design your presentation according to the interests of the audience, it is essential to make the audience aware of your focus from the outset. Suspense and mystery are excellent tools for playwrights and movie directors, but they are the nemeses of scientific presentations. To communicate scientific information effectively and maintain the attention of your audience, adhere to the old rule: "Tell 'em what you're gonna tell 'em, then tell 'em, then tell 'em what you've told 'em."

Consider yourself a waiter in a fine restaurant serving scientific information as different courses to an audience about

to enjoy a gourmet meal. They would like to see the menu beforehand and know what to look forward to. An outline on the first slide goes a long way toward keeping the audience aware of the central line of thought of the presentation. Different bulleted topics of such an outline can be highlighted as the outline slide recurs at strategic moments in the presentation. A verbal description that outlines the seminar early in the talk also guarantees that the speaker and the audience march to the beat of the same drummer—and in the same direction. "First I will describe to you how this enzyme was discovered. I will then show you evidence demonstrating that this enzyme represents the rate-limiting step in the metabolic pathway under discussion and that it is regulated by calcium. Finally, I will argue that altered activity of this enzyme as a result of changes in calcium concentration results in abnormalities in bone structure." Such a statement establishes a line of thought that enables the audience to comfortably make an organized mental inventory of the information that is about to follow and to apportion their total listener energy in installments that correspond to the announced segments of the presentation.

Each presentation consists of three segments. (1) The introduction provides the background and perspective necessary to appreciate the remainder of the presentation. (2) The body of the presentation, usually the largest section, conveys new information to the audience; this section can often be divided into distinct, interrelated subsections. (3) The conclusion summarizes the presentation and should provide the audience with a clear take-home message. When preparing a structure for your presentation, divide the allotted time and assign a defined number of minutes to each section of the presentation—for instance, 10 minutes for the introduction, 30 minutes for the main body of the presentation, and 5 minutes to summarize and conclude. This provides balance between the

different segments of your talk and ensures that the presentation stays within a restricted time frame.

In many cases, the visual aids will help structure your presentation by providing landmarks along which the lecture can be organized. In a later chapter, we discuss visual aids in detail; suffice it to mention that the number of images should be kept within reason. A good rule of thumb is to allot approximately 1 minute of presentation for each PowerPoint image, making 45, or at most 50, PowerPoint slides a good number to aim for when preparing a 45-minute presentation. A single sheet of paper with titles or key words for each slide or a printout of the slides and perhaps a few small reminder notes can provide a convenient "cheat-sheet" to which you can refer during your presentation. A well-prepared abstract, an organized set of well-chosen slides, a concise "cheat-sheet," and an introductory outline should all help keep you on track during your seminar.

KNOW YOUR STUFF

It happens often, especially in cases of novice speakers, that unjustified self-confidence leads to the belief that eloquence and style will make up for lack of knowledge, incomplete understanding, or absence of crucial data. A false sense of intellectual superiority to the audience, instilled by the assumption that no one else knows more about the topic than the speaker, frequently leads to the illusion that he or she will be able to "wing it" yet give the impression of being on solid ground. More often than not the speaker discovers too late that the audience consists of highly intelligent and insightful individuals. It takes only one knowledgeable listener to expose a lack of knowledge or data that the speaker has tried to hide behind a cloak of superficial information.

There is no substitute for knowledge. Long before the question period, it will become evident even to a lay audience whether the speaker has a thorough understanding and a broad, solid command of the field. Nothing is more embarrassing to a professional than to be caught unprepared to discuss recent literature or details of important, albeit peripheral, aspects of the field. Nothing is more disappointing to an expectant audience than a speaker who, having no data or only a limited amount, spends most of the time talking about planned but not yet performed experiments. If you have no data for a scheduled research seminar, choose another topic for which solid data are available or simply decline to speak. The decision not to speak is sometimes more beneficial to a person's reputation than a lecture devoid of data.

The extent of a speaker's knowledge reveals itself in subtle ways, especially in the articulation of sentences and the precision of statements. For instance, consider a speaker who asserts the following: "Mammalian pheromones mediate reproductive behavior by interacting with the vomeronasal organ. This chemosensory organ differs from the main olfactory system. It is distinct in all mammals, *except in higher primates, where only a vestigial remnant of this organ is found*." This speaker displays in a subtle but convincing manner a significant depth of knowledge. The additional information regarding the vestigial remnant in higher primates suggests that the speaker has a broad knowledge of the subject; the term *higher primates* rather than *humans* indicates that the speaker's knowledge is precise.

Contrast this example with that of a zoologist who discusses the evolution of birds and mentions that "*Archaeopteryx*, a Jurassic ancestor of birds, was a tree-dwelling creature." Although few members of the audience would challenge this notion, this speaker is perceived as less authoritative than the

speaker who states "Based on the high degree of curvature of the claws of *Archaeopteryx,* which is characteristic of perching birds, it has been argued that *Archaeopteryx* was a tree-dwelling Jurassic bird." In the latter case the speaker backs up the statement that *Archaeopteryx* was a tree-dwelling Jurassic bird with morphological evidence, thereby demonstrating knowledge of the literature and of the arguments that support this claim. The careful phrase "it has been argued that" indicates that the speaker is aware of the previous notion, persistent for many years, that *Archaeopteryx* was adapted to a more terrestrial lifestyle of running rather than perching and dwelling in trees.

Similarly, when presenting a mathematical model of a biological process, for example, predator–prey interactions under certain ecological conditions, it is important to accurately discuss the underlying assumptions and limitations of the model. Accurate, complete, well-phrased descriptions of scientific information portray the speaker as a knowledgeable, reliable source of information. In contrast, glib, inaccurate statements that are open to multiple interpretations gradually elicit skepticism and distrust.

Finally, knowledge and data alone are not sufficient. *Critical examination of the information is indispensable.* This is perhaps one of the most difficult tasks: to stand back and critically look upon your own work. Yet those who are able to do that can prevent or anticipate embarrassing questions. Furthermore, a critical, careful presentation during which you demonstrate familiarity with pitfalls of experimental design and ongoing controversies in the literature, as well as understanding the limitations of the data presented and their statistical reliability, further instills confidence that you are truly an authority in the field.

Rehearse

No matter how experienced a speaker is, it is always a good idea to rehearse a presentation. Often, the same presentation can be given on a number of occasions, but not without adaptation. "Canned" seminars pose the danger of providing a product not optimally tuned in to the audience—a danger we have already identified. I once listened to a presentation on drug testing given by a representative of a federal drug enforcement agency who evidently no longer rehearsed his lectures. The speaker, in front of an audience of professional chemists, gave the same talk he normally delivered at high schools and community colleges. He proudly presented pictures of a gas chromatograph and an automated analysis system to emphasize that these fancy machines really work and give reliable data! To his professional audience, his presentation was disappointing, embarrassing, and totally inappropriate. The moral of this anecdote: Always prepare each seminar for every individual occasion *de novo*, with the specific audience in mind.

A substantial period of time for preparation of the presentation should be allowed before the scheduled date. Frantic, last-minute preparations can result in acceptable performances but seldom in memorable ones. A scientific presentation is an expression of creativity, and creation takes time. I usually start thinking about scheduled presentations weeks, sometimes months, in advance. I draw up a rough outline early and then brood and daydream, letting the presentation go around in my mind, letting the concepts mature at their own slow pace, like a fine wine in the cellar of a French château. Rehearsing the presentation and going through the slides, improving and rearranging them again and again until I am fully

satisfied with their final order and appearance, is—in my experience—best done in the evening right before retiring. Somehow, the last impressions of the day are firmly embedded and integrated in our minds during our sleeping hours.

A rehearsal in front of an honest and perceptive colleague is invaluable. This person should preferably be someone who could fit in as a member of the prospective audience and does not feel inhibited about giving frank and critical feedback, with regard to both the presentation's scientific content and the delivery. For such a rehearsal to be useful, honesty must prevail over politeness. What a speaker needs most for the rehearsal is not necessarily a sophisticated expert in the field, but a well-informed colleague with whom a comfortable rapport or good friendship exists. Inexperienced speakers can benefit from rehearsing their presentations with a tape deck or cassette recorder. Listening to your own voice can be very revealing and may help turn a dull, monotonous account into an exciting story. A video recorder can also be helpful and may reveal such distractions as talking to the screen, talking with one hand in a pocket, or talking to the floor.

PREPARE—THEN RELAX

You have familiarized yourself with the composition and interests of your audience. You are armed with solid data, well-rounded knowledge, and a thoroughly organized presentation. You can do nothing more than confidently and quietly await the moment of truth. Relaxation is now essential. I have seen more seminars fail because of the self-destructive nervousness of the speaker than for any other cause. Novice speakers tend to experience extreme stress before a seminar. Yet, paradoxically, to give a good presentation it is essential to be relaxed. Listening to a nervous wreck

is disconcerting to an audience and distracts more than anything from the content of the presentation. Relaxing is, however, easier said than done. I advise my students to have fun the night before their scheduled presentations, to avoid any further rehearsals or preparations, and to engage in activities that take their minds completely off the upcoming presentation.

The worst period in terms of nervousness is usually the first 5 minutes of the presentation, during which novice speakers tend to choke, stammer, go blank, or rattle on. After a while, as the visual aids provide landmarks to guide the presentation, the speaker usually relaxes. To ease into the presentation, a nervous speaker should write down a few opening sentences on a sheet of paper and read them out verbatim in as natural and controlled a voice as possible at the beginning of the presentation (up to the appearance of the first slide), making sure not to speak too fast. In the end, the best cure for nervousness is experience. Just as time heals all wounds, experience in public speech removes all apprehension. Speakers who have to give important presentations away from home will benefit enormously from practice talks at home in their own departments, lab groups, student symposia, or journal clubs.

No matter how well prepared a presentation is, unforeseen problems may come up. The computer hook-up misses an adaptor; the light bulb in the projector burns out in the middle of the presentation; a last-minute change of lecture site delays the arrival of the audience. I have waited in front of locked lecture halls while my hosts frantically tried to find the keys. I have spoken into microphones hooked up to defective sound systems. And I have tried to use laser pointers that lacked batteries. These unforeseen setbacks should not rattle you. They are completely out of your control and are the responsibilities

of the host and the host institution. Lack of organization here reflects poorly on the host institution not on the speaker. In these cases, the audience has a responsibility to bear with the speaker and allow extra time to make up for any interruptions.

Yet such events do interrupt the flow of a presentation and are disturbing and distracting. When a laser pointer gives out, you can simply try to ignore the problem by pointing with a pen or a ruler, or describe the items on the slide verbally. Similarly, when a sound system goes down, you can speak louder. In other cases, however—when a crucial slide cannot be shown because of a burned out projector bulb—it is often better to just wait until the problem is fixed. Many destructive organizational incidents can be avoided by checking the lecture room and projection facility ahead of time. This avoids a last-minute rush after you discover that mathematical symbols prepared on your PC have all been turned into gobbledygook by the MacIntosh computer hooked-up to the projection system. Bringing your own laptop and your own pointer can prevent many potential problems. Arrive in the lecture room 15 to 30 minutes before the scheduled time and check that the projector, pointer, room lights, screen, and other accessories are in good working order. At that point, nothing more can be done to set the stage for a successful presentation, so relax!

BE PROFESSIONAL AND GRACIOUS

One year the students of our department invited a speaker to deliver a distinguished endowed lecture. He was a field ecologist who knew much about butterflies and little about social graces. Being invited by the students was an honor, as was the endowed lectureship itself. He acknowledged this by dressing in a dirty shirt that was only partially tucked into his jeans and he was wearing smelly woolen socks in open sandals.

When he met with me, 45 minutes behind schedule, in my office, he listened impatiently to my description of our student training program, then slammed a briefcase onto my desk from which he extracted a large map of Norway and proceeded to show me data on his butterfly field sites he "would not have time to discuss during his seminar." He never asked me about my scientific interests. In the evening, the students had prepared a reception for him at the private home of one of our faculty members. As soon as he arrived, wearing the same grubby outfit, he made a beeline for the food, grabbed several handfuls of sandwiches, sat down in the kitchen and stuffed himself without ever having a conversation with the host or the students. This was perhaps the worst example of inappropriate behavior imaginable, and it reflected poorly on him and his institution.

When you visit another professional organization, it is important to express interest in the activities of your hosts. This is especially important when giving a seminar as part of a job interview. Whereas the seminar is a critical factor in hiring decisions, a feel for how the candidate would blend into the community as a colleague is another prime consideration. It is always appropriate to ask the faculty member who has taken the time to meet with you what his or her research interests are; better yet, having looked at the website before the visit, one might ask about specific aspects of this person's research. If the seminar is scheduled later in the day, establishing a good rapport with several faculty members before the talk will help generate a good atmosphere during the presentation. During discussions with potential future colleagues, you should ask them (1) to talk about their research interests, (2) what they view as the strengths and weaknesses of their organization, and (3) how they envision you can help strengthen the organization.

Seminar visits can be intensive. Often I meet with speakers who arrive late the previous night, wake up early, and simply do not have the energy to talk about science with me first thing in the morning. Always arrive at a convenient time, preferably early evening or late afternoon the day before your seminar. This may give you a chance to meet with your host the evening before and get a briefing of your visit. Do not consume excessive alcohol, and retire to bed at a reasonable time to be alert and poised for an energetic visit the following day.

Avoid inappropriate topics during your visit. One seminar speaker, a well-known scientist, tried to ingratiate himself by spreading negative gossip about members of his department. It was awkward and unprofessional. As a seminar visitor you represent your institution, and it is your job to promote positively the organization with that you are affiliated. Bad-mouthing a colleague reflects poorly on you and often such stories get back to the colleague, which undermines your relationships at home. During job interviews, it is generally inappropriate to discuss start-up packages, space, or salary with faculty members other than the chairperson. Misinformation communicated by a poorly informed faculty member may create misunderstandings and difficulties for the Chair during later negotiations. In general, an initial job interview visit is intended to evaluate whether you would be a desirable colleague. Details for hiring, such as start-up funds and salary, are often discussed during the recruitment phase at a follow-up visit.

EXPECTATIONS OF YOUR HOSTS

Professional conduct is a must not only for the guest speaker but also for the hosts. Guest speakers get impressions of the

host institution, and these impressions ultimately contribute to the institution's national reputation. I have given seminars at departments where attendance was poor. Not only does this show low interest and poor hospitality, but also it reflects a socially dysfunctional and mutually nonsupportive community, often the result of poor departmental leadership. A visitor who has invested considerable time in preparing a polished presentation and has made the effort to travel to another city may expect that members of the host organization will express interest in his or her seminar, if only out of professional courtesy. When I visit an organization I expect to have an opportunity to interact with both faculty and students and to be hosted graciously. With many organizations facing budgetary constraints, one should not expect to be taken for dinner in a gourmet French restaurant, but McDonald's or the Chinese take-out restaurant are not reasonable options either. One of my colleagues once gave a seminar at a Canadian university. It required international travel and, because he felt honored to have been invited, he spent many days preparing a beautiful presentation. To his disappointment, few people showed up for his talk, because, as the host explained, "they were busy preparing for an upcoming conference." In the evening, he was taken for dinner at a Japanese restaurant, where his host and three colleagues each ordered a single sushi roll, accompanied by a glass of water for a total expense of less than $25! Back in his hotel, he was starving and, because no food service was available, he suffered a miserable sleepless night. If he were to be invited again by the same institution, he would politely decline. A host should treat his seminar guest the same way he would treat his demanding father-in-law. Social graces are a two-way street.

DRESS APPROPRIATELY

It is the day of my presentation. Here I am in my hotel room enjoying breakfast and coffee brought up by room service. I look at my PowerPoint slides again, my presentation is outlined firmly in my mind, and I feel calm, confident, and relaxed. Time to get dressed—but what should I wear? I remember a speaker who interviewed for a faculty position in our department and gave a seminar dressed in a sweaty T-shirt, jeans, and sneakers. This applicant must have thought that in academia how you dress does not matter, only how smart you are. Wrong! Dressing up for a scientific presentation conveys two important messages: respect for your audience and willingness to conform. This is especially crucial for job interviews. Many institutions think twice before offering an important position to someone who shows unwillingness to bow to the conventional social graces. Ignoring dress codes raises doubts about how the candidate would fit into a team and fears that the candidate's lack of etiquette might embarrass the institution at some future important occasion. It is true that members of an audience may not care about the speaker's attire, but some may be offended. These are often the more senior members, those who make the important decisions! Is it not wise to dress conservatively rather than insisting on making a personal statement of independence through "loud" or potentially controversial attire?

The small sacrifice of dressing conservatively shows that the occasion is important to the speaker and demonstrates respect for the host and the host's colleagues. Although most physicians do not need to wear a white coat (unless they are in the habit of spilling their coffee), many patients would feel uncomfortable if their attending physician did not wear one. The white coat is part of the professional image; it instills

Figure 1–1. This speaker may feel comfortable in jeans and an everyday sports shirt, but the careless dress and sloppy posture make him an unattractive picture. Some members in the audience may question whether he considers his presentation important, and, if this were a job interview, there would be concerns about his interpersonal skills, ability to work as a team member, and potential for representing the organization appropriately.

Figure 1–2. The speaker's appearance indicates that he has taken the effort to dress up for the occasion. It shows that the event is important to him and it expresses respect for his audience. Note that he stands in front of rather than behind the lectern, which increases his visibility and brings him closer to the audience.

confidence in the patient about the physician's competence. The same is true for seminar speakers. A well-dressed speaker commands respect as a professional. I always advise my students to dress up for their presentations, and more formal attire invariably correlates with better, more confident, more professional performances.

The formality of attire should be adjusted to suit the group to which you are scheduled to deliver your presentation. For a man, when speaking at a conservative grant-awarding foundation in Chicago, it might be wise to dress in a three-piece suit, whereas a sports jacket and a colorful tie may fit in better when addressing a small, less conservative biotechnology

FIGURE 1–3. This speaker is well dressed but is not wearing a jacket, generating an impression of friendly informality. He is talking to the audience, not just in front of the audience and presents an inviting appearance.

company in California. Jacket and tie may be unnecessary at an informal Gordon Conference in New Hampshire, but a clean, pressed shirt is perfectly appropriate. Black tie would not be out of place for a keynote address following a banquet.

Women have a wider selection of dress options than men. Just as for male speakers, however, conservative attire is always appropriate and ensures that attention remains focused on the presentation rather than on the speaker. Women should also be aware that at some occasions a radio-microphone may be used. These obnoxious instruments consist of a clumsy little box that is supposed to fit in a pocket and a microphone with a clip designed to be fixed onto a lapel or tie. I have seen many female speakers, whose dresses did

FIGURE 1–4. The advantage of a tie is that it provides a convenient central location for a clip-on portable microphone.

FIGURE 1–5. Here, the microphone is clipped to the lapel near the screen. Whenever the speaker momentarily focuses his attention on the screen, he will talk into the microphone instead of away from it.

not provide places to accommodate these items, suffer the inconvenience of having to hold the box in one hand and the microphone in the other throughout their presentations.

Finally, the moment is here! You are entering the lecture hall, well-prepared and appropriately dressed, and you take a moment to survey the arena. "Let the games begin."

IMPORTANT POINTS TO REMEMBER

- Know your audience.
- Always prepare each seminar for every individual occasion *de novo*, with the specific audience in mind.

FIGURE 1–6. The microphone is clipped to the lapel, which faces away from the direction of the screen. Thus, the speaker talks away from the microphone. It is advantageous to clip the microphone to the lapel closest to the screen, as illustrated in Fig. 1–5.

- Communication is the key. Look upon your presentation as a dialogue with the audience, not a monologue.
- Tell 'em what you're gonna tell 'em, then tell 'em, then tell 'em what you've told 'em.
- When preparing your presentation, divide the allotted time and assign a defined number of minutes to each section of the presentation—for instance, 10 minutes for the introduction, 30 minutes for the main body of the presentation, and 5 minutes to summarize and conclude.
- Never exceed the allocated time. A good rule of thumb is to keep the presentation at a length that is 80 percent of the allotted time.

- A good rule of thumb is to allot approximately 1 minute of presentation for each PowerPoint image, making 45, or at most 50, PowerPoint slides a good number to aim for when preparing a 45-minute presentation.
- Know your material. Accurate, complete, well-phrased descriptions of scientific information portray the speaker as a knowledgeable, reliable source of information. In contrast, glib, inaccurate statements that are open to multiple interpretations gradually elicit skepticism and distrust.
- Always rehearse your presentation.
- Relax. To ease into the presentation, a nervous speaker should write down a few opening sentences on a sheet of paper and read them out verbatim in as natural and controlled a voice as possible at the beginning of the presentation (up to the appearance of the first slide), making sure not to speak too fast.
- Dress appropriately to show respect for your audience.

chapter

2

The Structure of a Scientific Presentation

The Title: Information in a Nutshell

The first concern when preparing a scientific presentation is its title, which provides the first indication of the presentation's perspective. It should be brief and accurately cover the content of the presentation. Whereas *Gone with the Wind* is an attractive title for a novel or movie, "The American Civil War as Experienced by an Aristocratic Southern Woman" would be more suitable for a scientific presentation. Some scientists, like advertising agents, attempt to inject some humor into the titles of their presentations. "Thoughts of a Calcified Biologist" was the title of a seminar on aspects of calcium metabolism; however, humor lasts only a short while, and there is no information in the title to put the presentation in perspective.

Your title should help set a context for your presentation. The title should be concise and general enough to appeal to a wide audience, but not so general that it loses meaning and overstates the actual content to such an extent that the seminar

itself will be anticlimactic. Thus, titles such as "Consciousness and the Mind," "Understanding Biological Complexity," and "Expansion of the Universe" are best avoided. Often a general title can be qualified by a subtitle that specifies the scope intended for the actual presentation. "Axonal Regeneration in the Central Nervous System: The Role of Growth Cone Proteins" or "Global Warming: Its Effect on Speciation of North-American Songbirds" are titles that describe topics of general interest in the main heading and narrow the scope of the presentation within this general topic in the subheading. Note that both the main heading and the subheading are brief, to the point, and catchy. Verbs, which turn the title into a statement, should be avoided; "Growth Cone Proteins Play a Role in Axonal Regeneration in the Central Nervous System" is too long and has lost its brisk and striking character. The old scholarly preposition "on"—"On the Role of Growth Cone Proteins and Axonal Regeneration"—now seems pedantic even for written manuscripts and is certainly too formal for oral presentations.

CONTEXT AND PERSPECTIVE: ZOOMING IN

A bird's eye view of London: the Tower, Westminster Abbey, Big Ben, and the Houses of Parliament on the Thames. The camera zooms in near the river, where a group of people listen to a political speech. Suddenly, the body of a woman strangled with a necktie floats onto the shore. In the next scene, the camera shows a bird's-eye view of Covent Garden, zooming in to the vegetable stalls in the market, where the camera focuses on one man leaning against a fruit stand and eating an apple. It is clear that he is one of the main players in the movie. These scenes from *Frenzy*, one of Alfred Hitchcock's best, set the stage during the opening credits of the movie. We

know the location, the approximate era, the crime, and the main player, so the story can take off. Another cinematographic masterpiece is Federico Fellini's *La Strada*. Its most impressive scene is the last of the movie, in which the strong man Zampano, a traveling circus performer, finds himself a human outcast after he has murdered his rival and caused his devoted female companion to wither away from grief. He walks into the ocean, looks toward the horizon, and falls onto his knees in tears. The camera slowly zooms out as the music swells, showing the vast beach and ocean and the gradually receding figure of Zampano: a small man in a vast universe.

Zooming in and zooming out are not only effective cinematographic tools, but also essential concepts in structuring a scientific presentation. In fact, zooming in is the *only* effective method to put a presentation into perspective. The presentation must always start with the description of an important general principle, then gradually focus on the experimental model that the speaker wishes to describe.

Zooming in from a Major Overarching Principle

When talking about molecular aspects of olfaction, for instance (one of my own great interests), I always start my presentation by mentioning that "the olfactory system mediates the molecular recognition of a vast variety of molecules." I further mention that "these molecules represent chemical signals from the environment that provide information about the localization of food and the availability of reproductive partners and are, thus, essential for the survival of most animals." These opening lines make the importance of the topic unambiguously clear in its most general sense. It is then easy to pose the major overall question on which the rest of

the topic will focus: How does the olfactory system mediate the discrimination of myriad odor molecules?

The next step is to explain that it is essential to study this problem at the molecular level—that is, at the level of odorant receptors and the transduction processes that they trigger. But I do not immediately jump into this topic without explaining to the audience the functional anatomy of the system. I zoom in gradually, step by step. First I discuss the histology of the olfactory system and explain the organization of the tissue. Then I descend to the cellular level and explain the structure of the olfactory neuron. Finally I arrive at the molecular level and provide an account of what is known about the molecular components of the chemosensory membrane: the facts that underpin the work I am about to discuss.

By zooming in I provide the audience with a frame of reference, a bird's-eye view. I arouse their interest by starting with a general principle and narrowing the focus to the point at which they can understand and appreciate the experiments about to be described.

The following scenario is another example of how a presentation can be contextualized by zooming in: It is of paramount importance for a paleontologist analyzing fossil specimens of Miocene apes to convince the audience from the beginning of the presentation that the analysis of these fossils is not merely incidental but, in fact, crucial to the understanding of primate evolution. To achieve this objective, the speaker first provides an overview of primate and especially human evolution and indicates that there are significant gaps in our understanding of the evolutionary interrelationships between *Homo sapiens* and African apes. The speaker follows with a description of the similarities and differences in cranial features and blood serum proteins between orangutans on the one hand and chimpanzees, gorillas, and humans on the

other, and presents the argument that the African apes must share a common ancestor with modern man. This sets the stage for an account of the discovery of *Sivapithecus* and *Ramapithecus* found in the Chinji and Nagri formations in Pakistan, respectively, and proposed to represent the first Miocene fossils closely related to a common ancestor of apes and hominids.

The speaker continues to discuss in detail how the fossil bones of *Sivapithecus* and *Ramapithecus* reveal traits preserved to greater or lesser extent in each of the divergent descendants. A comparison can then be drawn between the Pakistani specimens and similar fossils found in 1989 in Greece (*Ouranopithecus macedoniensis*) and in 1992 in Hungary (*Rudapithecus hungaricus*). The description of these European specimens prepares the audience for a discussion of whether humans are more closely related to gorillas or to chimpanzees, including a survey of genomic differences in DNA sequences between humans and chimpanzees. The speaker can then zoom out again, summarize the different possible evolutionary trees, and conclude that the discoveries of the Miocene fossils in Pakistan and Europe have brought us closer to the identification of the common ancestor of ape and man.

If the detailed comparative morphology of the various skulls and bones were described for its own sake without having been placed in the context of human evolution by zooming in and zooming out, the presentation might bore the audience to tears. In contrast, to submit these findings in the context of a major biological question—namely, the quest for the evolutionary origin of man—makes the presentation fascinating.

I remember one speaker who discussed the mechanism by which the flow of calcium into adrenal chromaffin cells triggers the secretion of adrenaline. The speaker explained that

calcium enters the cells via two different pathways: the usual calcium channel, which is opened as a result of changes in membrane potential, and a second "facilitating" calcium channel. The detailed pharmacological description that followed showed how these calcium channels were regulated. Although the work was scientifically superb, the audience was disoriented from the beginning of the seminar, because the speaker failed to provide an outline that indicated why the work was important and what question the seminar was meant to address. Only at the end of the presentation was it evident that the facilitating calcium channel enables rapid and massive degranulation of the cells, which results in a fast increase in adrenaline levels in the circulation. Although it was not clearly stated, the speaker had in fact discussed an important molecular control point of the "fight or flight" response, a behavior essential for survival. If he had started off with a description of the role of adrenaline in mediating the "fight or flight" response, thus informing his listeners that regulation of the facilitating calcium current represents the molecular pathway that enables this response, then the audience would have appreciated the importance of the detailed characterization of this channel. The speaker made a crucial mistake: He zoomed out without ever having zoomed in! Although, ultimately, he did provide a punch line, failure to place his presentation in perspective from the beginning caused him to lose his audience's attention, and this seminar did not do justice to his otherwise outstanding work.

Zooming in has two important advantages. First, it emphasizes to the audience that the work to be described bears relevance to an important scientific principle rather than being an insignificant, isolated contribution. Second, zooming in defines the intellectual borders of the presentation. The scope of the talk is limited by the diameter of the diaphragm of our

zoom lens. We cannot easily stray outside this territory. Thus, zooming in automatically helps provide focus and coherence to the presentation.

Zooming in from a Historical Perspective

The process of zooming in can follow a historical description. For example, neurons depend on growth factors for their proliferation and survival. When discussing neurotrophic factors, a historical account of the exciting and Nobel prize–winning discovery of nerve growth factor by Rita Levi-Montalcini in the 1960s—might be presented. This can be followed by the discovery in 1990 of other related neurotrophic factors, such as brain-derived neurotrophic factor and neurotrophin-3, which affect the growth and differentiation of different classes of neurons. Following the historical development of this field demonstrates how the excitement of the discovery of nerve growth factor as the first neurotrophic factor received additional impetus from the subsequent realization of the existence of a whole family of related factors, of which many members may still await discovery.

Similarly, under certain conditions genes can move around in the genome, a process requiring pieces of DNA known as transposable elements, which can be exploited to generate mutations. A presentation on mutagenesis through transposable elements could begin with a description of the classic and elegant experiments by Barbara McClintock that led to her discovery of "jumping genes" in maize. This revolutionary concept, which antedated modern molecular genetics, was underappreciated for many years; finally, she received appropriate recognition in the form of a Nobel prize. Such historical accounts are also processes of zooming in and allow the audience to evaluate the importance of the speaker's

contributions relative to those of predecessors and within the context of the major scientific principle.

There are cases in which the historical perspective becomes an absolute necessity for the context of the presentation. Consider a lecture that deals with predictions of seismic activity along the San Andreas fault. Great earthquakes (magnitude exceeds 8.0 on the Richter scale) tend to occur in irregular cycles. For instance, the San Francisco Bay area experienced several small earthquakes in 1836, 1838, 1865, and 1868 preceding the great earthquake of 1906. After a period of quiescence, the area came to seismic life again in the 1950s. Small earthquakes along the fault in 1974, 1984, and 1988 preceded the major Loma Prieta earthquake that caused the collapse of the Bay Bridge on October 17, 1989. To put a presentation on predictions of seismic activity along the San Andreas fault into perspective, a speaker must not only explain the tectonic movements that generated the fault and its geographical extent, but also give an account of the dates and locations of previous earthquakes. Without this historical perspective, the audience cannot appreciate the complexity and significance of the speaker's predictions.

When putting a presentation in historical perspective, always give appropriate credit to contributions made by others in the field. This is important for two reasons. First, one of the major contributors (or a friend familiar with the work) may be a member of the audience and would greatly appreciate being cited. Second, the audience develops sympathy for a speaker who generously gives credit to previous investigators, colleagues, and coworkers; conversely, the audience distrusts a speaker who never mentions anyone else by name—for the sake of appearing to be the sole player in the game. I remember a speaker who interviewed for a faculty position at a major university. His presentation regarding state-of-the-art

molecular neurobiology was spectacular. But he did not refer at all to other groups who had made fundamental contributions to the same field several years earlier. Nor did he give explicit credit to his colleagues, who contributed to his achievements in a major way. The main publication describing his work listed him as third among five authors, and he did not make clear which contributions were his and what percentage of the work was done by his coworkers. His urge to make a big impression and his mistaken idea that withholding credit from his fellow researchers would help him succeed had an adverse effect, generating a feeling of distrust despite the excellence of the work. If he had been more generous during the introductory segment of his presentation, then his presentation would have been much better received and might have led to the desired faculty position.

Telling a Story

"When I go to a seminar, I want to hear a story." This simple remark by my friend and colleague captures the essence of a successful scientific presentation. There is a distinct difference between summarizing a collection of facts and telling an exciting and interesting story. A story has perspective, a context, a plot, and a climactic conclusion. A story should keep the listeners spellbound and fascinate them while the plot unfolds.

To deliver a coherent presentation you must have a focused concept of the topic in mind. The ability to speak coherently is closely correlated with the ability to think coherently. A clear thinker separates the central, relevant issues from merely supportive peripheral information and does not allow the direct line of thought to be interrupted by sidetracks. Moreover, experimental results do not necessarily emerge

chronologically according to their scientific significance. When presenting data, it is, therefore, essential to arrange the observations in a sequence that makes sense to the uninitiated members of the audience to generate a coherent story.

I remember a seminar that dealt with glutamate receptors. Glutamate, the major excitatory neurotransmitter in the mammalian brain, binds to receptors that mediate such fundamental processes as learning and such pathological processes as epilepsy. One would expect the presentation to have been fascinating. The presentation, however, completely lacked focus. It consisted of a collection of pharmacological, biochemical, and physiological facts that were not clearly interconnected, and the vast amounts of irrelevant detail lulled the disoriented audience to sleep. The speaker had not invested the effort to think about what was the central question to be addressed. Because glutamate receptors happened to be a fashionable topic, it was taken for granted that the audience *a priori* would be interested and assumed that an indiscriminate listing of facts would automatically result in a satisfactory presentation.

A story should have one focus and convey a single major message. Never break up a seminar by addressing one topic and then "switching gears" to address a different and unrelated topic. This often happens when a speaker does not have sufficient data to fill the allotted period of the seminar and tries to divide the available time into two portions, each dealing with different projects, both of which are often inconclusive. Sometimes young scientists interviewing for a faculty position think that combining more than one topic in a single seminar will show the breadth of their scientific exposure and enable them to display as many of their past accomplishments as possible. Readjustment to a new topic, however, requires considerable listener energy. After a listener has invested a

considerable amount of attention in following one story line, it is disconcerting to be returned to "square one." Expecting to hear only one seminar, the listener feels tricked into yet another. Changing the subject midway through a seminar makes the audience feel as if it is watching a Shakespearean play that suddenly continues as a Greek tragedy, or as if they are attending a rock-and-roll concert that unexpectedly features Schubert songs. The speaker will give a much better presentation by choosing to speak about only one of two beloved topics, even if it means shortening the presentation (a tactic often appreciated by the audience). Sometimes it is better to describe an exciting project that was completed rather than address incomplete current work; at another time a speaker may prefer to discuss exciting research in progress and forget about work done in the past that has been thoroughly chronicled and lost its appeal of innovation. Whatever the case may be, a scientific presentation should address a single topic and explore one focal idea.

The Importance of a Central Focus

Once a pediatrician gave a seminar to a group of basic scientists on inherited diseases that arise from defects in lipid metabolism. Determined to cover all of the different diseases of this kind that he had ever encountered—GM1-gangliosidosis, Tay-Sachs disease, Hurler's disease, Gaucher's disease, and Niemann-Pick disease—he provided very little introductory perspective and simply devoted about 10 minutes to the description of each syndrome. The presentation was an interesting catalogue of disorders, but it was not a *story*.

It would have been a far more interesting seminar if, at the beginning, the speaker had stressed that a defect in a single enzyme, perhaps arising from a single base substitution at the

level of the DNA, could make the difference between health and tragic illness. He could have mentioned that this is exemplified most dramatically by lysosomal storage diseases, especially those that affect lipid metabolism. He could then have provided some essential background by describing the biosynthesis and degradation of gangliosides and cerebrosides. Subsequently, he might have focused on only one of the best documented diseases, such as Tay-Sachs disease, an autosomal recessive disease that has an especially high incidence among Jews of Eastern European descent. Tay-Sachs disease arises from deficiency of a specific β-N-acetyl-hexosaminidase, resulting in accumulation of ganglioside GM2, normally present in the brain in only trace amounts. The speaker could have used Tay-Sachs disease to illustrate how a single deficient enzyme can have devastating consequences, including dementia, motor disorders, blindness, and usually death before the age of 3. He might have described diagnosis and management of Tay-Sachs disease and finished his seminar by discussing the feasibility of a future cure for this and related disorders through gene therapy. If he had provided a proper perspective and focused on one major disorder in great detail, from its diagnosis to possible future treatments, his seminar would have elicited far greater interest and appreciation.

One of the best presentations I ever heard was given by one of my students, whom I call "Joe" here. Joe's presentation described the discovery that the high-affinity receptor for nerve growth factor and the *trk* proto-oncogene product, which phosphorylates target proteins on tyrosine residues, are the same molecular entity. This suggests that activation of nerve cells by nerve growth factor is triggered via tyrosine phosphorylation. Joe first described the characterization of nerve growth factor and its receptor. He then "switched gears" and talked about the *trk* proto-oncogene. Finally, he brought

the two topics together and showed that both groups, the neurobiologists working on the receptor for nerve growth factor and the oncologists working on the *trk* proto-oncogene, realized that they were studying the same protein—a major discovery! Joe's seminar was a tour de force. He told a fascinating story that unfolded to an exciting climax. Superficially, he appeared to be talking about two separate subjects (the characterization of the receptor for nerve growth factor on the one hand and studies on the *trk* proto-oncogene on the other), but the seminar was really based on one focal idea and it conveyed a single important message.

Another delightful scientific story was presented by another one of my students, whom I call "Lisa" here, who discussed the mechanism of programmed cell death, a phenomenon known as *apoptosis*. First, Lisa convinced the audience that the question of programmed cell death was a universally important biological issue. She explained that apoptosis is an organized cellular process distinct from the traumatic cell death that occurs during necrosis. She then zoomed in to the nematode *Caenorhabditis elegans* and explained that this simple worm offers a beautiful model system because of its small number of individually identifiable cells and potential for genetic manipulation. She went on to describe a number of mutants that were defective in programmed cell death and identified one particular gene, *ced-9*, as a gene that normally suppresses apoptosis. Like Joe, she then apparently "switched gears" and focused the audience's attention on programmed cell death in of mammalian systems. She showed that a protein originally identified in a human B-cell lymphoma, known as the product of the *bcl-2* proto-oncogene, suppressed apoptosis in mammalian cells in a way similar to the product of the *ced-9* gene in *C. elegans.* At the end of her presentation, she described an

experiment in which DNA that encodes the mammalian bcl-2 protein was introduced into *C. elegans* and was able to suppress programmed cell death in the nematode! Thus the descriptions of *C. elegans* and mammalian systems came elegantly together as her seminar "zoomed out" to an exciting and climactic conclusion of general biological importance—namely, that nematodes and mammals are likely to share a common universal pathway for programmed cell death. Like Joe's presentation, Lisa's seminar presented a *story*, not just a presentation of experimental facts.

CONSTRUCTING THE PLOT

To construct a plot for a scientific "story," it is often helpful to phrase the basic idea underlying the talk as a question. The seminar then becomes structured as the gradual unfolding of the answer to that question. Writing the question on the board or projecting it on the screen helps provide an unambiguous focal issue placing both the audience and the speaker on the same wavelength. Basing your seminar on a single, well-formulated question results in a presentation that almost by necessity focuses on one basic issue. Asking fundamental questions is the essence of science. Therefore, virtually every scientific presentation can be structured as an answer to a fundamental question. These questions can be broadly or narrowly focused. How do neurons from the lateral geniculate nucleus project to the visual cortex? How does the extracellular matrix influence the growth of axons? How does deforestation cause climate changes in the Northern Hemisphere? How is fatty acid metabolism regulated during hibernation? What is the genetic architecture that determines life span? The structure of the question can also help place a presentation in proper perspective for a particular audience. Consider two questions. How

will research on AIDS benefit future AIDS patients? Will future research on AIDS benefit the American economy? These two questions would support two distinct seminars dealing with the same issue, namely, benefits of AIDS research. I often advise my students to make it clear at the beginning of the presentation what question is being addressed.

State the major question of the presentation at the beginning and then break this question down into sub-questions arranged hierarchically to gradually unfold the answer. Throughout this process, you can ask a question and then formulate the next question based on the previous answer. Segmentation of your talk into a sequence of chapters that are logically related to one another and that disclose the answer to the underlying question of the presentation step-by-step is a powerful device for structuring a coherent lecture.

Providing Focus by Constructing a Hierarchical Series of Questions

In 1982, I attended a student's thesis defense that focused on the structure and function of the nicotinic acetylcholine receptor, the first neurotransmitter receptor to be purified. After acetylcholine is released from a nerve ending at the neuromuscular junction, it interacts with this receptor on the postsynaptic membrane. This interaction generates a flow of ions across the muscle membrane, which ultimately leads to contraction of the muscle. In the late 1970s, a controversy existed as to whether the purified acetylcholine receptor also contained the acetylcholine-activated ion channel. The student began his thesis presentation by making the audience aware that the acetylcholine receptor represents the key component that mediates synaptic transmission at the neuromuscular junction and that understanding structural and

functional relations within the receptor molecule is therefore essential to understanding the molecular basis of neurotransmission. This convinced the audience that the topic was important and placed it in perspective. The general question underlying the student's seminar was "How is it possible to study structure and function relationships in the purified acetylcholine receptor molecule?" The overall answer to this question was that it is possible by incorporating purified receptors in artificial membranes under conditions in which these receptors remain intact and retain acetylcholine-activated ion channel activity.

During the seminar, the answer to the overall question unfolded in a stepwise fashion, a process during which the question was broken down into sequential series of smaller questions. To ensure that the audience was able to follow the logic of the presentation, each of the questions appeared on a slide and was addressed with data from appropriate experiments; afterward, another slide formulated the conclusion. The first question was "Can acetylcholine receptors be purified under conditions in which ion channel activity remains preserved after reincorporation into artificial membranes?" Experimental data showing that this is indeed the case were summarized on a slide with a conclusion written on it.

The next question appeared on another slide: "Are the binding sites for acetylcholine and its associated ion channel part of the same protein?" Evidence was presented showing that receptors purified under conditions defined in the first segment of the presentation can mediate the flux of ions when activated by acetylcholine. A summary slide stating "The purified acetylcholine receptor contains both the acetylcholine binding sites and the acetylcholine regulated ion channel" concluded the second segment of the presentation.

The final sub-question followed: "Are the pharmacological properties of the acetylcholine receptor in artificial membranes similar to those in the native membrane?" Data were presented demonstrating that after incorporation in artificial membranes, acetylcholine receptors are pharmacologically intact and show the same acetylcholine-induced conformational transitions as receptors in the native membrane. This third segment was followed by an overall summary slide that stated that pharmacologically intact acetylcholine receptors could be purified and reconstituted in model membranes, and that this approach demonstrated that the purified acetylcholine receptor molecule contained both the binding sites for acetylcholine and the acetylcholine-regulated ion channel.

The clear formulation of the major question (and its answer) as well as its breakdown into an organized series of sequential secondary questions and answers provided a logical structure for the presentation and made it easy for the audience to keep track.

Another example of a coherent presentation that was structured as a hierarchically arranged series of questions was a seminar given by a student in ecology. The student discussed mathematical models that could describe the growth of populations. The basic question addressed by the seminar was "Can the growth of a simple population that consists of a single species and lives in a controlled environment be predicted mathematically?" Because the answer to this question appeared not to be a simple "yes" or "no," the student proceeded to break this question down into a series of subquestions. The first was "What mathematical equation might describe the growth of such a population?" The student explained that the size of the population would be measured

after each generation and that, rather than counting the actual number of individuals, the population size would express the percentage of some limiting maximum number of individuals. Thus, the percentage of the population after n generations, P_n, could be described by the simple equation $P_n + 1 = kP_n(1 - P_n)$, where $0 \leq P_n \leq 1$ and where k is an environmental constant that depends on ecological conditions such as food supply or space limitations. The student wanted to argue that this seemingly simple equation could generate complex behavior depending on the value of k. Thus the next question was "How does this system behave at low values of k?" The student answered this question by showing an iterative model of the population's size at a value $k = 0.5$ and demonstrated that, at this value of k, the population would die out after about 8 generations.

To make the model more interesting, the student proceeded to ask the contrasting question: "What happens to the growth of the population at larger values of k?" A series of intriguing observations were then presented, showing that when values of 1.2, 2, or 2.7 were assigned to k, the size of the population would stabilize at a defined limiting value. However, when the value of k was set at 3.1, the size of the population showed fluctuations between two distinct values, and at $k = 3.7$ a more complex pattern of oscillations in population size between four distinct values was observed.

Finally, the student asked whether conditions might exist under which the behavior of the population became unpredictable. The answer to this question was revealed when he entered a value of 4 for k in the equation. The model then showed random fluctuations in the size of the population, revealing inherently unpredictable behavior. After this critical analysis of the model and its implications, the student concluded that the dynamic behavior of a simple population under controlled environmental conditions can be predicted

only under certain conditions that depend on the value of the environmental constant, k, and that the simplest prediction, namely extinction of the population, can be made reliably only when k is small. Focusing in on a single model to address an important biological issue by examining the model via a hierarchically arranged series of questions allowed the student to provide a coherent analysis that was intelligible even to a nonmathematically inclined audience.

Finally, let us consider an example from the industrial world. A university professor has developed a novel transdermal drug delivery system that is particularly suitable for the sustained administration of steroids. Realizing potential financial benefits, she attempts to convince a large pharmaceutical firm specializing in steroids to market her invention. The success of the college professor hinges on a presentation she has to give to the board of directors of the pharmaceutical company. Her goal is to convince them that use of the new drug delivery system would increase their profits.

For the presentation to be convincing, it has to be focused and coherent. Once again, it is possible to set up the talk as a series of questions. The major question would be "How can the large pharmaceutical company benefit from the drug delivery system developed by the college professor?" The professor would explain that the system developed in her laboratory can be used to deliver pharmaceuticals produced by the firm more effectively, thereby providing an advantage in the market.

The overall question can be subdivided into smaller questions: "What type of pharmaceutical formulations could be developed?" The professor would indicate how certain products could be developed only as a result of combining her expertise with the resources of the large company. "How much profit could be expected from marketing the proposed

products?" The professor would point out the size of the potential market, the ease with which already licensed compounds encapsulated in a new noninvasive delivery system would be approved by the Food and Drug Administration, the scarcity of competitors working on similar products, and so forth.

At the end of this analysis, a reasonable estimate of profits envisioned to be received by the large pharmaceutical firm and royalties payable to the professor would be discussed. Finally, the important concluding question is asked: "How much would the pharmaceutical firm have to invest?" The professor would indicate to the board of directors that the necessary investment would be modest for a company of their size.

The presentation could then be summarized by concluding that it would be advantageous for the large company to market the researcher's invention. Structuring the talk as a hierarchical series of questions results in a focused and convincing presentation.

MAINSTREAM AND SIDETRACKS

The most characteristic feature of an exciting story is its *momentum*. Momentum is hard to define. It is the perceived integrated quality of the presentation, composed of the inherent interest of the story, its structure, and its delivery. A story that lacks momentum puts an audience to sleep, whereas a story endowed with momentum keeps the listeners at the edge of their seats. An unfocused story, not properly put into perspective, can never gain momentum, but focus and careful structure of the presentation alone are not sufficient. The delivery, which is discussed in greater detail later in this book,

contributes in a major way to the momentum of a presentation. However, focus, coherence, and a well-orchestrated plot are prerequisites for the seminar to acquire momentum, which may ultimately generate the conquering pizzazz and irresistible flair that make a presentation memorable.

As I have asserted, a scientific presentation must have a focal point. The mainstream of the presentation should be directed toward answering the single major underlying question. However, it is often necessary while building an argument to provide the audience with background information that is not directly relevant to the major focus of the presentation but that is nevertheless essential for the audience to appreciate the argument thoroughly. Several such excursions may be required during the course of a normal presentation. These sidetracks have their advantages and inherent dangers. On the one hand, they provide accentuation and depth to a presentation in the same way in which the multitude of colors of Renoir's marvelous painting *La Fête dans le Moulin de la Galette* provides an unequaled feast of light, or the embellishments of a Mozart aria provide richness and glamour to the music. But more often than not, sidetracks to the mainstream of the presentation threaten the loss of the lecture's most important attribute—its momentum.

There are three simple rules for preventing the loss of momentum as a result of sidetracks: (1) Keep the number of sidetracks to a minimum and use only those that are absolutely essential. (2) Keep the excursion from the mainstream as brief as possible, providing only the minimal amount of ancillary information that is absolutely crucial for a full appreciation of the presentation's mainstream. (3) Always make clear where the sidetrack starts and, when it is complete, return to the same point of the mainstream.

When giving a seminar on the neurobiology of learning, for example, one might build the seminar around the argument that the phenomenon of "long-term potentiation" in the hippocampus underlies at least some forms of learning. After describing the phenomenon of long-term potentiation, it may be essential to familiarize the audience somewhat with the pharmacology of glutamate receptors, which mediate long-term potentiation by allowing calcium to flow into the post-synaptic cell. The pharmacology of glutamate receptors, although not part of the mainstream of the presentation, may constitute a sidetrack that provides ancillary information necessary for the remainder of the presentation. Because it would be very easy to give a whole seminar on the complex pharmacology of the glutamate receptor alone, the speaker must limit the description to the minimal information needed to support the rest of the presentation. To introduce this sidetrack, the speaker, while showing a slide demonstrating the phenomenon of long-term potentiation, could say, "At this point I have to take a few moments to describe to you the molecular basis for this phenomenon, namely the glutamate receptor." At the end of the *brief* sidetrack, the speaker could show the same slide that introduced the sidetrack and continue the presentation from there. This strategy allows both the speaker and the audience to mentally separate the mainstream from the sidetrack, retaining emphasis on the mainstream and preserving the momentum of the presentation.

Another example is a presentation in which alternative nucleotides in the DNA sequence of a gene are shown to be associated with variation in the number of mechanosensory bristles in a natural population of fruit flies. Associating such alternative nucleotide sequences known as single nucleotide polymorphisms (SNPs) with phenotypic variation requires a statistical genetic technique, known as linkage disequilibrium

analysis. To place the presentation into perspective, the speaker would start off introducing the fruit fly, *Drosophila melanogaster*, as a superior genetic model system for studies on the development of the peripheral nervous system, as exemplified by the number of mechanosensory bristles on the fly's sternum and abdomen. The speaker would indicate that in natural populations this number varies among individuals just as different people differ in height or weight. The speaker might emphasize that genes that contain sequence variants that contribute to this variation provide the substrate for evolution and natural selection. Next, the speaker might indicate that such candidate genes have been identified. At this point, the speaker wants to present proof that a particular polymorphism in one of these genes is indeed associated with variation in bristle number. This requires the introduction of a sidetrack that explains the concept of "linkage disequilibrium"—that is, the observation that nearby sites in the genome that have not been separated by historic recombination events will not segregate independently—and how this property of the genome can be exploited to prove a statistical association between sequence variation and bristle number. It would be easy for the speaker to digress into a long-winded discussion of statistical models and equations to the point where the audience that expected to hear a presentation about evolutionary genetics of the development of the peripheral nervous system feels that they have wandered into the wrong lecture hall and are attending a lecture on statistical genetics. Thus, the sidetrack should be brief, explained with as little mathematical complexity as possible the basic concept of linkage disequilibrium, and returned swiftly to the point in the presentation where understanding this concept can now be used as proof that variation in the DNA sequence of the gene is indeed associated with variation in bristle number.

PROVIDING EMPHASIS ON A TOPIC BY RELATIVE TIME SPENT DISCUSSING IT

Every teacher is well aware that the extent to which points conveyed during a lecture are remembered is proportional to the amount of time dedicated to them. Thus, relative time dedicated to a segment of the presentation determines whether this segment is perceived as part of the mainstream or as a sidetrack.

An example of the deliberate use of relative time spent on a topic to emphasize a particular perception occurred in 1996 at the U. S. Republican National Convention during the acceptance speech of Senator Robert Dole as presidential candidate. During his long speech, he reminisced extensively about his younger years but barely mentioned his major qualification for public service, 40 years of distinguished service in the Senate. He had chosen to portray himself as a "Washington outsider," and mentioning his long career in the Senate, however respectable, would have undermined that image.

A lecture on the visual system may cover refraction of light by the cornea and lens, retinal physiology, the neural projection to the thalamus, parallel processing of the visual signal, and the organization of the visual cortex. If the lecture lasts 1 hour, and three-fourths of that time is dedicated to how light is refracted in the eye and how, consequently, the image is projected upside down and left to right on the retina, it is likely that days later students may remember some of the mechanisms of image projection on the retina, but they may not even remember that the thalamus and cortex were ever mentioned in the 15 minutes remaining when all else was discussed. Time spent on an aspect of the presentation should be directly proportionate to the emphasis one wishes to place on that aspect.

Different Perspectives for Different Audiences

The temptation to enter into sidetracks is greatest with interdisciplinary subjects or topics that bear directly on diverse areas of biological sciences. For example, consider a presentation on malignant hyperthermia. This human genetic disorder only becomes manifest during anesthesia when it results in skeletal muscle rigidity, hypermetabolism, and high temperature. If not immediately reversed, it can be fatal. The disease is thought to arise from a defect in the calcium-release channel of skeletal muscle sarcoplasmic reticulum, also known as the ryanodine receptor, which is encoded by the *RYR1* gene. This gene has been localized to human chromosome 19q13.1. A presentation on malignant hyperthermia for a group of clinicians could focus on the function of the normal gene product and explain how a genetic defect in the *RYR1* gene results in impaired calcium metabolism in skeletal muscle during anesthesia. The speaker may want to emphasize that knowledge of the chromosomal localization of the *RYR1* gene may enable the development of improved diagnostic tests to identify individuals predisposed to malignant hyperthermia. It may be necessary for the speaker to enter into a sidetrack to describe the genetic mapping procedures. But by showing large numbers of families containing normal and affected siblings and by detailing all the chromosomal markers and linkage studies, a speaker could easily allow this type of sidetrack to overtake the focus of the presentation. For this audience, the brief digression could start at the point where the lecturer has indicated the problems that may arise during anesthesia in patients afflicted with malignant hyperthermia. At the end of the sidetrack, the speaker can return to the same point and indicate how information on chromosomal localization of the

RYR1 gene may be of value in identifying the disorder in individuals at risk before administering anesthesia.

The same speaker addressing an audience of geneticists involved in mapping the human genome, however, might well want to focus the presentation primarily on the mapping procedures and describe in great detail several linkage studies and polymorphisms in and near the *RYR1* gene. The chromosomal localization itself rather than the manifestation of the disease can then be placed in the spotlight; in this configuration, the description of symptoms resulting from the genetic aberration becomes the sidetrack, serving to illustrate how mutant phenotypes encountered in certain families can be identified and used to map the gene. The description of the disease and its prevention, which represented the main focus of the presentation for the audience of clinicians, becomes merely incidental to the audience of geneticists who are interested in the organization of the long arm of chromosome 19. Notice how in this example the composition of the audience determines the focus of the presentation and how this focus can shift dramatically even though the central topic remains the same.

AVOID BACKTRACKING

It may happen that during the course of a presentation the speaker realizes that he or she forgot to mention something that should have been said earlier. This can pose a problem, in that backtracking is one of the most certain ways to undermine momentum. The best way to avoid backtracking is to be so well prepared for your presentation that the problem will never arise. If it does occur, however, you must carefully and quickly decide how really important is the deleted material. Is it possible to simply carry on without it? This is often the

preferable solution. For instance, consider a speaker who discusses the function of the *Hox* gene, which regulates segmentation during ontogenesis of the mouse. This speaker intended, but forgot, to mention that this gene was discovered as a homologue to the *Ubx* gene, which controls segmentation during the development of *Drosophila*. If this information is not essential for the rest of the presentation, which focuses on embryogenesis of the mouse, it can simply be deleted. The predicament is slightly more complicated if several *Drosophila* researchers working on the *Ubx* gene are members of the audience. The speaker must then decide whether to offend them by not giving credit to *Drosophila* researchers, who opened up the field currently being discussed, or whether to harm the momentum of the presentation by backtracking (notice also the temptation for sidetracks, which in this case could involve a lengthy discussion of segmentation in *Drosophila*). If the deleted information is crucial for the final conclusion of the talk or for other reasons, the speaker has two options: (1) to incorporate the information somehow at another place in the presentation as smoothly as possible, whenever an opportunity arises, or (2) to backtrack openly: "I am sorry, but I forgot to mention . . ." The latter certainly leads to a flaw in the presentation, like a scratch on a brand-new car. The irritation to both speaker and audience will perhaps teach the speaker to be better prepared next time!

Formulation and Argumentation

"Is there a method to your madness?" is a question that sometimes appears in the eyes of the confused listener. To keep an audience motivated to invest energy in trying to comprehend your arguments, it is essential that the lecture proceed as a logical unfolding of information. During the presentation,

facts must be enumerated in sequential steps, each step firmly building upon the previous one. Every statement that provides new information should tie into information from the previous sentence. Because every sentence has the ability to alter the context or the interpretation of the presentation, explicit ongoing reference to the subject of the story limits the number of possible interpretations.

Consider, for example, a presentation that starts with the following statement: "In 1987, a team of British scientists sailed to the Galapagos Islands to study turtles. When they arrived, they were in poor condition." It is not clear to the audience what to expect next. Were the turtles in poor condition? Were the scientists in poor condition? Or were the islands in poor condition? Of course, the title of the seminar helps shape the context for the audience, unless the title is also uninformative, for example, "Nineteen Eighty-Seven: A Memorable Year for a Group of British Scientists." The title "Turtles of the Galapagos Islands, an Endangered Species" would suggest that the speaker meant to indicate that the *animals* were in poor condition when the scientists arrived. Had the title been "Aftereffects of Seasickness in the Tropics," the audience might expect that the *British scientists* were in poor condition after sailing to the islands. Finally, "Erosion of the Shore Line of the Galapagos Islands" would indicate that the scientists, who had come to study the turtle population, noticed that the *islands* were in poor condition. Revised, such a statement eliminates ambiguity and prepares the audience for a presentation on the fate of turtles of the Galapagos Islands: "In 1987, a team of British scientists sailed to the Galapagos Islands to study turtles. When they arrived, the animals were in poor condition." Frequent statements of the explicit subject under discussion make it easier for the

audience to follow the speaker's line of thought as the story unfolds.

It is useful at this point to introduce the concept of *Umwelt*. In ethology, the German word *Unwelt* is defined as the total characteristic perception with which an organism perceives its surroundings, depending on the sensory organs with which it is endowed. Although operating in the same milieu, your audiovisual Umwelt is different from the predominantly olfactory Umwelt of your dog. Speakers each live in an intellectual Umwelt, a realm of concepts and insights with which they are so familiar that it has become second nature to them. Each member of the audience also has his or her own intellectual Umwelt, and it is where these Umwelts overlap that we can effectively exchange information.

Remember that your labyrinth of knowledge, with its familiar shortcuts, alternative routes, and interconnections is unfamiliar to the audience listening to your story for the first time. The audience has to be led by the hand through this maze of information to arrive safely at the treasure in the center. Many speakers, when presenting experimental data, presume that the audience is familiar with technical details that to them represent an everyday routine. They treat the experimental design as merely incidental and expect that the audience can fill in the gaps if they simply mention the conclusions of their data.

For example, a speaker who addresses an audience consisting primarily of nonexperts in biochemistry may present data as follows: "This Northern blot shows that this receptor is only expressed in the heart." The audience stares at the picture of the gel without really understanding what the blobs represent. It would be little trouble for the speaker to modify his presentation as follows: "To investigate in which tissues

this receptor occurs, we extracted messenger RNA from several different tissues, fractionated these RNAs on a gel, and immobilized them to a nitrocellulose membrane. We then probed the membrane with DNA that encodes the receptor to identify bands containing messenger RNA complementary to this DNA. As you can see on this slide, the only tissue that shows a band is from the heart. Thus, we can conclude that this receptor is only expressed in the heart." The speaker has now guided the audience through the data so that they can better understand and appreciate the results. Furthermore, explicit descriptions of experimental design display a speaker's knowledge and authority.

AVOID JARGON

To communicate effectively, avoid the use of hyperbole or jargon whenever possible! Few members of an uninitiated audience may understand what is really meant by "the functional significance of defining the molecular parameters of a protein's structure"; instead of using complex terminology, simply ask how the protein's structure enables it to perform a given function. Similarly, when the molecular biologist talks about "footprints in the CAAT box," few members of the audience will recognize the reference to gel patterns that reveal a well-known regulatory region controlling the expression of many genes. A neurobiologist who talks about the PFC and VTA, which in his mind are perfectly familiar concepts, is guaranteed to lose his audience instantly, if he does not explain that he is referring to the prefrontal cortex and ventral tegmental area and where these areas are anatomically located.

Scientists immersed daily in a world of professional terminology may not appreciate that what in their intellectual

Umwelt are considered ordinary phrases are perceived as unintelligible jargon by an uninitiated audience. If the audience has to invest part of its limited energy to decipher unfamiliar terms, less energy will remain for attending to the scientific content of the presentation. In general, it is difficult for members of an audience to absorb new information and at the same time manipulate that information mentally and analyze it. They need all of the help the speaker can give them to keep track of the story as it unfolds. It is easy to lose an audience, and once that happens it is usually impossible to reactivate their interest.

Express Yourself Precisely

Precision in formulating your arguments is another prerequisite to delivering a strong scientific presentation. Speech reflects our thought processes, and an imprecise speaker is often an unfocused thinker. Moreover, unlike a written article that can be edited and revised, read and reread, an oral presentation gives the author only one chance to present his or her views. Once the words are uttered, they move into the audience's memory and outside the speaker's control. There is no revision, no editing, no correction after the fact. A glib, nonchalant speaker leaves a poor impression on the audience and can get in trouble during the discussion session if forced to retract or clarify imprecise or poorly formulated statements that were open invitations to attack. "That is not what I meant" is a very poor answer to a question that arises because the speaker was initially careless in formulating a point.

A careful and thoughtful speaker impresses the audience as a solid scientist. There are big differences among the phrases "These data *demonstrate* that," "These data *support the notion* that," "These data *consolidate* the notion that," and

"These data *suggest that*." There is also a big difference between statements that something "*can* occur" and "*might* occur." New scientific ideas are often developed through combinations of hypotheses, speculations, and experimental evidence. You should carefully analyze the often fuzzy borders that separate experimental evidence from speculation. The care with which this intellectual process is performed is reflected in the manner in which you choose your words.

HANDLING DISAGREEMENT GRACIOUSLY

Discussion and disagreement are two characteristic properties of the scientific endeavor. Frequently, we find ourselves compelled to present experimental data or a personal viewpoint not in line with generally accepted ideas or in conflict with data or hypotheses promulgated by a competitor. In these situations you have two options. You can ignore the prevailing ideas or the competing opinion and simply present your own observations, or you can discuss the points of dissent explicitly. The latter is almost a necessity if your idea is a radical departure from accepted notions rather than a minor disagreement, or if the dissenting competitor is a member of the audience. In such cases, present first the generally accepted viewpoint or the competitor's hypothesis and subsequently formulate the arguments supporting your own point of view. This allows the story to evolve from the generally accepted viewpoint toward your own hypothesis while you present arguments to convince the audience that the concept initially described is inferior to your newly developed model. In addition, your hypothesis—treated last—receives greater emphasis. To offer your own hypothesis first and then mention possible alternatives is likely to generate skepticism

toward your ideas and place more emphasis on their limitations and alternatives. As speaker, you have the opportunity to have the last word. That opportunity should not be ignored.

Always be tactful and discreet when referencing data or hypotheses from other investigators that are in disagreement with your own ideas. Even if certain notions are considered simplistic or if some data are likely to be artifacts, you should never bluntly point this out to your audience. There are elegant and gracious ways to convey the same message. Begin by simply stating the ideas with which you disagree: "Dr. Jones obtained the following data, which illustrated that this agent has potent antihypertensive effects; based on these data, she hypothesized that these effects may be mediated via a target site in the central nervous system." Your description of her approach can now, in subtle ways, point out that the initial experiments by Dr. Jones were seriously flawed: "Because Dr. Jones's experiments were primarily done on old, pregnant, female rats, we decided to investigate whether similar effects could also be observed in male rats or nonpregnant females. Furthermore, rather than using the chemical measurements described by Dr. Jones, we used a highly sensitive radioimmunoassay, which shows absolute specificity for this compound. Our data, demonstrated on the next slide, show that the target sites for this antihypertensive agent are localized specifically to the kidney. Of course, this does not mean that in older, pregnant females, the compound's target sites could not be located in the brain." Nobody in the audience will think it feasible that this drug suddenly affects areas in the brain of old, pregnant rats but not other rats. It is clear to the audience that Dr. Jones's chemical measurements were most likely flawed and that the sources of her animals were dubious. Your listeners will be convinced that your results are correct,

even if Dr. Jones's original paper has been a classic for many years. If you boldly state that Dr. Jones is incompetent and the experiments artifactual, the audience will be shocked and Dr. Jones offended. There is a difference between a street urchin's brawl and a gentleman's duel. The scientist should always fight like a gentleman. (And, of course, one never knows; in the end, Dr. Jones may be right.)

RECOGNIZE LIMITATIONS UP-FRONT

To present sound and convincing argumentation throughout the presentation, always reflect on the following questions: How solid are my data? Is it justified to draw these conclusions based on the facts that I am presenting? Are there alternative interpretations of my data? A critical assessment of your own presentation is essential to gain the listeners' credibility. Especially in science, it is important to understand relationships of cause and effect. Most flawed arguments result from lack of appreciation for the difference between causation and correlation. For example, for many years the American Cancer Society argued that smoking causes lung cancer, based mostly on the substantially higher incidence of lung cancer among smokers. Protagonists of the tobacco industry challenged this contention as a mere correlation that fails to establish a direct, causative link between this disease and the activity of smoking.

The migratory behavior of birds is another example of the difference between correlation and causation. Every fall Canada geese travel many miles from their northern breeding grounds to the central and southern United States. Because the onset of their journey correlates with declining temperatures, one could conclude that colder weather triggers migration. However, it has been established that the shorter photoperiod

(lengthening nights) rather than the cooler temperature directs the onset of migration. If different observations are made under the same experimental conditions, it is difficult to conclude that one of these observations leads to the other without showing this *directly and unambiguously*.

By recognizing the limitations of your experiments and clearly defining the conditions under which your conclusions are valid, you gain the respect and credibility of your audience.

The issue of argumentation is also directly related to the amount of detail that should be included in your presentation. Ask "What argument do I want to make?" Present only information directly relevant to this argument. Peripheral, "decorative" information should be deleted. When I advise one of my students to omit a slide from an upcoming presentation, I often hear "But it is such a pretty picture!" Pretty is not enough. The information needs to function within the presentation; if it has no functional merit, it becomes distracting and interferes with the main focus. On the other hand, the arguments that support an important point of the presentation should be complete. The audience cannot guess what type of supportive data the speaker is *not* presenting. Like a jury in a courtroom, it can only weigh the validity of the speaker's argument based on the data presented. A court indeed it is! The speaker is being judged, and the punishment for a guilty verdict may be as light as a blemish on the speaker's reputation for a seminar deemed mediocre or as severe as the loss of a job opportunity or the possibility of funding.

The Conclusion: Brief and to the Point

Just as zooming in is essential in the early stages of a presentation to put the talk into perspective, zooming out can be a

valuable tool near the end of a presentation, when we can remind the audience once again that the data we have offered relate back to the major scientific principle with which we started. This, again, enables the audience to appreciate the significance of the work within a larger context.

I remember an excellent presentation by an evolutionary geneticist who argued that species differences during evolution are mostly driven by changes in regulatory sequences that control relative expression levels of genes rather than in their coding sequences. After presenting numerous examples, she concluded her presentation by paraphrasing the legendary evolutionary geneticist Susumu Ohno who had asserted that "if you give me the coding sequences of a chimpanzee and the regulatory sequences of a mouse, I will give you a mouse." This elegant conclusion provided an effective take-home message for her presentation that was concise and memorable.

In a similar example, a speaker who delivered a presentation on the genetic architecture of chemosensory behavior in the fruit fly, *Drosophila*, showed that single gene mutations with small effects on this behavior have far reaching effects on the expression of a multitude of other genes. At the conclusion of his presentation he showed the famous signature poem by the Japanese seventeenth century haiku poet Matsuo Basho "At an old pond, a frog jumps in, there is the sound of water." His PowerPoint effects then transformed the "old pond" into the genome, the "frog" into a mutation, and "the sound of water" into ripples through the transcriptome. Ending the presentation in this catchy way captured the major take-home message effectively in such a way that all those who attended the presentation would remember the main point.

Not all presentations have to end with a flamboyant or unusually creative conclusion slide. A well-phrased statement

or well-designed diagram is usually perfectly adequate, but the conclusion of a scientific presentation should always be firm and decisive, like the final chords of a Beethoven symphony. I have seen many potentially excellent seminars fizzle out or fade away because the speaker did not know how to end. The conclusion of the presentation is its most important moment. It provides the take-home message, often the only thing that will be remembered. It determines the final impression and impact that you will make on your audience. The conclusion should always be reduced to a concise statement, preferably shown as text or a simple diagram on a slide or overhead transparency. Sometimes speakers finish their presentations with long lists of conclusions that occupy several slides (often such a presentation is unfocused in the first place). It is impossible for an audience to absorb a diverse array of conclusions. The conclusion should consist of a single major statement, with not more than two or three connotations, if these are absolutely essential.

Speakers frequently finish their presentations by acknowledging contributions by their colleagues and coworkers, often showing their names or pictures on the final slide. I prefer to show the names of my collaborators on slides just before I discuss their contributions to the overall work: "At that moment, Dr. X [slide with the name or picture appears] in my lab decided to follow up on these experiments and designed the following approach [next slide]." These strategies not only give more effective and explicit credit than simply listing all the various contributors at the end of the presentation, but they also prevent the credits from diluting your final take-home message.

After stating the conclusion, the speaker should simply say "thank you" and stop talking. Any further words will distract

from the conclusion and harm the presentation. The conclusions should very clearly demarcate the end of the lecture. I have listened to many speakers who show a clear and crisp conclusion and then feel compelled to continue to discuss their ideas for future research or to indicate what else their labs are doing. When the audience thought that the presentation was over, they were forced to listen to more, unrelated material for which they were not properly prepared. They could only guess when the talk would end. They started to look at their watches, and some sheepishly sneaked out of the room when the speaker turned toward the screen.

INCORPORATING FUTURE DIRECTIONS DURING INTERVIEWS

When a young scientist interviews for a faculty position, it is often required that he or she indicates future research directions. Although the ideas for future research should be clearly demarcated as separate from previous work, they should nonetheless be interconnected with the seminar's main storyline and should precede, not follow, the main conclusion. For example, a young scientist, who identified genes that regulate flowering time in the plant, *Arabidopsis thaliana*, a mustard weed that is a popular model for plant developmental biology, is interviewing for a position as assistant professor at a major university. During her seminar, she describes the effects of mutations on flowering time and indicates how these mutations implicate two genes in this important reproductive process. She could then present a conclusion of her work and after that continue to discuss her future research interests. These might include asking how the genes she identified previously interact, for example, by creating double mutants, or searching for additional genes by performing a large mutagenesis screen. If she organized her seminar in this format,

however, it might dilute the impact of her past accomplishments. Her presentation would be more effective if she discussed the value of double mutants and the need for a large mutagenesis screen immediately while discussing her discoveries of these genes, indicating that this would constitute her future research. She could then finish the seminar with an overall conclusion that she has identified two genes critical for determining flowering time and that interactions between these genes and the identification of additional genes that impact flowering time represent a clear avenue for future studies. Rather than inserting an overall conclusion to demarcate a break with the past and a new beginning, this organization of the seminar generates the impression that she has a well-defined career focus with a clear conceptual path in which her past experience guides her seamlessly toward reasonable future goals.

Never Go Overtime

As mentioned earlier, the audience comes to a seminar equipped with a defined amount of listener energy. This energy is dispensed as the presentation proceeds and is exhausted at the moment the seminar is expected to terminate. If your presentation goes only 5 minutes overtime, those 5 minutes represent less than 10 percent of the total allotted time of a 1-hour seminar. Yet the audience experiences this increment as disproportionately longer, and their attention drops dramatically. A car with an empty gas tank will not go that one extra mile, even though it has been driven all the way across town. A speaker who does not know when to finish can do irreparable damage to an otherwise excellent presentation. Violating the time limit generates in the audience the same feeling we have when stuck in a traffic jam on the

highway; impatience and irritation mount every minute. The most important rule for a scientific presentation is to finish on time and on a clear and resonant note. A single exclamation point, one glamorous crescendo, one majestic moment—then silence.

SOME BASIC PRINCIPLES OF HOW TO STRUCTURE A PRESENTATION

We can now summarize four of the basic principles that enable us to structure a focused and coherent presentation:

1. Three devices can put a presentation in the desired perspective:
    a. Indicate the scope of the presentation by an informative title.
    b. "Zoom in" to the topic during the introductory segment of the presentation and "zoom out" near its end.
    c. Decide on the underlying question that the presentation seeks to address, then divide that question into a hierarchically organized array of sub-questions, and develop the presentation as a series of answers to these questions.
2. The mainstream of the presentation should address a single focal issue, tuned to the interests of the audience. Sidetracks from this mainstream should be brief and should always return to the same point in the mainstream where they started. Omit information not directly relevant to the focus of the presentation, and avoid backtracking.

3. The statements constituting the mainstream of the presentation should delineate a clear, logical line of thought. Formulate explanations of scientific concepts and experimental methodology unambiguously, without using professional jargon.

4. The presentation should end with a clearly formulated, concise conclusion. When the take-home message has been delivered, stop.

Important Points to Remember

- Tell a story. There is a distinct difference between summarizing a collection of facts and telling an exciting and interesting story.
- Your story should have one focus and convey a single major message.
- Zooming in is an effective method to put a presentation into perspective. It emphasizes that your presentation bears relevance to an important scientific principle and defines the intellectual borders of the presentation.
- When putting a presentation in historical perspective, always give appropriate credit to contributions by others in the field.
- To construct a plot for a scientific "story," it is often helpful to phrase the basic idea underlying the talk as a question. The seminar then becomes structured as the gradual unfolding of the answer to that question.
- The presentation should proceed as a logical unfolding of information. Separate the central, relevant issues from merely supportive peripheral information, and do not

allow the direct line of thought to be interrupted by sidetracks.

- Avoid the use of jargon whenever possible.
- There are three simple rules for preventing the loss of momentum as a result of sidetracks: (1) Keep the number of sidetracks to a minimum and use only those that are absolutely essential. (2) Keep the excursion from the mainstream as brief as possible, providing only the minimal amount of ancillary information that is absolutely crucial for a full appreciation of the presentation's mainstream. (3) Always make clear where the sidetrack starts and, when it is complete, return to the same point of the mainstream.
- Time spent on an aspect of the presentation should be directly proportionate to the emphasis one wishes to place on that aspect.
- Carefully separate experimental evidence from speculation. By recognizing the limitations of your experiments and clearly defining the conditions under which your conclusions are valid, you gain the respect and credibility of your audience.
- Handle controversy graciously. Always be tactful and discreet when referencing data or hypotheses from other investigators who are in disagreement with your own ideas. Present first the generally accepted viewpoint or the competitor's hypothesis and subsequently formulate the arguments supporting your own point of view.
- Zooming out can be a valuable tool near the end of a presentation, when you can remind the audience once again that the data you have offered relate back to the major scientific principle with which you started.

- The conclusions should clearly demarcate the end of the lecture and be firm and decisive. It should consist of a single major statement that delivers a concise take-home message.
- The most important rule for a scientific presentation is to finish on time and on a clear and resonant note.

chapter

3

Visual Displays: How to (and Not to) Use Them

The Power of PowerPoint

Visual displays are at the very heart of scientific presentations, because they show the actual data. Appropriately chosen and well-designed diagrams, figures, and cartoons go a long way toward making a presentation successful. Whereas slides and overhead transparencies used to be the common means of data presentation, computer-assisted projection is now the norm; among the available programs, Microsoft's PowerPoint has emerged as the nearly universal standard. PowerPoint allows not only high-quality visual displays but also full audiovisual integration, and it contributes convenience and flair. However, the basic guidelines for the appropriate design of visual displays are the same whether the image is presented on a conventional slide, a transparency, or through computer-assisted projection.

Attention needs to be paid to the illumination in the room. If dimmers are available, the room should not be darkened more than necessary to clearly show the slides. Darkness

invites the audience to daydream or fall asleep. When the seminar contains a period in which slides are not shown, the screen should be blank and the lights up. An image that remains on the screen although the speaker has long since finished describing it becomes a distraction. Changing the illumination in the room according to ongoing needs also helps keep the audience alert and attentive.

As indicated earlier, the pacing of visual images should be reasonable, approximately 40 to 50 slides spaced fairly evenly for a 45-minute presentation. Presentations prepared with PowerPoint have a distinct advantage over conventional slides or overhead transparencies by allowing a smoother flow of the presentation and easier transitions from one slide to the next. They also tend to be aesthetically more pleasing. Overhead transparencies are still popular among many engineers and mathematicians, because it is easy to write equations on transparencies and the speaker can add to the projected image during the presentation by writing directly on the transparency. Personally, I find it distracting to watch the speaker's magnified hand block part of the image on the screen, while the speaker looks down at the overhead projector rather than maintaining eye contact with the audience. I prefer to watch a speaker use the blackboard when he or she wants to communicate ideas in writing during the presentation. However, transparencies come in handy when additions need to be made to a pre-existing complex figure during the talk. Overhead transparencies are also inexpensive and, like PowerPoint, can be prepared or altered at the last minute before a presentation. Nothing, of course, precludes the use of both computer-assisted images and overheads in the same presentation.

A major advantage of the replacement of conventional slides by computer-assisted projection is that PowerPoint

images are always in the intended orientation and sequence. When using slides, as recently as a few years ago, I always had to carefully double-check their sequence and orientation before the presentation. Nothing used to be more disruptive to the momentum of a seminar than an inverted or out-of-sequence slide that had to be rearranged. Speakers who still use conventional slides should mark them with an orientation dot on the frame in the lower left-hand corner; the slide will then be projected correctly when it is placed in the carousel with the orientation dot in the upper left-hand corner facing away from the screen toward the back of the projector. If possible, bring your own carousel; you can arrange and double-check your slides at leisure well before the presentation. In the modern era, however, the use of conventional slides rather than PowerPoint is viewed as a charming eccentricity and is best abandoned. In addition to greatly enhancing the aesthetics of the presentation, computer-assisted projection eliminates the embarrassment that results from incorrectly oriented slides or slides that are out of sequence. Advice on the appropriate use of computer-assisted projection is discussed herein.

Keeping It Clear and Simple

The three most important prerequisites for visual images are that they be *carefully prepared*, *simple*, *and necessary in the storyline*. Imperfectly drawn figures or typographical errors reflect sloppiness on the part of the speaker. Slides that have obviously been prepared in a rush and without precision are omens of a poor presentation. Well-prepared visual images are especially important for job interviews, where, like the speaker's attire, they are likely to be interpreted as signs of whether the speaker has lax work habits or is conscientious with an eye for detail and aesthetics.

Each visual image should illustrate a single point and, like the presentation itself, have only one focus. Images shown during an oral presentation differ from figures in a written document. They serve a different purpose: to communicate concepts and data to a listening and viewing audience. It is, therefore, often impossible simply to take an unmodified figure from a paper and present it as a slide without simplifying it visually and elaborating it verbally with a title and perhaps a brief summary statement underneath. Many journals limit the number of figures per publication; as a result, authors often compose elaborate panels. For a written publication this may be an effective way of showing as many facts as possible in the most compact and concise manner. During an oral presentation, however, the audience has only a limited opportunity to examine the data while at the same time focusing its attention on the speaker.

Complex data delivered during a seminar cannot be fully appreciated unless the speaker separates them into a series of simplified constituents. Figures composed of multiple panels should be avoided. Instead, the individual panels should be presented sequentially as separate images. After showing the individual components separately, you can display the composite to demonstrate interrelationships or comparisons between panels. With PowerPoint it is especially easy to build an image gradually by smoothly bringing in additional components of the image as the speaker describes the figure.

TABLES, GRAPHS, DIAGRAMS, AND TEXT

It is important to avoid showing tables. Tables containing rows or columns of numbers are an excellent way to document data in written form, but nobody in the audience can read, compare, and analyze tabulated data points during an

Effect of Growth Supplement on Antibody Production by Lymphocytes in Cell Culture

time after plating (days)	growth supplement	antibody concentration (mg/ml) ±SEM	number of cultures tested
1	+	0.1 ±0.1	5
	-	0.2 ± 0.1	5
3	+	3.0 ± 0.4	4
	-	0.8 ± 0.1	4
5	+	12.0 ± 0.8	6
	-	2.5 ± 0.3	5
9	+	10.8 ± 0.4	6
	-	1.9 ± 0.2	5
14	+	11.7 ± 0.8	4
	-	3.2 ± 0.4	5

FIGURE 3–1. This table presents results from a fictional experiment by an immunologist who has discovered a growth supplement that stimulates the production of antibodies by lymphocytes in cell culture. Note that data presented in a tabulated form are extremely difficult to appreciate by a live audience during the few minutes the slide appears on the screen. These data can be presented far more effectively as a graph. If there is no alternative to a table because of the nature of the results, the speaker should keep the table as simple as possible, highlight important data points through color, bold font, or arrows, and inform the audience up-front what is the conclusion of the table before walking them through the numbers.

oral presentation. Instead, the data should be converted into a bar graph or, if possible, a line drawing—both far more effective vehicles for conveying information during lectures.

Equations frequently appear on slides when the content of the presentation is mathematical or biophysical. For audiences consisting mostly of mathematicians, biophysicists, or engineers, equations present no problem. However, most

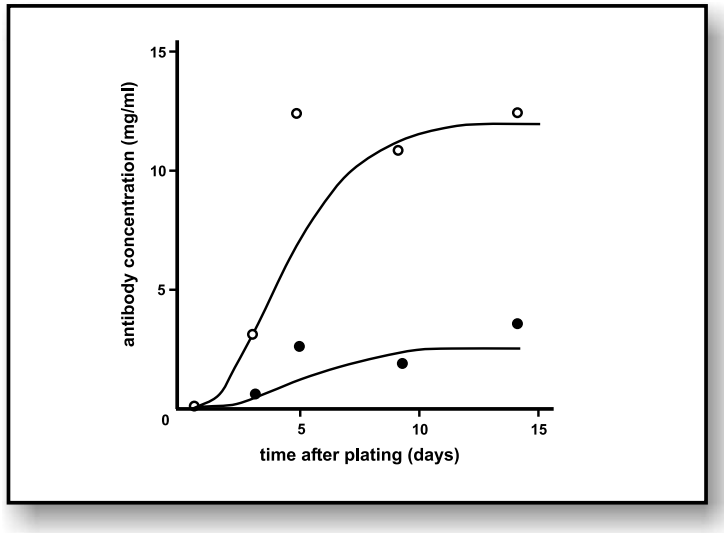

FIGURE 3–2. The graphs in this figure show the same data as the table in Fig 3–1. The effect of growth supplement (*open circles*) compared to the control (*closed circles*) is immediately evident. The lesson is: A picture is worth a thousand words!

audiences find equations intimidating and are likely to "tune out" as soon as one appears on the screen. Often the significance of an equation can be described verbally (for example, "the increase in volume is proportional to the surface area of the cell").

Graphs should be clearly labeled. Some precision may be sacrificed for the sake of brevity and simplicity. For example, the label "Adenylate cyclase activity (nmoles·min^{-1}·mg protein^{-1})" can in some cases, when presented on a slide, be replaced by the simpler indication "Generation of cyclic AMP." Lettering along the axes should be as large as possible.

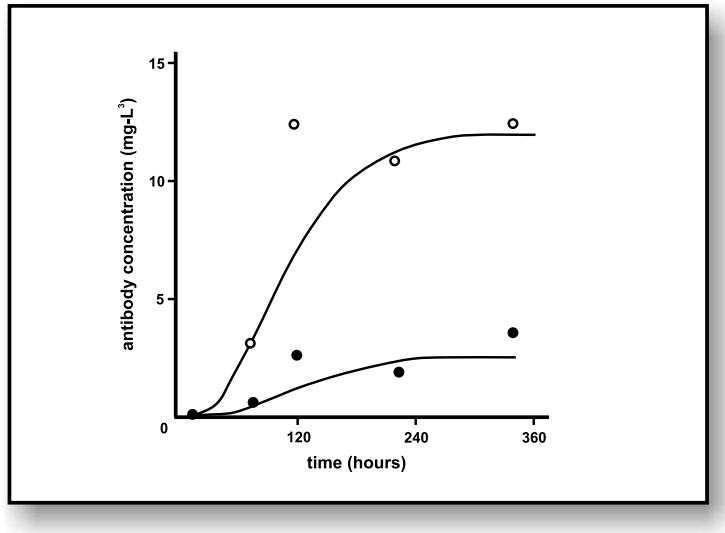

FIGURE 3–3. In contrast to written articles, it is important for an oral presentation to keep figures as simple as possible. This applies also to the labels on the axes of graphs. Note that the units indicated on the axes in this figure are much harder to evaluate than their equivalents in the previous figure.

Only the minimum number of scale divisions should be indicated along the axes. When the Y-axis designates percentage of activity, for example, often only the 50th and 100th percentiles need to be labeled (rather than every 10th percentile). The less busy a figure appears, the more justice it does to the information it attempts to communicate.

Often speakers present images that are essentially invisible, a small figure with microscopic lettering lost in a vast ocean of light. A diagram on a slide cannot be too large. This is especially true for text. Make sure that your slides are designed so that the image fills the screen and labels are large.

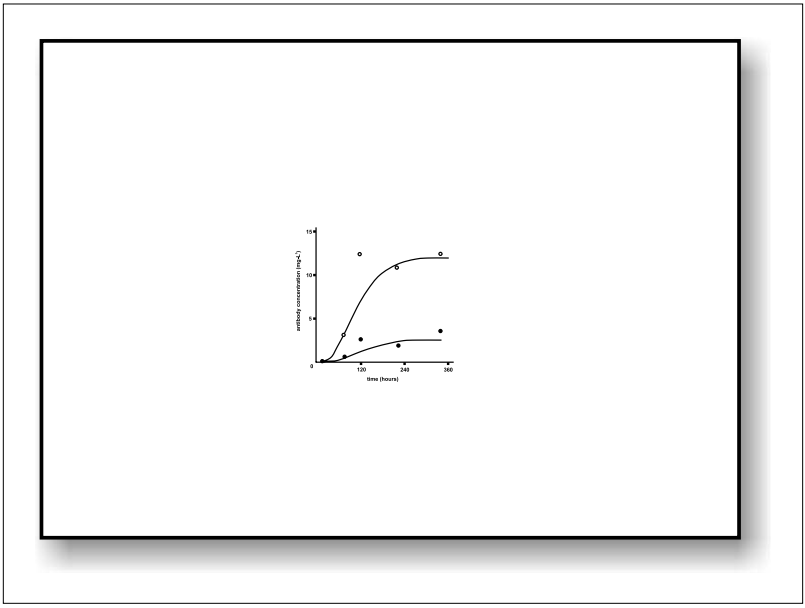

FIGURE 3–4. The same graph as in figure 3–2, but shown at an inadequate size. Figures should be large enough to be clearly visible. When a speaker says to an audience "I know you cannot see this very well, but trust me, the data show that, "he undermines his credibility and comes across like a used car salesman.

One of the most important rules that I impress on my students is: *Lettering on slides can never be too big*!

When presenting text, some speakers like to use color contrast, such as white on blue or yellow on black lettering. This is a matter of taste, although personally I prefer black and white for clearest contrast. In any case, maintain uniformity among all the slides used in the presentation. Uniformity of style throughout the presentation accentuates and underscores the flow and coherence of the talk. Once a speaker has decided on a preferred style, it is easy enough to ensure that a collection of images is built up in a uniform style. Whereas

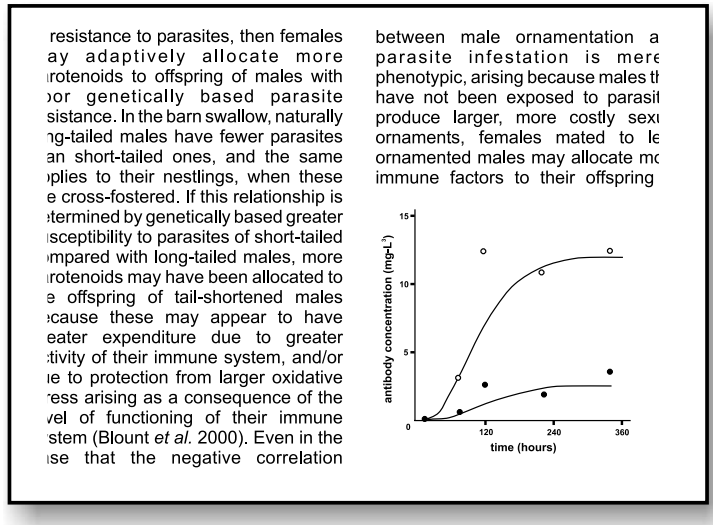

FIGURE 3–5. When a figure is lifted out of a publication and shown with surrounding text, the audience will focus on trying to decipher the text rather than paying attention to the data. It is important to delete all distracting material from the display and show only the relevant item.

modifying an image used to require making a new slide, with PowerPoint there is no excuse not to generate a presentation with a uniform background and uniform font styles, sizes, and colors.

Include only images that are necessary to and functional within the storyline. Since the quintessential purpose of slides is to communicate information effectively, delete all information that is irrelevant to the presentation. When the pictures reproduced from published articles are shown, any text, including the original legend, should be cropped away so as not to distract from the figure. However, an image can

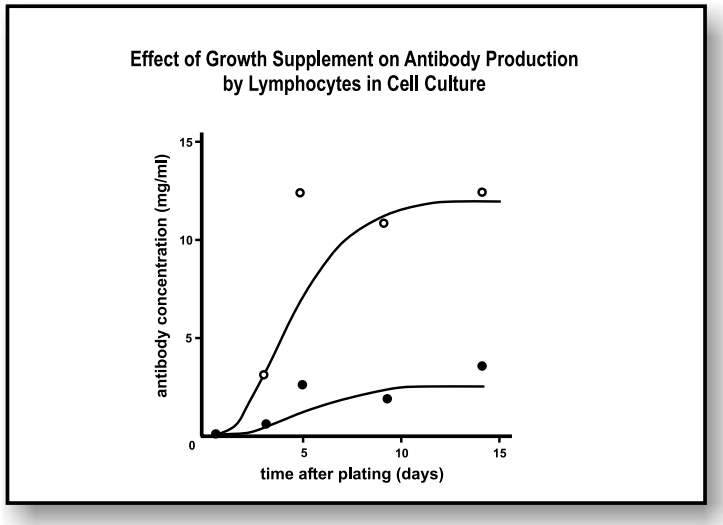

FIGURE 3–6. A figure can be enhanced by adding an informative title.

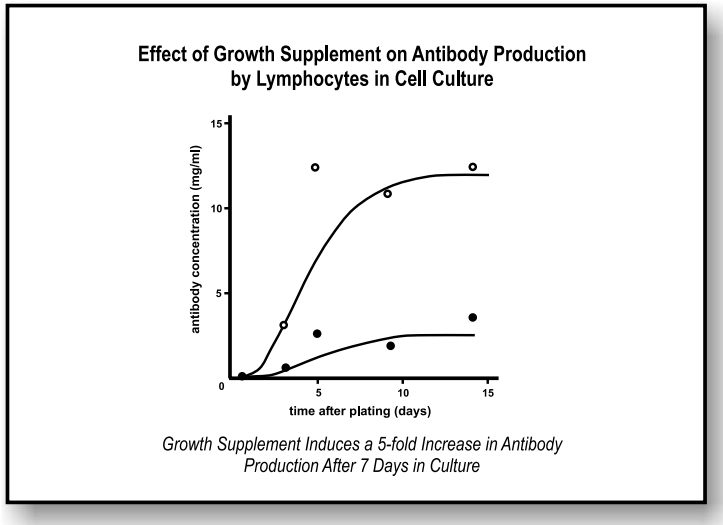

FIGURE 3–7. In addition to a title, information contained in a graph or diagram can be emphasized by a conclusion statement at the bottom. Notice that too much text around the figure becomes a distraction. This problem can be solved by showing the slide first without the conclusion and then entering the conclusion with an appropriate PowerPoint effect (e.g., checkerboard).

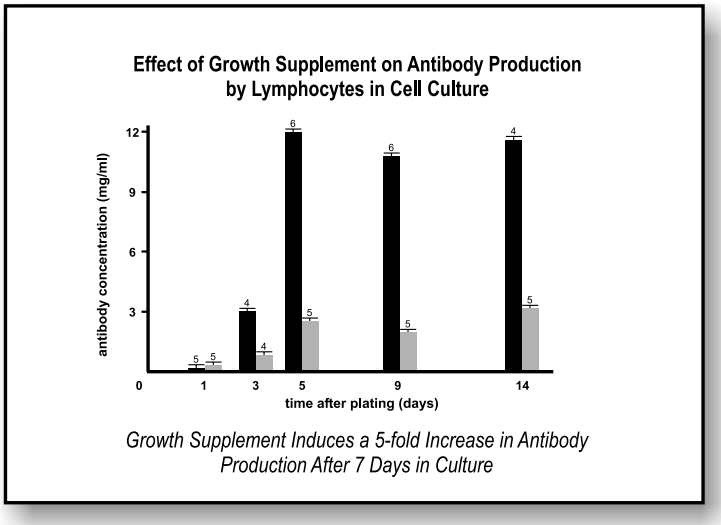

FIGURE 3–8. If it is essential to show standard errors and sample sizes for each measurement, bar graphs are a good alternative to line drawings.

be enhanced by adding a title to the diagram and a line or two that concisely describe the conclusions to be drawn from the slide. Credit to the original authors may also be added to a slide.

Speakers regularly present images in which crucial information is poorly depicted. Sometimes the speaker is aware of this and offers a sheepish apology: "You may not be able to see this, but take my word for it." This is embarrassing and creates a subconscious feeling of skepticism. It is better to simply mention the information without showing a dubious image. Examples of important information often presented in an essentially incomprehensible manner are amino acid sequences of proteins or nucleotide sequences of DNA. These

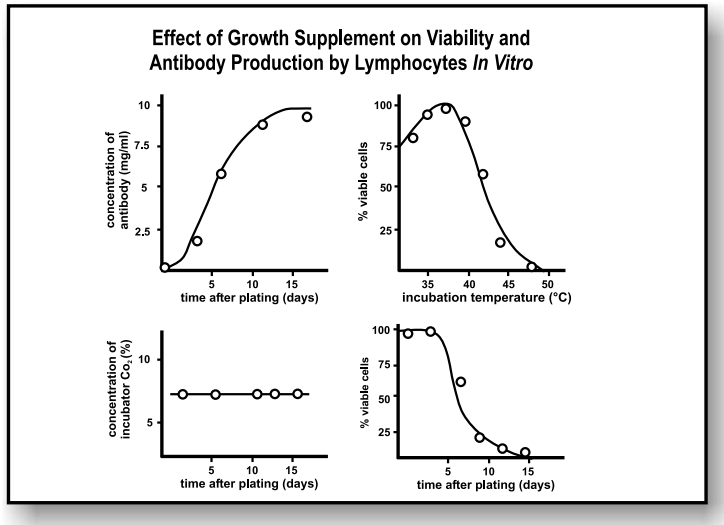

FIGURE 3–9. Each display item should have a single focus and should be relevant to the presentation. The upper right panel of this figure shows that cells grow optimally at 37°C and die when the temperature in the incubator increases to 50°C. The lower left panel shows that the concentration of CO_2 in the incubator remains constant throughout the experimental period. This trivial and irrelevant information just clutters the figure. Using multiple panels on a display should be avoided. The upper left panel and the lower right panel are the only relevant panels and should be shown sequentially, as illustrated in figures 3–10 and 3–11.

myriad small letters on the screen convey no significant information. Such sequences are better displayed diagrammatically or as horizontal bars in which parts of the sequence can be highlighted. A series of bars representing a family of related species can contain colored or shaded boxes to indicate regions of homology. Similar visual codes can be used to designate transmembrane domains of proteins, leader peptides, sites that control initiation of transcription, and a host of other

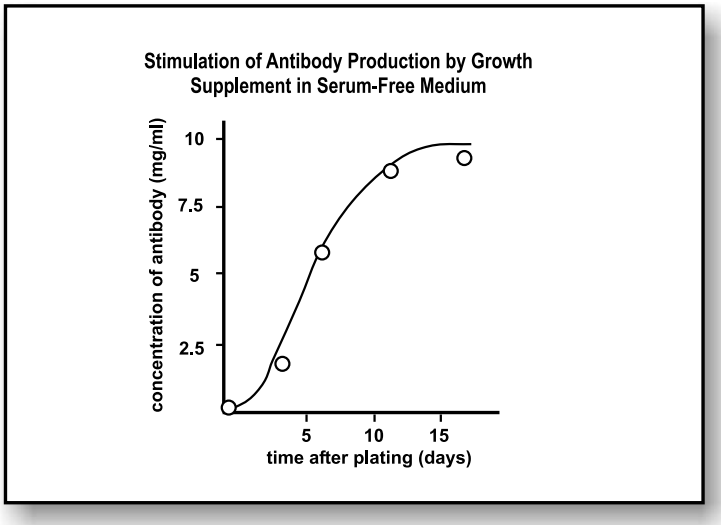

FIGURE 3–10. The upper left panel of the previous figure shows that the production of antibody increases after addition of growth supplement and is here shown without the distracting presence of the other panels.

properties. Representing protein or DNA sequences in this manner accentuates those aspects of the sequence that constitute important information, while deleting an enormous amount of inconsequential documentation.

At the end of the presentation, a concluding statement should be projected on the screen to emphasize the take-home message. Always keep summary statements concise and to the point. Conclusion slides should contain only essential information and should not be muddled by ancillary facts of secondary importance that distract from the main take-home message.

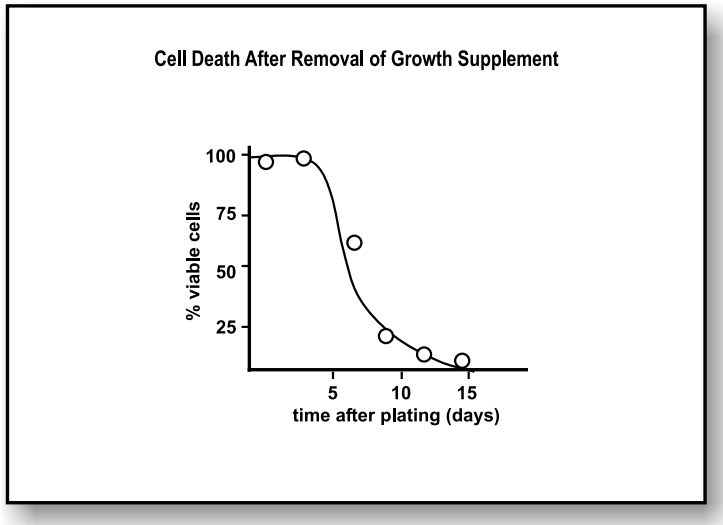

FIGURE 3–11. The lower right panel of figure 3–9 shows that cells die after the removal of growth supplement and is here shown without the distracting presence of the other panels. If this graph needs to be compared directly with the previous graph, the graph that shows that the production of antibody increases after addition of growth supplement could be shown first on half the screen and the graph that shows loss of cell viability can then be introduced subsequently with a PowerPoint effect.

Sometimes a speaker refers to a figure several times during a presentation, for instance, when returning to the mainstream after a sidetrack, as discussed earlier. In such cases, the diagram central to the presentation could be permanently displayed on the blackboard. This is not always possible, however, especially when the blackboard is obscured by the screen or if the figure is too complex to draw on the board in a way that does it justice. If the same figure has to be shown more than once, use duplicate images in sequence rather than

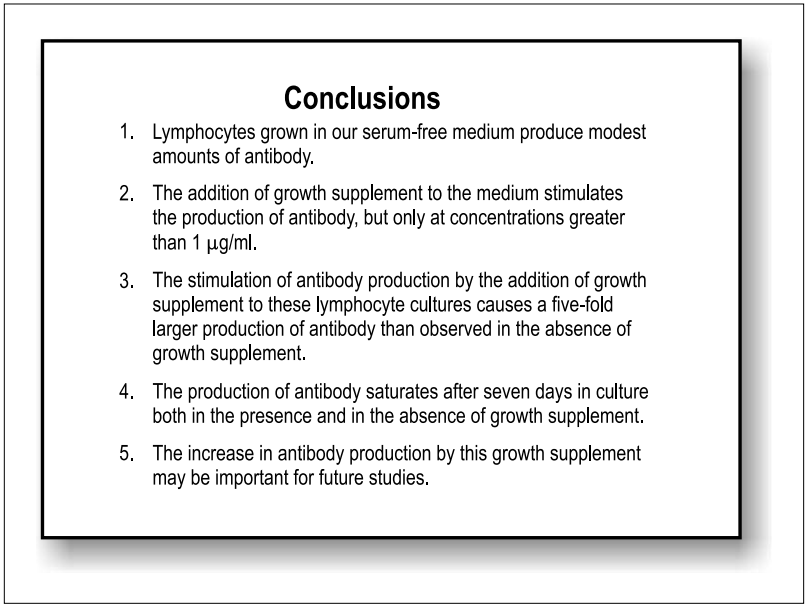

FIGURE 3–12. Excessive lists of conclusions confuse rather than enlighten the audience. The conclusion of a presentation should be concise. Compare the conclusions on this slide with the conclusion of the same set of experiments in figure 3–13.

disrupt the momentum of the presentation by flipping back to the previous image and afterward advancing again through a series of images that have already been shown. When using transparencies it is a good idea to use duplicates as well, although it is possible to lay a transparency aside for repeated use later in the talk. With a duplicate there is no need to engage in manipulations to keep the transparencies organized; you can dedicate full attention to the delivery of the talk.

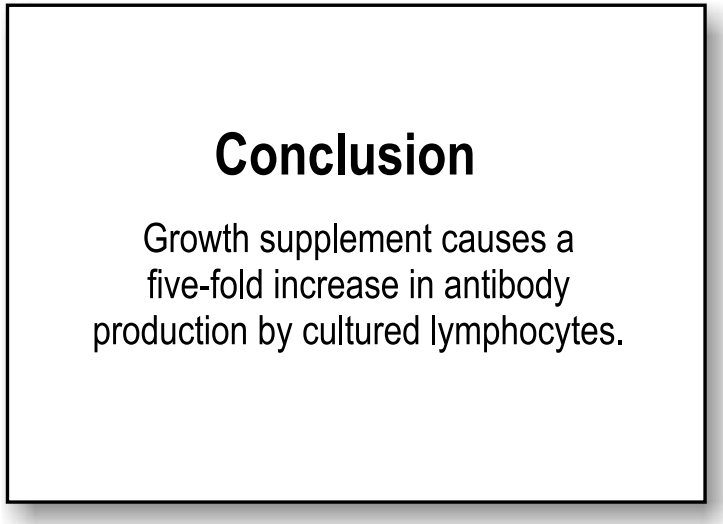

Figure 3–13. A crisp and concise conclusion delivers a clear take-home message. Compare this conclusion with the conclusions shown in the previous figure.

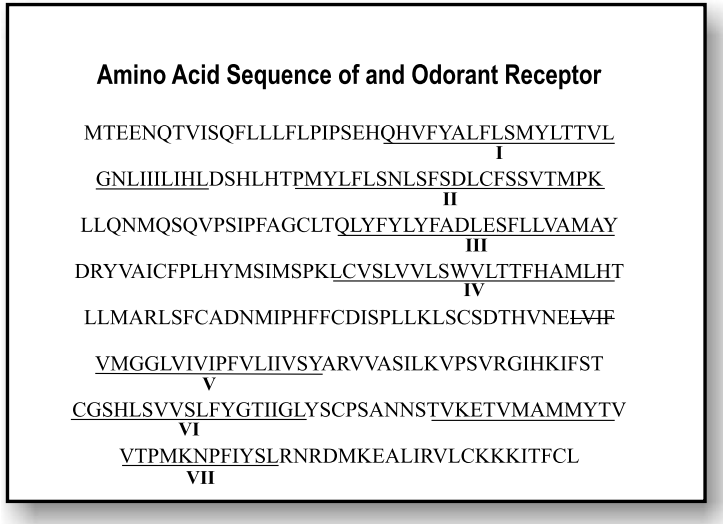

Figure 3–14. This slide shows the amino acid sequence of an odorant receptor. Sequences of nucleotides or amino acids provide little information to a live audience and should be avoided if possible. A diagrammatic representation is more effective for communicating relevant information that emerges from the sequence, as illustrated in figure 3–15.

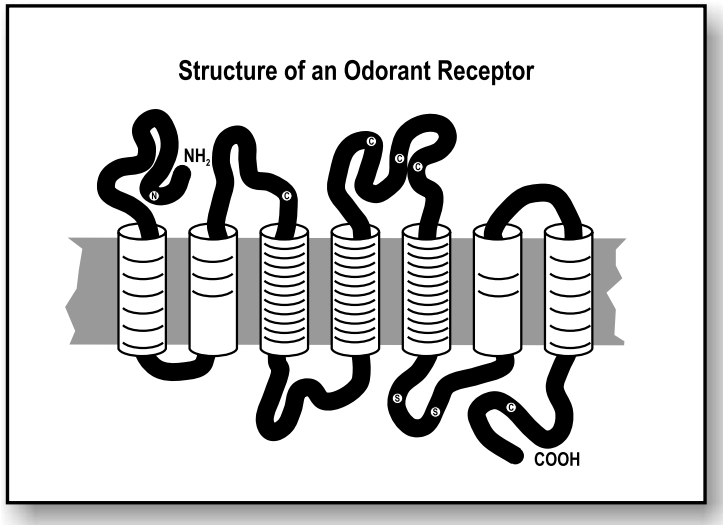

FIGURE 3–15. The same data shown in the previous figure are presented here as a diagram. Notice that this way of presenting the data is far more informative. The transmembrane organization of the protein is immediately evident. Shading of the transmembrane regions can indicate the extent of homology with other proteins of the same receptor family. Amino acid residues that are particularly salient to the presentation can be highlighted, and their location with regard to the structure of the protein can be readily appreciated.

COMMUNICATING COMPLEXITY

One of the greatest challenges of scientific presentations is to convey complex concepts in a readily understandable manner. To achieve this, it is essential initially to break the concept down into an array of simplified components. Two strategies meet this challenge through the creative use of visual aids. One way to simplify intricate diagrams is to start by showing the basic components and gradually increasing its complexity.

For example, when discussing neuronal circuitry in an area of the brain, you can first show a picture that illustrates the primary pathway—two neurons synapsing onto each other. Then add to this image excitatory interneurons, which contact the first two cells. Finally, add inhibitory interneurons. If the last image had been shown without the first two, it is likely that the audience, baffled by the complexity of the neural connectivity, would have lost interest. In the old days of slide projectors, the gradual building of complexity in this example would have required a series of three separate slides. PowerPoint, however, makes it easy to seamlessly add components or highlight aspects of an image with a push on the button or a click of the mouse.

Electrical wiring diagrams provide another example of complex representations that can be difficult to appreciate on a single viewing. Such diagrams can be rendered more palatable by first showing a simplified version of the basic connections, then gradually increasing the complexity by adding components in a series of sequential images. The audience, seeing the diagram created step-by-step, will become familiar with its different components; they will no longer feel overwhelmed when the complete circuit is displayed. By building up a complex diagram from its components and allowing the audience to follow its development, the speaker retains the audience's attentiveness and appreciation.

In addition to building complexity gradually, a second way in which complex issues can be simplified is through the creative use of color. Color-coding components of an image and consistently maintaining this code through a series of slides facilitates the audience's understanding. One of my students once lectured on the cellular architecture of the retina. He showed first only the primary neural pathway—the connections between retinal rods and ganglion cells and the projec-

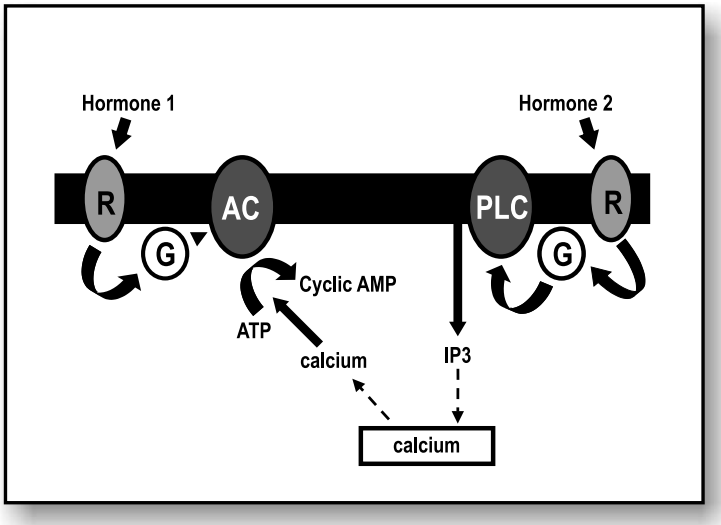

FIGURE 3–16. This diagram shows complex interactions between two hormone-activated signal transduction pathways that involve different receptors (R), regulatory G-proteins (G), adenylyl cyclase (AC), and a phospholipase C (PLC), which generates inositol triphosphate (IP3) and causes release of calcium from intracellular stores. It may be difficult for an audience of nonexperts to absorb a complex figure like this, which may cause members of the audience to "tune out."

tions of the latter to the central nervous system. These cells were all colored red. In the next slide the same image appeared, but amacrine cells had been added and were colored green. His last slide showed the complete circuitry of the retina and its projections to the central nervous system, using three different colors. It was one of the best explanations of the neural circuitry of the retina I have ever seen.

Another way in which overhead transparencies can be used to build up complexity is by superimposition: components can be added to an image simply by laying another

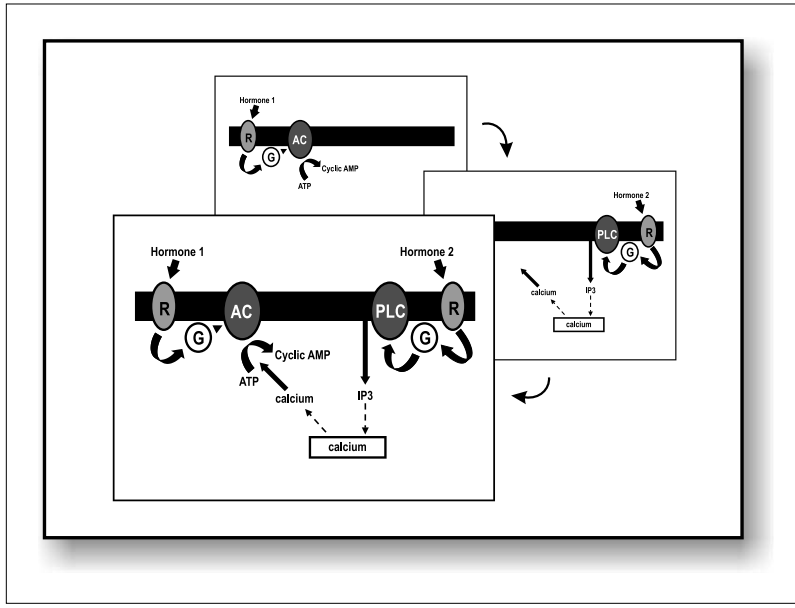

FIGURE 3–17. In this example, complexity can be built gradually, either using PowerPoint effects to introduce the elements of the transduction pathways one by one rather than simultaneously, or by showing first the pathway of hormone 1 and then the pathway of hormone 2 before combining them to show the full complexity of their interactions.

transparency on top of the first one. I remember one speaker who made creative use of both color and superimposition to describe the fate of migrating cells during embryogenesis. Superimposition of transparencies allowed her to gradually add complexity as she described the ontogenetic process. At the same time, color-coding the cells enabled the audience to follow with ease as each different cell type reached its final destination.

One irritating technique that should be avoided is to cover part of a transparency and gradually disclose more of the information as the talk progresses. This results in a dark, hidden area on the screen under or above the figure. The

speaker may think that gradually revealing secrets may keep the audience's attention by appealing to their curiosity. This is true; however, the audience will focus primarily on the hidden part of the image to be revealed rather than on the part the speaker is trying to describe. This technique of using transparencies is, therefore, distracting and detrimental to a presentation. Better to go to the small expense of buying a few more transparencies that can be shown sequentially than to cramp several pieces of information onto one sheet and gradually divulge them.

Transparencies allow attention to be focused on different components of the image by coloring them during the course of the presentation. Although transparencies work as an alternative to computer-assisted projection, personally, I prefer to see figures neatly prepared in advance in PowerPoint, because it gives a more organized aura to the presentation.

Of course, there are instances in which it is impossible to simplify a complex diagram. In such cases, the best strategy is to inform the audience immediately—up-front—of the conclusion of the diagram. Then proceed to describe the figure and explain how it leads to the stated conclusion. In this manner the audience at least will appreciate why the complex diagram is necessary and important, and they should be motivated to pay attention as the speaker describes the evidence contained in the figure that will convince them that the conclusion is justified. Frequent summary messages presented as text on slides can protect the speaker from losing his audience when discussing a complicated topic.

The Dangers of PowerPoint

I remember vividly a rather unusual presentation at an international symposium in a lovely Florida resort. The

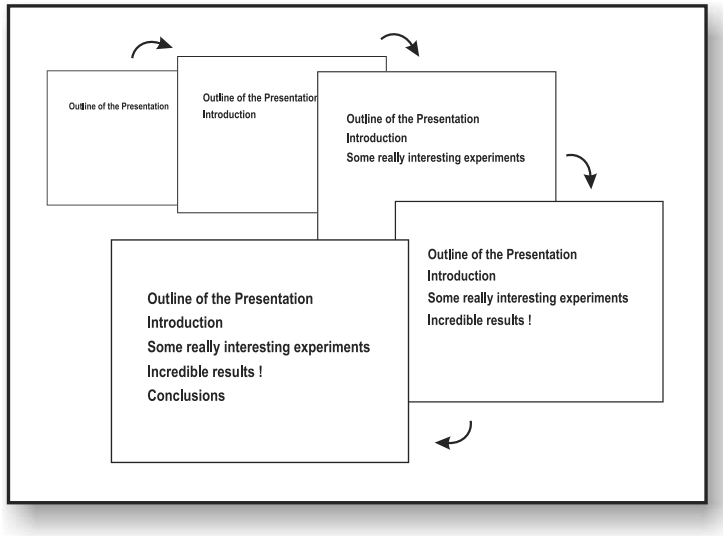

FIGURE 3–18. PowerPoint can be used effectively to introduce text sequentially, such as the summary text shown here that provides an outline for the presentation. Providing such an outline at the beginning of the presentation and returning to this outline while highlighting the next section of the talk at appropriate intervals keeps the audience informed about the presentation's road map.

symposium focused on G proteins, transduction components that link the binding of a hormone or neurotransmitter to its receptor to activation of an intracellular effector enzyme, such as adenylyl cyclase. One of the speakers had decided that he would make a big impact by preparing a particularly flamboyant presentation. He was very well prepared and spoke with flair. Every other sentence was accompanied by a click on the mouse and the appearance of text boxes, cartoons, diagrams, representations of enzymes, substrates, and all kinds of animations that appeared rapidly in dazzling colors with

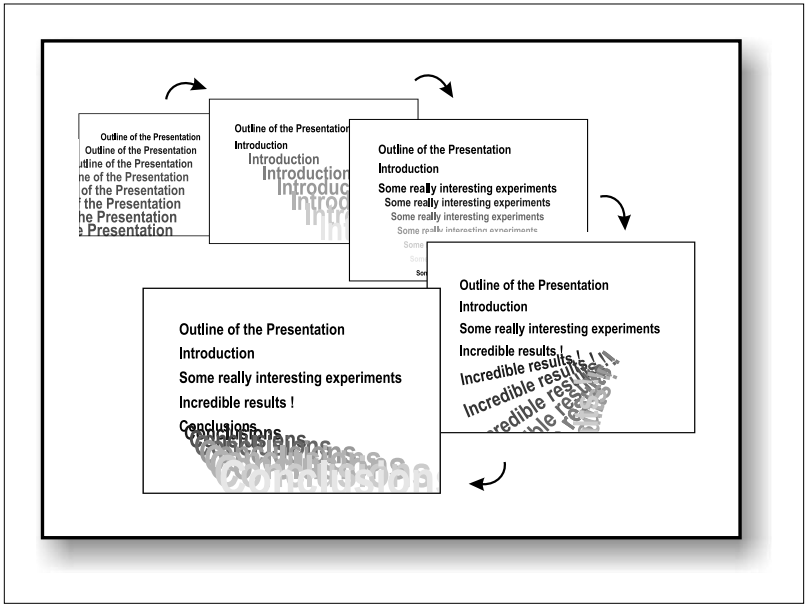

FIGURE 3–19. Excessive PowerPoint effects with text zooming and spiraling in from different directions become a distraction to the presentation and should be avoided.

an array of special effects. Items would fly in from all directions, blink, spiral in and fade out, crawl up the screen from the bottom and checkerboard across. Many of these appearances were accompanied by computer-generated sound effects, drum rolls, cash register clinks, gongs, and computerized applause. Hollywood could not have done a better job. The audience was impressed by the sheer flair of the performance. However, when asked afterward what the take-home message was of the presentation, no one could really tell; in fact, most people could not recall the exact topic of the talk. The scientific content had been thoroughly drowned out by the razzle-dazzle of the visual fireworks.

In this age of unlimited technological capabilities, it is easy to go overboard and become obsessed with visual effects. The presentation by the razzle-dazzle speaker in Florida was not unlike a recital of Schubert lieder I once attended. The pianist was intent on showing off his virtuosity and hammered the piano with such gusto and flamboyance that he drowned out the soprano he was supposed to accompany. It is important to remember that visual aids are an accompaniment to a presentation, but that the main aspect of the presentation remains its scientific message. Excessive visual aids become a distraction if they take center stage.

SIMPLICITY IS CLASSY

When designing a PowerPoint presentation, one should choose a quiet, muted background, which should be uniform throughout the presentation. Predesigned backgrounds offered by the PowerPoint program look good in the portfolio of the graphics artist who designed them and may dress up corporate presentations, but they are not optimal for scientific presentations. It is safe to use a quiet off-white or blue background. Background colors should be chosen to allow good contrast with images and text and should be composed of soft colors. Bright orange, pink or yellow screens are hard to view; they make the audience wish they had brought sunglasses to the seminar. Color gradients lend an aesthetic air of sophistication but should be used judiciously by placing text and images in locations where contrast is clear.

Backgrounds can be further enhanced by decorative emblems in faint watermark outline that subliminally illustrate the thrust of the presentation. For example, a presentation that discussed the genetics of complex traits in *Drosophila* used a design in which the ensemble of chromosomes of the

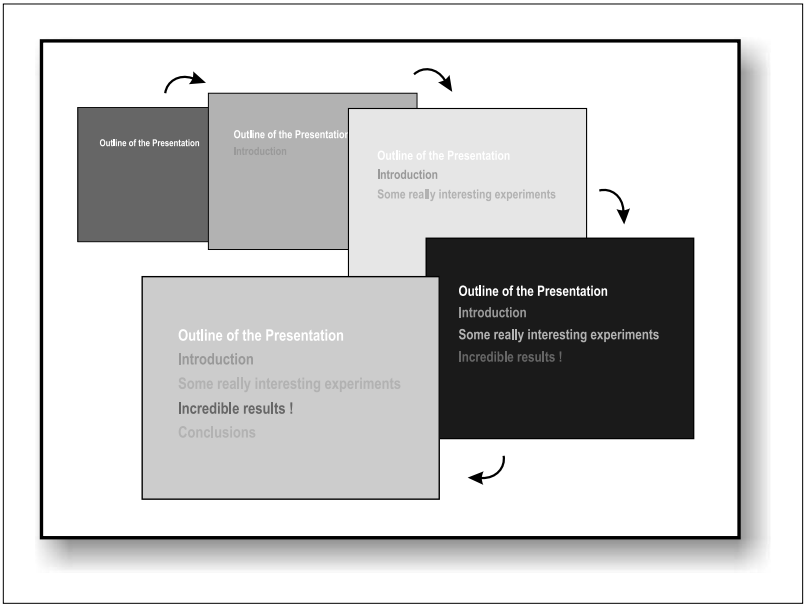

FIGURE 3–20. Avoid the excessive use of different font colors and poor contrast between text and background. Text should be large enough to be clearly readable from the back row of the auditorium and have clear contrast with the background of the slide. Text color, font size, transition effects, and background color should be uniform throughout the presentation.

fly was embedded in the background in an off-blue color that faded unobtrusively into the blue background. Similarly, if the presenting author wants to advertise the reputation of his organization, a small institutional logo could appear in one of the corners of every slide. Enhanced backgrounds done in good taste render a presentation classy. However, the border between good taste and gaudiness may not be obvious at all times. Soliciting opinions of trusted colleagues known for their experience in delivering polished presentations is always a good idea.

The font and color of the text should be uniform throughout the presentation and large enough to be easily viewed from a distance. I prefer black lettering on an off-white or muted blue background. Many colors work well, however, and this is a matter of personal preference, as long as there is good contrast. Pink letters on red, or teal on a light green background will not work! The use of too many different colors in the same presentation becomes a distraction. In terms of color designs for PowerPoint presentation, the best advice is: Keep it simple.

Similar rules of simplicity and uniformity apply to slide transition effects. The newest versions of PowerPoint allow virtually every type of special effect in the Hollywood arsenal. One can, of course, choose not to use transition effects between slides, but well-chosen effects do polish a presentation. I prefer the "wipe right" transition as a quiet and innocuous effect, barely noticeable to the audience. Again, it is best to avoid dramatic transitions, in which images whirl in and out of the screen.

Ostentatious sound effects have no place in a scientific presentation and should not be used. Building an image by introducing successive items on the screen should also be done with subdued effects. I find that "boxing in" images and "checkerboarding in" text works well. Of course, a single dramatic effect in a presentation to focus attention on a crucial point, for example, an arrow that spirals in and points at a particularly critical data point helps focus attention and can be very effective, but such effects should be used sparingly. Again, personal judgment may determine for each speaker what effects are preferred. One should remember, however, that effects are like wearing makeup. A little, delicately applied in the right places, makes a classy, polished appear-

ance; too much, slammed on in thick layers, has the opposite effect.

Internet Access

Today's remarkable technology allows us to connect instantaneously from virtually anywhere in the world to any website with instant access to information. The expectation of a smooth and problem-free Internet connection during a presentation is, however, not always borne out, and live Internet connections are generally best avoided. It is a good idea to have "screenshots" of Internet search results available on a laptop computer in case of a lost connection. Waiting for the Internet connection during the talk breaks the momentum of the presentation and web pages are often not easy to view when projected on a screen, especially if they contain a large amount of regular font text. If a speaker wishes to display website information, it is best to store the web page as a static image incorporated in the PowerPoint presentation. It is even better to convey only essential information from a website and attempt to edit out unnecessary and distracting information.

In some instances, however, it may be essential to have a live Internet connection during the presentation. For example, the purpose of the seminar may be to explain applications of a publicly accessible database, such as GenBank. A demonstration on site is here essential. It is important for the speaker to communicate with the host beforehand the need to have access to a live Internet connection and the connection should be established before the seminar starts and be kept active on the background while the speaker proceeds with a PowerPoint presentation, until the connection is no longer needed.

COMPATIBILITY AND BACKUP

A practical issue that requires some attention when using computer-assisted projection is compatibility. I have seen many speakers who were surprised to find during their presentation that male (♂) and female (♀) iconic symbols had been changed into bells, open book diagrams, smiling faces, or mailboxes. Mathematical and iconic symbols are the first to change when MacIntosh and PC programs are interchanged. Furthermore, some of the older versions of PowerPoint may be incompatible with newer versions.

Carrying your own laptop computer can often circumvent such problems. When speaking at scientific meetings, however, it is customary for every speaker to load the presentation beforehand on a common computer. Most of the larger scientific organizations have worked out the compatibility "bugs." However, it is a good idea for the speaker to quickly view the presentation before the session starts. Often, there is a designated "speaker preparation" room where the speaker can watch the presentation exactly the way it will appear in front of the audience. In other cases it is a good idea to arrive early at the lecture hall, 30 minutes to an hour before the scheduled session. This allows enough time to ensure the absence of problems and, if necessary, to quickly correct them. It is disconcerting for the session chair and the other speakers when a symposium speaker arrives 5 minutes before the scheduled start of the session and discovers that she has a computer problem. It is highly recommended to contact the seminar host or the symposium organizer beforehand to verify which PowerPoint versions and computer platforms can be used during the presentation. Taking the time to get this information beforehand may prevent embarrassment during the talk.

I always carry my presentation with me on a 256-Megabyte thumb drive with a compact disc as a backup. The thumb drive is a small memory storage device that can be carried conveniently on a key ring and can be plugged into a USB port, with which every modern computer is equipped. With the increased inconvenience of carrying laptops through airport security checkpoints, I find thumb drives and CDs excellent alternatives. As a final backup I often send the PowerPoint presentation as an e-mail attachment to myself. If all else fails, I should be able to retrieve it from cyberspace by accessing my e-mail account from a computer at the host institution.

Video, Audio, and Props

One of the most memorable seminars I attended recently described the role of the hippocampus in the acquisition of memory. The speaker explained how he measured memory in rats through cleverly designed olfactory discrimination tests. He showed the behavior of normal rats or animals in which brain regions had been removed by brief video clips at appropriate moments during the presentation. One video sequence showed a rat running through a maze while electrodes in its brains recorded neural activity as audio signals. If a picture is worth a thousand words, then these video clips were a treasure. Dynamic processes can be illustrated through a series of images showing the same phenomenon at different points in time. However, nothing is more effective than a good quality video clip to illustrate a dynamic process to an audience.

Showing movies used to be cumbersome. One had to rely on celluloid and film projectors that were often not available or malfunctioned. The development of VHS tapes facilitated the use of videos and many lecture rooms are still equipped with video monitors that allow VHS tapes to be played

during presentations. Currently, however, embedding video sequences in a computer-assisted PowerPoint presentation is state-of-the-art. The use of video during scientific presentations has become increasingly popular. In many cases, as in time-lapsed sequences of migrating cells during development of the nervous system in zebrafish or when showing social encounters in animal communities, videotaped evidence is indispensable for the maximum appreciation of scientific observations.

Video provides a wonderful tool for enlivening scientific presentations, but it has to be used prudently. Video sequences should be brief and functional in the storyline; otherwise, the videotape takes over and diverts attention from the speaker. For this reason, the speaker should provide the commentary rather than having a soundtrack on the videotape itself, except when sound is an integral component of the phenomenon illustrated by the video (for example, video clips that show vocal communication in frogs or treatments for speech therapy patients). Several short stretches of video intermingled with the slide presentation are guaranteed to keep the audience alert and attentive. It is important to make sure beforehand that the available projection system is compatible with the video and that sound, if included in the presentation, will be clearly audible in the room.

I attended once a presentation on the development of the song system in birds, in which the speaker relied on the sound system contained in her laptop. She promised to treat the audience to actual bird sounds, but the sounds were so faint that even when the audience was totally quiet they were virtually inaudible. The promised treat turned into a disappointment that hurt rather than helped the presentation.

Anything out of the ordinary usually gives a presentation a special memorable touch that sets it apart from others. We

may think that "show-and-tell" is a childish technique that only applies in our elementary school days. This is not true. Show-and-tell is a teaching method that remains effective throughout our lives. Whenever I talk about olfaction, I arouse the audience's interest by giving them the opportunity before the lecture to smell some sample odors that I bring along as a demonstration. When I discuss the structure of taste buds, I may bring in a six-pack of soft drink cans. These are often used as models for taste cells with their small apical membranes (where the cans open) exposed on one side and separated from the large basolateral membrane (the rest of the cans) by tight junctions (the plastic filler, which holds the cans in the six-pack together).

Recently, I attended a doctoral defense seminar of a student who had worked on the genetics of negative geotaxis in *Drosophila* (that is, the tendency of flies to fly up). The student brought with her the behavioral apparatus, a plexiglas geotactic maze, which she used effectively to explain to the audience how she measured geotactic behavior. In this way, props may serve to engage the audience and set the tone for a lively and stimulating presentation.

I remember still how excited we were as children when the biology teacher brought in the human skeleton to teach us about bones and muscles, or when we were shown a plastic model of the brain that could be taken apart to show its various constituents. Chemistry classes were fun because of the inevitable malodors and explosions. Props do not lose their magic as we grow older. It is still a lot of fun to put on the 3-D glasses handed out by a speaker who discusses depth perception or who demonstrates optical illusions that may help tease apart the mechanisms by which visual information is processed in the brain. I do not remember every seminar I have listened to, but I do recall most presentations that used

video, audio, or props. Not only were they informative but also fun—after all, enjoyment and pleasure motivate us more than anything else to pay attention.

HANDOUTS

Handouts are valuable for two applications. They serve an instructional purpose when accompanying lectures, and they provide material (for example, curriculum vitae, a description of a project's history) that can be evaluated after the presentation, if the talk is part of a job interview or a research proposal. Instructional handouts can vary in length, whereas handouts that accompany interviews or research proposals should always be brief and to the point.

It is often advantageous to make instructional handouts such as lecture notes available before the actual talk to give attendees an opportunity to familiarize themselves somewhat with the content of the "upcoming attraction." They will then be able to focus all of their attention on the lecturer without being distracted by the handout, and they can pay special attention to concepts they found difficult to understand from just reading the notes. The lecture here serves to clarify and cement the information, and the handout and lecture have become two equal, integrated partners in the educational process. The handout can contain more information than could possibly be covered in the accompanying lecture. The lecturer's job is to make clear which information is central and which is peripheral to understanding the material.

I participated once in a series of lectures given to high school teachers to familiarize them with recent advances in the neurosciences. It was clear that a handout to which they could refer later would be useful. At the same time, few of the teachers would have the time or inclination to read many pages on

any one of the numerous topics to which they were exposed during the series. Therefore, I designed a single-page handout. My lecture dealt with the olfactory system, and my handout contained the three most crucial images of my presentation: a schematic diagram of the histology of the olfactory neuroepithelium, a figure that clearly illustrated how different odor molecules elicit different patterns of neural activity in subpopulations of olfactory neurons, and a model of the transmembrane organization of a putative odorant receptor. Each diagram had a title, a short legend in smaller print, and one sentence that provided a brief take-home message. Although my presentation covered much more information in greater detail than was presented in the handout, that page ensured that the recipients would be able to refer at a glance to the most important concepts of my presentation.

The Old-Fashioned Blackboard

Technological advances in our modern projection capabilities have gradually diminished our respect for what is perhaps the most effective teaching tool of all: the blackboard. Few speakers use it at all, and those who do use it sparingly. Those of us who grew up with the old-fashioned blackboard vividly remember how we had to strain to keep up with the teacher who wrote equations or diagrams on the board, while we simultaneously tried to copy the precious information into our notebooks. One swipe with the eraser and the knowledge inscribed on the board would be lost to us forever! The blackboard required us to put effort into the process of learning and made us active participants in the classroom. The creation of diagrams or text in front of our eyes by a lecturer who moves around to write on the board, while addressing the audience, provides a more dynamic experience than simply seeing the

complete image appear on the screen. Sure, the blackboard has its shortcomings. It is less fancy, less aesthetic, and less convenient than slides. More than any other visual aid, however, it commands active attention from the audience. It remains a powerful teaching tool.

The blackboard can be used effectively in combination with slides and handouts as a teaching tool for students. An outline of the presentation on the board can help the audience keep track of the story as it unfolds. Similarly, a diagram central to the presentation, when drawn on the board, provides a reference point to which the audience can resort at any time. The board can be used to create a list of arguments supporting (or contradicting) a hypothesis as it is being discussed. It can also be used during a lecture to add complexity to initially simple diagrams placed on the board before the presentation. This is similar to the use of a series of slides or transparencies that show an increasingly complex image, as discussed earlier. Some seminar speakers like to write the names of their collaborators and coworkers on the board to acknowledge their participation in the project that is being presented.

Some projection screens lower in front of the board. When using the blackboard in combination with slides or overhead transparencies, make sure that information written on the board before the presentation will remain visible when the projection screen is in use. Remember also to have the room lights turned up whenever attention should be focused on the board. You should ascertain before the presentation that chalk or, as in many cases nowadays, erasable markers are available in colors, along with an eraser and a pointer. Finally, remember that it is frustrating for an audience when the speaker stands in front of the board and obscures the information being discussed. This generates the same feeling we have

when an uncle stands up in front of the television just as a touchdown is about to be scored.

The board can be a highly effective teaching tool in combination with handouts. One of my colleagues gave a superb lecture to medical students on the interconnections between the limbic system and other regions of the brain. The handout the students received contained an empty diagram showing the different areas of the central nervous system. The same diagram was drawn on the board, and as she filled in the different pathways in that diagram, so did the students on their handouts. There is no better way to teach than to actively involve students in the process of acquiring knowledge.

Any lecturer can give a presentation. It takes a scholar to use the blackboard effectively. Slides project information for us in its entirety, but to generate diagrams and text on the blackboard requires active thinking, intellectual discipline, and an organized mind. Maybe we respect the blackboard because the brain rather than the projector conjures up the information. Unlike the slide projector, the blackboard forces speakers to think on their feet during the delivery of the presentation. The board is most effective in small, intimate seminar rooms. Poor visibility may compromise its use in large lecture halls, where slides remain the best visual aid.

I knew one highly respected biophysicist who refused to use slides as a matter of principle and used only the blackboard. Throughout his presentation, he filled the board with equations, diagrams, and figures. He defended the idea that the blackboard is the only acceptable way to communicate with the audience on, as it were, a one-to-one basis, and to convey information effectively. Some of his students have adopted the same philosophy. Their lectures are always excellent and have the old-fashioned, scholarly aura of an intimate teacher-student relationship around them. Besides admiration,

however, these purists, who shun the slide projector as a matter of principle, draw a lot of criticism. Many of their colleagues have expressed the desire to see some real data occasionally, rather than their improvised representations on the board. A counter-argument might be that the actual data will be documented ultimately in the scientific literature, while the purpose of a lecture is to communicate the underlying ideas, approaches, and tenets. Still, a modern-day scientific audience will find a graph drawn by hand on the board less compelling than a slide that shows the actual data points with their standard deviations and appropriately labeled axes.

The old-fashioned blackboard with its chalk (or its modern counterpart, the white board with its erasable markers) can still play a useful role in scientific presentations. Using a combination of all available visual aids appropriately can dramatically enhance the impact of a scientific presentation and make it memorable.

POSTER PRESENTATION: THE YOUNG SCIENTIST'S DEBUT PERFORMANCE

Poster sessions are often the forum of choice for the young scientist who ventures for the first time into the scientific arena at a local or national convention. Poster presentations provide an intimate, low-pressure, and nonthreatening opportunity to exchange information with colleagues. In contrast to slide presentations, they allow direct personal contact, and as a result they enable not only the presentation of information, but also a true exchange of ideas. The chance for young scientists to receive instant feedback in the form of constructive comments, criticisms, and suggestions makes the poster session especially valuable. To benefit most from a poster presentation, you should consider it primarily an opportunity for exchange

of ideas and dialogue, rather than merely a forum for data presentation.

A poster is a visual display, subject to the same guidelines for presenting data that were previously outlined for the preparation of slides. The poster should be aesthetic and clean. Make sure that it does not exceed the dimensions of the poster board—usual standard dimensions are 1.1 m (3′ 8″) × 1.75 m (5′ 8″), but this may vary. The poster should not flop beyond the edges of the board, where it will interfere with neighboring posters or sloppily hang down below eye level. Choose a muted background color such as gray, beige, light blue, or white. Screaming colors like pink, orange, or purple focus attention on a poster but distract from the actual information presented. Personally, I find it painful to try to view data against a psychedelic background. If for easy transport the poster is composed of several panels, attempt to keep them similar in size so that they fit together neatly to form the complete display. The relationship between components of a poster that are conceptually connected can be accentuated by placing them together against a background shade slightly different from that of the rest of the poster. Many institutions have the capability of producing full-size printed posters that can be transported as scrolls and easily set up. These posters can be prepared using the PowerPoint program and always look neat and tidy. They are today the preferred standard, even though they provide less flexibility for last-minute revisions than posters organized on cardboard panels. I prefer a matte rather than a glossy finish, because the latter causes glare under overhead illumination.

Keep It User-Friendly and Simple

Figures and diagrams displayed on a poster should be designed to be viewed from a distance with clear and legible

graphics. Each figure should be clearly identified with a number or letter at least 1 inch in size. To provide coherence and focus, each image should make only a single point. Again, simplicity is the key to success. Like a slide presentation, a poster presentation differs from a publication in that the author is on site to explain the figures and diagrams. Details in legends and descriptions can, therefore, be kept to a minimum. A concise summary above or underneath each figure in large, bold type will enable the viewer to conveniently absorb the take-home message of every component of the poster. Like any scientific presentation, the poster should *tell a story*.

Choose a brief and informative title and provide a concise introduction that indicates why the work presented is important within the context of a major scientific principle. Describe the approach in an engaging, condensed style without excessive detail, and organize the presentation of data in a logical, coherent sequence. The lower portion of the poster should contain a small number of well-phrased conclusions and a major, concise summary statement.

Like any scientific presentation, the poster should focus on a single concept. I have seen many young scientists who, driven by an unbridled desire to display as many of their achievements as possible, cram into their posters a jumble of unrelated data. Usually this mistake results in a disorganized, unfocused display, the significance of which is hard to appreciate. Include only material relevant to the storyline.

Arrange the figures and diagrams in vertical columns rather than horizontal rows. It is easier for viewers to scan a poster when they are not required to zigzag back and forth in front of it. Vertical organization of data on a poster also allows different viewers to study the poster simultaneously and move along sequentially without bumping into one another.

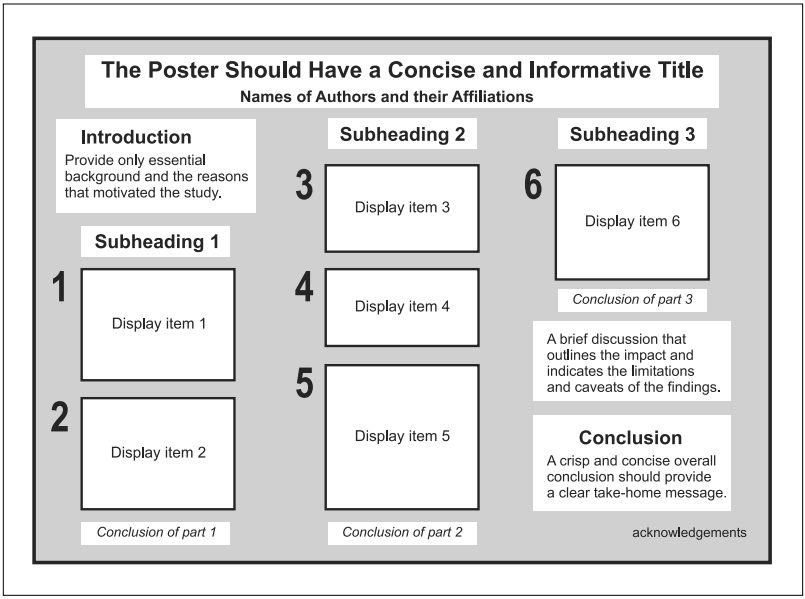

FIGURE 3–21. This diagram shows an example of a well-organized poster that is easy to view and designed to facilitate efficient interactions between the presenter and viewer. Text is kept to a minimum, and display items are organized as vertical columns and numbered to help viewers navigate comfortably through the poster. Subheadings and brief conclusions of different segments facilitate communication. An informative title and clear overall conclusion are essential. Attention also needs to be paid to the use of a muted, attractive background, uniform lettering, and an aesthetic layout.

INTERACTING WITH POSTER VIEWERS

The presenting author should be available for explanation at her poster at the designated time and wear her name tag for easy identification. It is a good idea to come equipped with extra thumbtacks, tape, or glue for emergency repairs. The presenting author should stand in a position that does not obscure the poster or interfere with traffic. Viewers should

be allowed to look at the poster at their leisure without being pestered by overly aggressive or energetic authors.

It often happens to me at meetings that I accidentally glance at a poster while making my way to the restroom or cafeteria, only to be gratefully snared by the presenting author who, like a used-car salesman in the off season, desperately insists on providing me with a detailed tour of his display. Needless to say, I remember such an individual as only someone to avoid for the rest of my life. A presenting author at a poster session should behave like a waiter in a first-class restaurant, who is there when needed but does not aggravate the guests by interrupting conversation every 10 minutes to inquire whether they are enjoying the food. The author should provide explanations when necessary and, above all, be open to discussion if he or she senses that his or her audience is willing and interested. Be prepared to provide a brief description of your poster when asked to do so. It is essential to keep such explanations short, because most visitors view a large number of posters one after the other and their attention span for each individual poster is limited. Also, other interested colleagues may be waiting in the wings. A well-organized poster will make it easy for a newcomer to enter immediately into an ongoing explanation, after briefly viewing the title and a few of the summary headings above the figures.

Remember that it is not the number of people who come to view your poster but the quality of interactions with them that determines its success. Often a detailed informative discussion with a single interested and knowledgeable colleague can be more useful to the presenting author than continuously rattling off the explanation of the poster to crowds of casual viewers. Poster presentations provide a unique opportunity for young scientists to build relationships. Several years ago I attended a national conference where undergraduate students

presented posters about their summer research projects. One young lady impressed me with her poise and clarity of explanation. She handed me a fancy business card that contained not only her contact information, but also a mini-CD, which could be inserted into a computer CD drive and showed her curriculum vitae and a copy of her poster. I was thoroughly impressed. The next summer I invited her to work in my lab and afterward she applied to our graduate program. Most universities can provide standardized business cards, also for graduate students. Being able to hand a card to poster visitors is far more convenient than having to scribble your name on a piece of paper. It is never too early for students to view themselves as professionals.

Conversations in front of posters can lead to collaborations or establish long-term relationships that prove to be important career boosters. When you introduce yourself to a viewer who shows a clear interest in your poster, try to remember her name and perhaps write down her address. You may meet again on future occasions, and she will be pleased to find out that you remembered the discussion you had with her. Follow-up letters or e-mails to people who came to view your poster, indicating that you enjoyed meeting them and discussing your data with them, go a long way to establishing valuable relationships and will provide them with a lasting memory of you and your work. Handing out reprints or copies of an abstract to your poster visitors will enable them to reflect on your data afterward and, among the multitude of posters viewed, will make your presentation memorable to them. One of my colleagues prepared small reproductions of his entire poster, which he sent to all of his poster visitors after the meeting. Receiving the reproduction of his poster in the mail allowed me to look at his data again in the quiet surroundings of my office and enhanced my appreciation for his

work. The poster presentation does not necessarily end when the display is taken off the board. Active follow-up by young scientists can help them emerge as known personalities within their field. In this way the poster can serve as a catalyst for establishing relationships with colleagues in the field.

Finally, science should be fun! Anything out of the ordinary will attract attention and draw people to a poster they might otherwise ignore. There is an increasing trend among presenting authors to show video sequences from their laptops along with the poster. Imagination, however, requires no multimedia technology. A colleague of mine once presented a poster that examined the genetic predisposition of humans to perceive the boar pheromone, androstenone, which has a strong odor of stale urine to about half of the human population and is odorless to the rest. From his poster dangled a little sniffing device consisting of a tube that held cotton wool impregnated with androstenone. Thus, people could come up to the poster and test themselves. Another colleague hung three-dimensional viewers from his poster; these enabled visitors to appreciate the depth perception of his electron micrographs. In 1983, I attended a large international congress in Mexico. On the last day of the meeting, when most participants were burned out by the vast number of presentations, I noticed in a corner of the poster hall a crowd that had gathered around what should have been an empty board. When I approached I saw that a poster had been improvised in the space. It consisted of multicolored drawings of an *Apatosaurus* and a *Tyrannosaurus rex*, created by the 5-year-old son of one of the meeting's participants. Effectively titled "Macromorphology of Dinosaurs," it was the most popular poster of the congress!

Important Points to Remember

- The three most important prerequisites for visual images are that they be *carefully prepared*, *simple*, and *necessary in the storyline*.
- Each visual image should illustrate a single point and, like the presentation itself, have only one focus.
- Include only images that are necessary to and functional within the storyline.
- Uniformity of style throughout the presentation accentuates and underscores the flow and coherence of the talk.
- The less busy a figure appears, the more justice it does to the information it attempts to communicate.
- Avoid showing tables, complex equations, or nucleotide and amino acid sequences, if possible.
- For text, use a font size that is large enough to be easily readable in the back of the room.
- Images can be enhanced by adding a title or a conclusion.
- Always keep summary statements concise and to the point.
- If the same figure has to be shown more than once, use duplicate images instead of backtracking.
- Avoid complex figures composed of multiple panels. Instead, show the individual panels sequentially as separate images.
- One way to simplify intricate diagrams is to start out by showing the basic components and gradually increasing

its complexity. A second way in which complex issues can be simplified is through the creative use of color.

- If it is impossible to simplify a complex diagram, inform the audience up-front of the conclusion of the diagram, then proceed to describe the figure, and explain how it leads to the stated conclusion.
- When designing a PowerPoint presentation, remember that simplicity is classy and that excessive visual effects become a distraction.
- Keep transition effects and color designs for PowerPoint presentation simple. Choose a quiet, muted background and keep it uniform throughout the presentation.
- Contact your host or symposium organizer beforehand to verify which PowerPoint versions and computer platforms can be used during your presentation.
- Video sequences should be brief and functional in the storyline. Make sure beforehand that the available projection system is compatible with the video and that sound, if included, will be clearly audible.
- When using the blackboard in combination with slides or overhead transparencies, make sure that information written on the board will remain visible when the projection screen is in use. Remember to have the room lights turned up whenever attention is focused on the board.
- A poster presentation is an opportunity for exchange of ideas and dialogue, rather than merely a forum for data presentation.
- A poster should be aesthetic and clean. The layout should be organized in vertical columns rather than as horizontal

rows and display items should be numbered to guide the reader through the poster. Choose a muted background color and remember that simplicity is the key to success.

- Like any scientific presentation, the poster should *tell a story*. Choose a brief and informative title and provide a concise introduction that indicates why the work presented is important within the context of a major scientific principle. Describe the approach in an engaging, condensed style without excessive detail, and organize the presentation of data in a logical, coherent sequence. The lower portion of the poster should contain a small number of well-phrased conclusions and a major, concise summary statement.
- A poster should include only material relevant to the storyline.
- Remember that it is not the number of people who come to view your poster but the quality of interactions with them that determines its success.

chapter

4

Delivery

Voice Control and Eye Contact

No matter how spectacular the information or how beautiful the slides, a scientific presentation, like any oratorical endeavor, stands and falls with the delivery. Effective use of the voice, eye contact, posture, gestures, and enthusiasm distinguish a routine presentation from a memorable one. Some purists will claim that in scientific presentations it only matters what you say, not how you say it. Nothing is further from the truth. Delivery is important in establishing the impact a scientific presentation makes on the audience, and speaking skills can be determining factors in scientific careers. The force of your delivery may make the difference between whether or not you get a job offer, or whether or not your grant proposal is approved.

Although we might not like to admit it, delivery, not content, often makes the lasting impression. General Charles de Gaulle practiced his speeches in front of a mirror to underscore his eloquence with carefully orchestrated gestures. When dropping in popularity, U.S. President Jimmy Carter

practiced clenching his fist to show determination and restore his leader image. Being a confident and powerful speaker is not only a talent; it can be an acquired skill. Most recent presidents of the United States speak in similar speech patterns—a somewhat patriarchal, soft-spoken yet determined voice with a slightly majestic undertone. A presidential manner of speaking has evolved, which successful candidates need to adopt to appeal to the expectations of the electorate. This manner of speaking is a characteristic attribute of the office, not an inherited trait of those destined to occupy it.

The characteristics of delivery in terms of voice control can be separated into several interrelated properties: sound, volume, speed, and intonation. The last term refers to such issues as monotony and emphasis. Of these four vocal characteristics, sound is the least problematic, because audiences rapidly become accustomed to almost any sound. The only time sound can be a severe problem is in the case of certain accents. My Dutch accent has stayed with me as an inseparable companion, even though I have lived in the United States for 28 years. The moment I greet a stranger with a simple "Hi," the first question I am asked is invariably "Where are you from?"

It is virtually impossible for an adult to get rid of an accent. In most cases, accents present no difficulty; they may even be an asset, attracting the attention of the audience. Some accents give an air of sophistication. It would be unusual to hear the conductor of a major symphony orchestra speak with an Ohio twang. For the maestro, his European accent is a valuable aspect of his image. Sometimes, as in the case of presidential speech patterns, accents can be acquired as a distinguishing feature. Some Oxford scholars have learned to speak English as if they are holding hot potatoes in their mouths. They were not born that way!

Challenges for Nonnative English Speakers

I have taught many foreign students the art of oral scientific presentation. Whereas most European and South American students had few problems, Chinese, Korean, and Japanese students often are hampered by their accents, which can make them hard to understand and actually interfere with their attempts to communicate with the audience. They find it difficult to adjust to the many sounds and half-sounds of the English language and to its structure, which, unlike Japanese and Chinese, makes a clear distinction between singular and plural. The confusing use of singular and plural forms and frequent inappropriate deletions of "the" or "a" in front of nouns, combined with a heavy accent in which the "r" and "l" have merged as one sound, often tax an audience's patience. When considerable amounts of the limited store of listener energy must be invested in deciphering the words themselves, less energy is available to perceive the concepts that the speaker is trying to communicate.

Although accents will never disappear, they can be modulated to within manageable limits. I remember one Korean student who had a difficult time not only with his accent, but also with the English language as a whole. He persevered, and several years later this initially unintelligible student gave a polished and eloquent thesis defense. To improve their accents, foreign students should mingle in everyday life with native English speakers. This encourages them to communicate in English and, ultimately, will enable them to *think* in English. Many foreign students have learned to speak English by translating word-for-word from their native language. This tendency gives rise to an unnatural, stilted speech pattern; moreover, expressions translated from another language into English do not always accurately reflect their intended

meanings. Once a foreign speaker becomes thoroughly immersed in the English language through everyday use, he or she stops translating and starts thinking in English, leading to a big improvement in accent and communication skills. A cassette or tape recorder can also be used to listen to one's own voice, paying particular attention to prominent features of the accent. Speaking the same text with gradual improvements into the tape over and over again will ultimately lead to the desired result: modulation of the accent into a more fluid vocal sound.

Foreign speakers who have severe language problems but nonetheless have to give scientific presentations in English should do two things: (1) Rehearse often, preferably with a friend who is a native English speaker, and (2) Structure your slides in such a way that the images are able to convey most of the story by themselves, even if your delivery is difficult to understand. This approach may lead to the inclusion of more text on slides than would normally be desirable, but again we have to compromise and shift the weight from the speaker's oral presentation onto the visual aids to achieve our minimum goal: to communicate an understandable story to the audience. My experience is that, given enough time and investment of effort, foreign speakers rival their native English-speaking colleagues in eloquence. After 2 years of training, several of my Chinese students were among the top performers in my graduate seminar.

SPEAK UP

Volume and speed are two characteristics of speech that can, if necessary, be easily modified simply by paying attention to them. I have dealt with many students who spoke so softly that only listeners in the front row were able to hear them. It is important to raise the volume of your voice when giving a

seminar; I do not remember ever having listened to a scientist who spoke too loud. My advice to any speaker is to use a microphone whenever one is available. It makes life easier both for you and for your audience.

Speaking softly is often an expression of shyness. I had one soft-spoken student rehearse her upcoming presentation with me by placing her at one end of a long corridor and myself at the other end. She literally had to shout to make herself audible to me. The next day, when she gave her talk, she spoke up and projected her voice. The louder volume, although it still felt unnatural to her, did not bother her as much after having had to shout the previous day. Just getting her to speak louder turned her into an excellent speaker. A similar remedy worked well for another student with the same problem. Student seminars were usually held in a room that holds about 40 people. To rehearse his presentation, I took him next door to a large lecture hall with a capacity of several hundred and placed him on the enormous podium. I sat up in the back of the auditorium as far away from him as possible. Forced to speak louder and project his voice, he grew accustomed to the vast space in which he found himself. The next day, the intimate lecture room looked much more sympathetic to him, and like his fellow student, he spoke up and gave an excellent presentation. In other cases, I have made a little cardboard sign that said "Speak louder" and flashed it at the speaker when necessary. This small seminar room, like many others, has a low ceiling and a loud ventilation system. The acoustics are terrible—often it is difficult to understand a speaker from less than 20 feet away. Projecting the voice and raising it to an almost unnatural volume are essential to be heard by those sitting in the back row.

Articulation and eye contact are the two most important components of voice projection. Take the time to articulate

every word of each sentence clearly, while maintaining eye contact with your audience. Mumbling, whispering, and letting sentences fade should be avoided, unless deliberately planned. A sudden lowering of the voice for one or two sentences, while maintaining eye contact with the audience and articulating each word carefully, can be used as a device to attract attention. The audience feels that it is being let in on a secret and allowed access to intimate information. The lowering of the voice forces the audience to listen more closely. Needless to say, this device is effective when used only occasionally.

EFFECTIVE USE OF THE STRESS POSITION

Fading of the voice at the end of sentences is a frequently encountered problem even among experienced speakers. It represents more than just an aesthetic flaw in delivery. As with written text, the end of a sentence designates the "stress position." It is here that the audience expects to be provided with the most important information. Note the different emphases among the following sentences:

1. In mathematics Michael received an A.
2. Michael received an A in mathematics.
3. In mathematics an A was given to Michael.

The first sentence stresses the importance of the grade that Michael received in mathematics (he received an A, unlike the lousy grades he got in his other courses). The second sentence emphasizes the field in which Michael received an A (it's not surprising for Michael to get As in other fields, but in mathematics?—his least favorite subject?). The third sentence puts

emphasis on the person who received the grade (Carla and Jamal and Sarah always get As in mathematics, but Michael?).

Consider another example of the importance of the stress position in both spoken and written language, using the following three sentences:

1. Albert Einstein discovered the relationship $E = mc^2$ as the basis of his relativity theory.
2. The basis of Albert Einstein's relativity theory is the discovery of the relationship $E = mc^2$.
3. The relationship $E = mc^2$ was discovered as the basis of his relativity theory by Albert Einstein.

Again we can see the effect of the stress position. The first sentence draws our attention to the relativity theory, whereas the second sentence emphasizes the relationship $E = mc^2$, and the third sentence focuses our attention on the fact that Albert Einstein deserves credit for the discovery of his relativity theory. Both in written and in spoken language, important information should be placed in the stress position, where the recipient expects to find it. In written language, the stress position can be further emphasized by punctuation or changes in font style. In spoken language, information contained in the stress position can be accentuated by alterations in the voice, such as an increase in volume or a pause, and underscored by gestures.

When a speaker's voice fades at the end of a sentence, the audience receives a contradictory signal. They expected the important information to arrive at the end of the statement, but instead that information is deemphasized by a lowering of the voice, leaving the listeners' expectation unfulfilled. When the last words of sentences are repeatedly inaudible or

delivered with a fading voice, the audience becomes frustrated, like children who may look at the ice cream but are not allowed to have any. Consider delivery of the first sentence from our Einstein example above by two hypothetical speakers:

1. Albert Einstein discovered the relationship $E = mc^2$ as the basis of his *relativity theory*. [increased volume at the italics]
2. Albert Einstein discovered the relationship $E = mc^2$ as the basis of his *relativity theory*. [fading of the voice at the italics]

In the first case the expectation of the audience is fulfilled loud and clear, whereas in the second case many members of the audience may never learn of what $E = mc^2$ formed the basis. Speakers who constantly allow their voices to fade at the end of sentences lose the audience's interest. Fortunately this detrimental habit can be corrected easily once the speaker has been alerted to the problem if he or she pays special attention to articulating the last words of every sentence until the habit is broken.

AVOID THE RISING INTONATION

A related problem to consider here is that of the rising intonation. Consider the following firmly delivered statement:

"I would need someone to help me move some furniture. We will first put it in the basement for storage. Then, tomorrow we will help my brother load it on the truck."

With emphasis on the last word of each sentence, the statement takes on an emphatic commanding tone. Now consider the same statement uttered as a series of questions:

"I would need someone to help me move some furniture? We will first put it in the basement for storage? Then, tomorrow we will help my brother load it on the truck?"

The last word of each sentence finishes here with a rising intonation and we have softened the command by turning it into a request. The rising intonation is popular, because it reflects a polite, more demure speaking style. Whereas in normal interpersonal communication the use of the rising intonation may be commendable, it is detrimental to the delivery of a scientific presentation. When a speaker talks an audience to sleep despite a good vocal volume, an interesting topic, and appropriate visual aids, the continuous use of the rising intonation is probably the cause. With the rising intonation, every sentence ends with a comma (equivalent to the question marks in the example shown above), and the entire seminar becomes one long never-ending sentence. The stress position becomes nonexistent, giving rise to the soporific effect of the delivery. It also inadvertently makes the speaker appear less confident. The use of the rising intonation to lesser or worse degrees is common. I would estimate that at least one in every three speakers is afflicted to some extent with this speech habit and is often unaware of this tendency. It is worthwhile to pay special attention to the consistent use of either the emphatic or rising intonation during rehearsals with a colleague or to listen to a taped practice talk. Once the speaker becomes aware of this undesirable speech pattern, it is often easily corrected.

Slow Down

Mumbling and letting sentences fade can also be related to the speed with which one speaks. Nervous, hurried speech often leads to inaccurate articulation. Take your time and do not

speak faster than your normal conversational speed. When we take our car into the garage to be fixed, we explain very carefully to the mechanic the problems we have experienced with our miserable vehicle and what we would like to have done to it. The same careful speech pattern is appropriate for scientific presentations.

One of my students used to speak with dazzling speed, so fast that it was remarkable that the words had time to take shape before they left her mouth. She also left no breaks between her sentences. I worked carefully with her, using audiotapes and rehearsals to slow down her speech. Again, I made a little cardboard sign that said "Speak slower" and held it up to her whenever she showed the inclination to speed up. She was initially tortured by the urge to exceed the imposed velocity, which to her felt impossibly slow and unnatural. By slowing down, however, she became an excellent speaker. Moreover, she found that she had no problem covering the same amount of material. The speed of her thoughts was allowed to catch up with the speed of her speech, and as a result she expressed herself more effectively. She has permanently modified her style of speaking and remains a superb lecturer.

BREAKING THE MONOTONY

Despite good volume, clear articulation, and a comfortable speaking speed, a speaker can still deliver a soporific story if the rhythm of the voice is not controlled. Monotony is the greatest enemy of a scientific presentation. The use of the rising intonation, described above, is one problem that may give rise to the perception of monotony. I advise students, unless they have a severe language problem, never to learn their seminars by heart or read them verbatim from notes.

Both approaches generate the "tape recorder syndrome," in which a speaker rattles off a prepackaged script. Once a speaker recited a prelearned seminar without noticing that her message had gotten "out of synchrony" with her slides. The effect, unbeknownst to her, was hilarious. On another occasion, one of my students learned his presentation by heart. He was a foreign student with a language problem, and I had recommended that he try to memorize at least parts of his lecture. Everything went fine until suddenly someone in the audience asked a question in the middle of his presentation. Not only was he unable to answer the question, but also he could not continue his talk. The tape had stopped and he had gone blank. He had to rewind and restart at an earlier point, repeating part of his prelearned message verbatim to be able to pick up where he left off. Although I used an extreme example, reading a written seminar or reciting a prelearned presentation hinders spontaneity.

Breaking the monotony is most effectively accomplished by placing emphasis on important phrases throughout the presentation. There are three ways in which emphasis can be placed in spoken language: (1) changing the volume of the voice, (2) repeating words or phrases, and (3) pausing. Combining all three devices is often extremely effective. For example, to motivate the audience to pay attention when I lecture on olfaction, I start the presentation by stating that "olfaction is the molecular recognition of chemical signals, which carry information about the localization of food and the availability of reproductive partners, and which are crucial for the survival of most animals." To emphasize this point and arouse the audience's interest, I change volume, repeat phrases, and pause, as follows: "Olfaction . . . olfaction is the **molecular recognition** . . . the molecular recognition of chemical signals . . . chemical signals which carry information . . .

chemical signals which are **crucial** for the survival of most animals. . . ." (bold type indicates increased volume). Repetition like this should not be used excessively throughout the presentation, but can be a powerful tool to create a sense of excitement, urgency, and importance at certain key junctions in the talk, especially near the beginning or the end.

REPETITION

The power of repetition in rhetoric has long been recognized among politicians, who use endlessly repeated sound bites to implant desired perceptions in voters' minds. A good example of the effective use of repetition was the 1996 speech by Senator Christopher Dodd (D, CT) during the Democratic National Convention, in which he nominated President Clinton for reelection. During his speech he enumerated the President's accomplishments and after each accomplishment reiterated the same statement: "You did a good thing, Mr. President; you did a good thing for America." This phrase was repeated about a dozen times during the speech. Note that within this statement the phrase "you did a good thing" appeared twice. The desired effect was to drum home the message to the electorate that the President had done "good things" during his previous term. It was highly effective.

Consider the example of a fisheries scientist who delivers a presentation at an international Fisheries Science conference on fluctuations in herring populations in the North Sea. The take-home message she wants to get across is that strict government management by countries with active fishing fleets in the North Sea is essential for maintaining viable herring stocks. She may, in fact, start her presentation by stating that she will provide an overview of herring populations and their migrations in the North Sea, that populations are dwindling,

and that strict government management will be essential to maintain economically viable stocks. She might proceed to describe the life cycle of herring and indicate the time it takes for a fish to reach full maturity and how current fishing practices deplete the population faster than it can be replenished. She may mention again that only strict government management will be able to ensure economically viable stocks in the future. She can then show charts of population sizes for the last 20 years and illustrate how overfishing resulted in a decline of the population. She then can demonstrate that when government restrictions were put in place the population recovered. Again, she would emphasize that strict government management will be effective to ensure economically viable stocks in the future. The audience may not remember all the details of the life cycle from spawning to larva to adult fish, or the different herring species that were discussed. Neither may they remember the exact locations most prone to overfishing, or the economic figures, or the precise percentages of annual declines in the herring population. But, the frequently repeated message that "strict government management is essential to ensure economically viable herring stocks in the future" will be remembered loud and clear.

Another example that illustrates the power of repetition in a different manner is that of an epidemiologist who addresses a conference dedicated to the alarming rise in obesity and diabetes among children. First, he shows that childhood obesity and diabetes have increased exponentially with the advent of the fast food industry. He might emphasize this point by demonstrating that in countries where fast food franchises have opened up only recently, an increase in the same juvenile health problems is becoming apparent, where previously it was virtually nonexistent. He might then drive the point

home further by indicating that in school districts where salads are routinely served for lunch instead of cheeseburgers the incidence of juvenile obesity and diabetes is lower. The use of repetition in this case consists of the repeated correlation, through different examples, of proliferation of the fast food industry with juvenile obesity and diabetes. The take-home message is clearly that the fast food industry can be held largely responsible for the spread of juvenile obesity and diabetes. However, rather than stating this contentious opinion directly, the speaker enables it to emerge as an implicit perception from the series of repeated statements made during the presentation.

Restating conclusions or reminding the audience of a conclusion reached earlier in the talk, which serves as a basis for additional arguments, is an effective means of emphasizing important aspects of the presentation's content.

THE POWER OF SILENCE

Pauses are a highly underrated, powerful means for impressing a point on the audience. A moment of silence can achieve more than a thousand words. Many people are uncomfortable with silence. One of my former mentors, a psychiatrist by training, was a master in the use of silence. When you entered his office, he would offer you a seat, sit down across from you, and simply look at you in silence. This atmosphere forced his visitor to say something, anything! Soon, without realizing it, you would be telling him all your plans, worries, and secrets. Similarly, during a scientific presentation a gap in the steady flow of words creates a slight discomfort, an air of expectation, which causes the audience to pay attention. Most importantly, the pause allows the last words to sink in, giving the audience time to fully digest the information.

FIGURE 4–1. An emphatic pause delivered under eye contact focuses the audience's attention on the last words the speaker said and makes them attentive to what will be said next.

One of the most effective and most underused techniques for emphasizing key statements during a presentation is the double pause. The statement that the speaker wishes to emphasize is both preceded and followed by a pause, isolating it from the continuum of spoken text. The first pause serves to arouse the audience's attention in preparation for the upcoming statement, whereas the second pause allows the message conveyed by this statement to "sink in." Consider, for example, a sociologist who has been invited by a local government agency to give an informative briefing on alcoholism in the community. A section of the sociologist's presentation near the end of the talk might run as follows:

"The data presented on the last slide clearly indicate that government spending to combat alcohol addiction in this state has consistently lagged behind the per capita expenditures allocated to deal with this problem in other states. Furthermore, there is a severe communication problem between local government agencies and volunteer community organizations. Alcohol addiction is a major social problem in our community. Each year more than 100 alcohol-related fatalities occur on the roads in this city alone. Drunk driver convictions have skyrocketed. However, alcohol addiction is not a crime, it is a disease. The government has to work together with community groups to cure this disease. This, of course, requires the availability of additional financial resources."

Let us now suppose that the sociologist wants to emphasize particularly the drunk driving problem, to stress the message that lack of adequate government funding is in part to blame for alcohol-related fatalities. Her presentation would be identical except for the insertion of a double pause, as follows:

"The data presented on the last slide indicate that government spending to combat alcoholism in this state has consistently lagged behind the per capita expenditures allocated to deal with this problem in other states. Furthermore, there is a severe communication problem between local government agencies and volunteer community organizations. Alcohol addiction is a major social problem in our community.

[pause] Each year more than 100 alcohol-related fatalities occur on the roads in this city alone. **[pause]**

Drunk driver convictions have skyrocketed. However, alcohol addiction is not a crime, it is a disease. The government has to work together with community groups to cure this disease. This, of course, requires the availability of additional financial resources."

The perception of a state official in the audience is as follows (pauses are again indicated by square brackets): "words, words, words, words, words, words, words, words, words, words [Hey, what is happening? The words have stopped. Why, what is going on? (Attention has been roused)] each year more than 100 alcohol-related fatalities occur on the roads in this city alone [More than one hundred. That is about two fatalities every week. That's a lot! That's truly shocking] words, words, words, words, words." If the sociologist instead wanted to emphasize that alcoholics should be considered patients rather than criminals, a double pause could be used to isolate the statement:

[pause] However, alcohol addiction is not a crime, it is a disease. **[pause]**

Now the state official in the audience will leave the room with the idea that alcoholics should not be punished but rather treated as patients suffering from an illness. The verbal text of the presentation is the same, but the simple use of an emphatic double pause has changed the listener's perception dramatically. Notice also that the use of the emphatic double pause has allowed the sociologist, who was invited merely to present an informative briefing, to express a political opinion very effectively ("government negligence is in part to blame for alcohol-related fatalities" or "more drunk driving convictions will not solve the deeper underlying problem of alcoholism"). The presentation may have contained extensive documentation on alcoholism among different age groups and economic classes, data on alcoholism in minority groups, and an evaluation of the regional prevalence of this problem. Although they represent only a small percentage of the presentation, the few words flanked by the double pause will receive a disproportionate amount of attention. The double pause is a powerful tool because of its subtle simplicity. It can also be used

easily by shy speakers who feel inhibited to raise their voices or use gestures for emphasis. A slight increase in volume and a deliberate slowing of speech can further enhance the dramatic effect of the double pause.

Like the audience, speakers usually feel uncomfortable with silence. When gathering their thoughts between sentences, they often say "um." This is a very distracting habit and should be unlearned, if possible. Plain silence is preferable to mere noise. Many speakers also insert "filler" words like "basically" ("What this slide *basically* shows") or "specifically" ("We can *specifically* conclude that these effects are *basically* artifactual"). I listened to one seminar speaker who not only talked with great speed, but after every other sentence used the word "okay?" with a rising intonation. Obviously he did not expect an actual response from anyone in the audience, but employed this little phrase as a filler between sentences. He used it so often that it became ridiculous and made some people laugh. If he could slow down and get used to incorporating moments of silence between his sentences, the urge to say "okay?" every minute or two might fade away. Moreover, brief pauses between sentences allow time to think and clearly formulate the next statement. Slowing down is a remedy for 90 percent of most speakers' problems.

EYE CONTACT

Finally, as mentioned earlier, eye contact is one of the components of a strong delivery. Many speakers avoid eye contact with the audience. Yet eye contact and posture contribute crucially to charisma and presence. We communicate with our eyes as much as with our words. A speaker who exclusively addresses the projection screen or has her eyes permanently

Figure 4–2. An example of avoiding eye contact and a slouching posture, which detach the speaker from his audience.

cast down to the lectern or the floor fails to connect with the audience.

Looking straight at members of the audience establishes the notion that you are talking *to* them, not just *in front of* them.

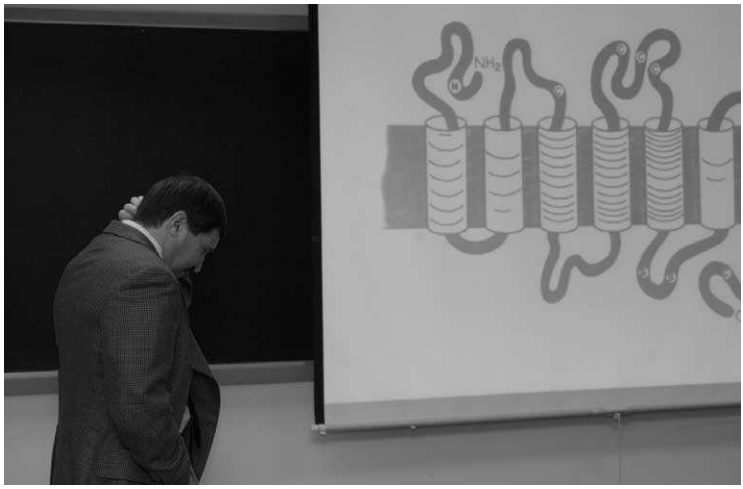

FIGURE 4–3. Another example of poor stage presence. Looking at the ground and a slouching posture will detach the speaker from his audience. As a result, members of the audience lose interest in the presentation.

Eye contact should not fix on one individual but should be supple, move around the audience, and involve all of the listeners. Often it happens that throughout their presentations, speakers fix their eyes on the chairperson of the department and make the rest of us in the audience feel as if we are intruders in a private conversation.

Eye contact not only helps voice projection and communication, it also generates confidence. He who can look his fellows in the eye is instinctively perceived as having a clear conscience and is considered trustworthy. Information offered with eye contact subconsciously gains more credibility than the same data delivered by a speaker who avoids looking at his audience. So, let us look the jury straight in the eyes and

Figure 4–4. Telling a story!

say in a clear, emphatic voice: "Here I am! I will tell you the truth, the whole truth, and nothing but the truth!"

Posture and Gestures

When we are on the podium in the spotlight, we become performers. Actors are acutely aware not only of voice but also of posture and gestures. Posture and gestures, like eye contact and vocal inflections, contribute to the stage presence of a speaker. The stage presence, in turn, will help determine whether the presentation will linger in the audience's memory or quickly be forgotten. I rather enjoy being "on stage"—you may as well, because there is no alternative. On stage I let my inhibitions go and speak freely, deliberately using my voice, body position, and gestures to give a *performance*, not just a lecture.

FIGURE 4–5. Slouching behind a lectern obliterates stage presence. A scientific presentation should be delivered with the speaker standing up and being clearly visible.

To make a lasting impression you have to be visible. Speakers tend to be glued in place behind the lectern, especially at scientific conventions where each speaker has only 15 minutes to give a platform presentation. The audience listens to just a few presentations before its attention may start drifting. To avoid losing the audience's attention, especially when scheduled in the middle or near the end of such a session, it is important to *perform* rather than just talk. Stand up straight. You, the speaker, are the leader, the general who gives the commands, and need to look the part! Step out and away from the lectern and avoid talking to the screen, the slide projector, the floor, or the pointer.

When pointing to the screen, interrupt your eye contact with the audience only momentarily and reestablish it as soon

Figure 4–6. When the speaker steps away from behind the lectern, he becomes more visible and has greater stage presence.

as possible. Hold the pointer in the hand near the screen; when the screen is on your right, the pointer should be in your right hand, which allows you to keep eye contact with the audience while pointing at the screen; if the pointer was in your left hand, it would force you to turn toward the screen with your back to the audience every time you wanted to focus attention on the screen.

Do not be stationary. Change position occasionally and move around the podium, if possible. Again, this motility helps keep the audience's attention and allows eye contact with different sections of the room.

Many novice speakers, especially when they are apprehensive, do not know what to do with their hands. They often

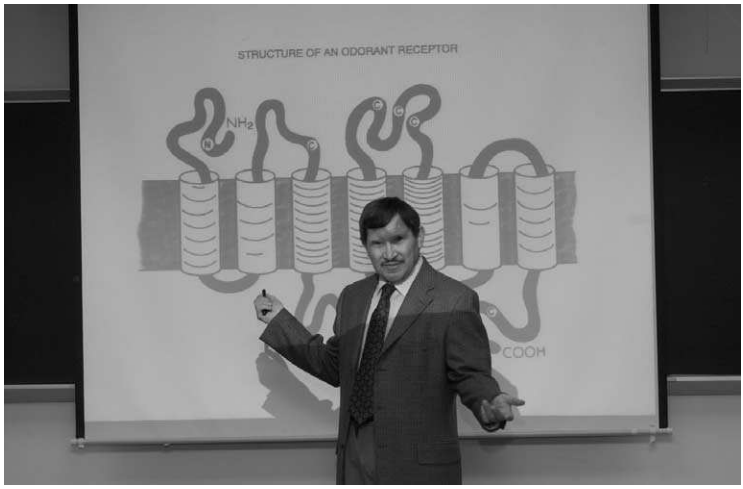

Figure 4–7. A speaker who stands in front of the screen obscuring the image he is discussing becomes an object of frustration for the audience.

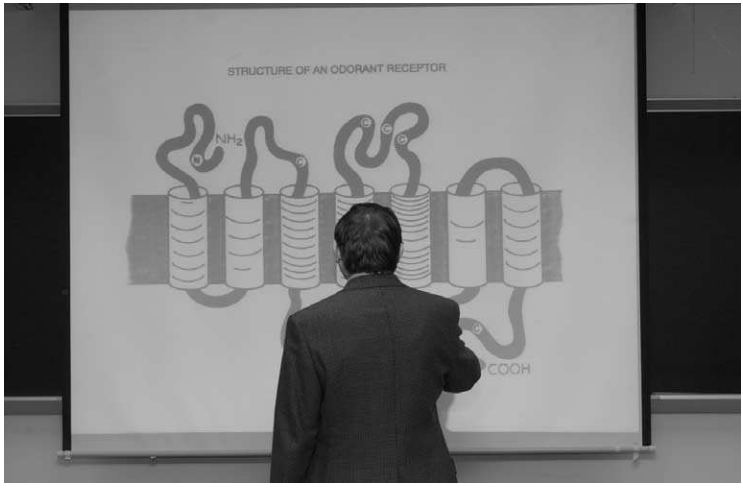

Figure 4–8. Talking to the screen prevents communicating with the audience through eye contact. After watching the speaker's back for a while, the audience "tunes out." In addition, voice projection is adversely affected when the speaker does not face the audience.

FIGURE 4–9. Talk to the audience not just in front of the audience. The eye contact and body language of this speaker shows that he is tuned in to the audience. The "voila" gesture demonstrated here is inviting, emphasizes the data that are being presented, and subliminally generates trust as the speaker's empty hands show that he has nothing to hide.

put one hand in a pocket, while fiddling with or leaning on the lectern with the other hand. Avoid distracting nervous mannerisms like rattling a key chain or snapping your fingers. I have seen speakers with shaky hands try in vain to focus the laser pointer on the screen, while the untamable red dot darts around amplifying their tremors. (Thereafter, when they forget to turn the pointer off, the red dot drifts up to the ceiling or down onto the podium, taking with it the audience's attention.) I have seen speakers give entire presentations with hands clasped behind their backs. Others hold onto the lectern. None of these are natural or relaxed positions.

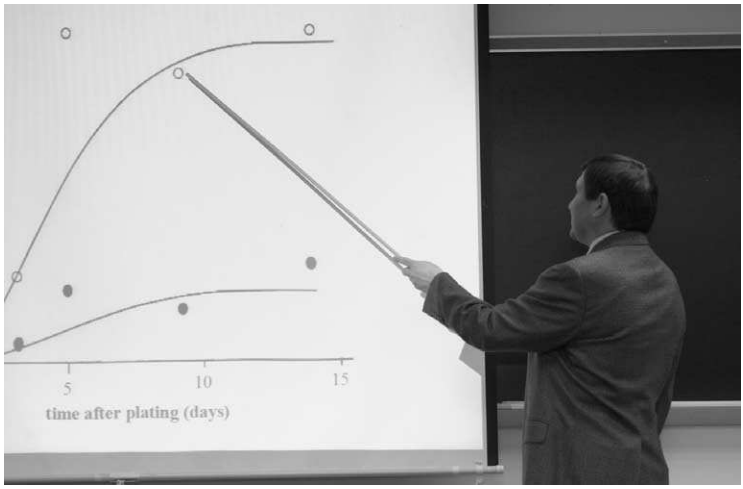

Figure 4–10. When the screen is to the speaker's right, holding a pointer in the left hand causes him to turn his back to the audience when pointing to the screen.

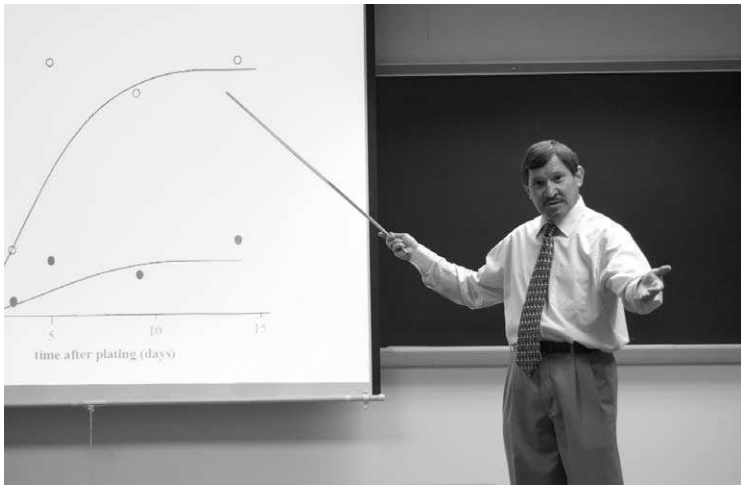

Figure 4–11. When the screen is to your right, hold the pointer in your right hand; that way you do not have to turn your back to the audience when pointing to the screen and you can maintain eye contact.

Speaking with a hand in your pocket looks sloppy and unattractive. Far from nonchalant, this posture reflects tension and insecurity. You can, however, make positive use of your hands when you want to emphasize phrases during your presentation. As pointed out before, gestures, such as the clenched fist to show determination, can underscore spoken language. Consider the *voila* gesture, the outstretched arm that extends an invitation to the audience to inspect the information on display; the raised hand and forefinger that stress a point; the hand motions that underscore words, palms up reaching out to the audience. Finally, immobility of the speaker with a frozen gesture and intense eye contact can punctuate an emphatic pause.

As Shakespeare said, "All the world's a stage,/And all the men and women merely players." When giving scientific presentations, we all are actors. The scientific community is our audience, our careers rest on the applause, and the best performers get to play the leading roles.

Enthusiasm: The Indispensable Ingredient

Several years ago, I attended an international convention in Amsterdam and listened to a particularly dull speaker. One would expect anyone to greet the opportunity to give a presentation to the international scientific community with excitement and enthusiasm. In this case, the reality was different. Seldom have I listened to a less vibrant or less inspired lecturer. I have had only one similar experience: at a meeting in Florida, a researcher managed to present very elegant and important experiments in a flat, bored fashion. Needless to say, both managed to convey a deep sense of depression, and ignited no appreciation for their scientific accomplishments.

Most speakers show at least some enthusiasm for their work. It is impossible to motivate anyone in the audience to pay attention if even the lecturer is not excited about the presentation. I remember a speaker who began his seminar by apologizing to the audience for the fact that he was missing his best slides, which one of his students had borrowed and forgotten to return. In addition, he confided, the beginning of his talk was bound to be boring since he would have to cover some very basic aspects of his field. He informed his listeners that if they wished to sleep through the first half of his seminar, they should certainly do so; he promised to wake them when he was ready to discuss the more interesting findings of his research. Thus forewarned, many members of the audience followed his advice and did not wake up until the end of the presentation.

Enthusiasm cannot be taught. It is the spark from within, the belief that no matter how slight your contribution is in the grand scheme of Mother Nature, it provides a glimpse into her secret treasure box—a small advance, but one that endures forever. Every scientist deserves to be respected in the conviction that the topic of his or her work is the most important issue in the universe. Nothing is a greater pleasure than to watch truly enthusiastic speakers who intensely enjoy a moment in the spotlight for themselves and their research.

Enthusiasm is often suppressed, especially by novice speakers, out of timidity or insecurity. Let these inhibitions go! General principles of how to become a better speaker can be laid down, as in this book, but in the end genuine enthusiasm accounts for 90 percent of a speaker's success. It is this spirit of excitement that inspires the next generation of scientists, that convinces the prospective buyer to try the product, that leads management to give the proposal a shot. It is passionate absorption in our work, a deep commitment that cannot

Figure 4–12. Whether it is a sales pitch or a scientific presentation, enthusiasm gets you half-way there! It is immediately evident that this speaker is communicating his work energetically and enthusiastically. His posture, gestures, and eye contact establish a charismatic stage presence, which allows him to communicate effectively and keep the audience attentive.

be expressed in monetary terms, that gives us the irrepressible energy to move forward in our research. True enthusiasm and excitement can light a spark in the minds of your audience and arouse their eager interest.

ANSWERING QUESTIONS

"I want this talk to be informal. Please feel free to interrupt me at any time." I frequently hear naive speakers extend this open invitation to the audience to disrupt the presentation at will. Not a good idea! Although a stimulating discussion with the audience should be encouraged and often is one of the most valuable aspects of a seminar, it is counterproductive to invite the audience to break up and disrupt the momentum of the presentation with ad hoc questions. The speaker should permit questions only at *his* or *her* convenience. You can either ask at an appropriate moment in the presentation whether there are any questions, or (preferably) take questions at the end of the talk. Compartmentalizing the event in this manner allows the presentation to flow smoothly without disturbing your train of thought.

Interruptions may require lengthy answers and become full-blown discussions, permanently derailing your talk. Most audiences are disciplined enough to wait until the end of the presentation. Occasionally, however, someone in the audience will blatantly interrupt with a question. The speaker has two options: to answer it, preferably briefly, or to ask that the member of the audience please let the seminar proceed—you will get back to the question at the end of the presentation. If you opt to answer at that moment, you risk encouraging further interruptions. Try to delay the answer until after the conclusion of your talk, by which time the need for the ques-

tion has often dissipated. By making it politely clear that the audience should not interrupt, the speaker will discourage additional ad hoc questions and allow the audience to focus on the presentation.

The discussion following the lecture is an extremely valuable opportunity for the speaker to show depth of knowledge and engage in stimulating debate with the audience. Preserve the same poise in terms of clearly articulated speech, posture, and gestures during this period that you mastered during the presentation itself, rather than collapse into your off-stage persona. The performance is not yet over. Always answer questions briefly and to the point. Some speakers use a simple question as an excuse to lead into a continuation of their

FIGURE 4–13. This speaker shows confidence and authority as he invites questions after the conclusion of his presentation.

Figure 4–14. Caught off-guard by an unexpected question, this speaker has lost his confidence and stage presence. When the answer to a question is not known, admit the fact and invite the person who asked the question to discuss the issue with you afterward.

FIGURE 4–15. Explaining the answers to questions clearly, concisely, and with poise elicits a sustained interest from the audience during the postseminar discussion period.

seminars. This habit is annoying to the audience and adversely affects the perception of the preceding talk. Precise, short, and well-articulated answers (rather than protracted expositions) allow the discussion to retain the vibrant momentum established during the presentation itself.

Who is given the opportunity to ask a question? The selection is sometimes made by the host, sometimes by the speaker. It happens often that one or two members of the audience dominate the discussion. It is important to involve as many people as possible, however, and to provide the opportunity to ask questions to different listeners.

It is in many cases advantageous to repeat the question before answering it. Not only does this give you extra time to reflect, but it also keeps your audience attentive without allowing the postseminar discussion to deteriorate into a private dialogue between you and one or two vocal members of the audience. In addition, repeating the question gives you the chance to *rephrase* the question. This can be of strategic value when the question you face is hostile. Following a presentation on neural development in *Drosophila*, for example, a speaker was asked whether she really believed that studies of fruit flies had any direct relevance to modern medicine and human disease. The lecturer not only repeated the question but also reshaped and generalized it, informing the audience that the issue was whether studying organisms other than humans can advance our knowledge of biological systems and, therefore, ultimately benefit medicine. Rephrasing the question helped represent the question as unsophisticated and ill-conceived. By repeating—and recasting—the question, the speaker turned the tables on her hostile interrogator even before she proceeded to answer.

DEALING WITH UNEXPECTED QUESTIONS

There are two types of questions: those that are anticipated, which can be readily answered, and those that are unanticipated, which in some instances pose problems. Anticipated questions usually recur on different seminar occasions, and

the speaker has answers ready for them. It is always a good idea to be polite and gracious. Tell your listener, even if the inquiry is obvious, "That is an excellent question" or "You bring up a fundamental point" before answering the question. It makes you look good and makes the questioner feel brilliant. Everyone is happy. Sometimes an aggressive competitor with dissenting ideas may be in the audience. It is important to remain calm and composed when challenged by an opponent. Never be abrasive. It is often preferable to avoid a full-blown confrontation in front of the audience. Remember, the antagonist is one of them—they are on the same side! In such cases, it is best to say "I see your point, even though I disagree

FIGURE 4–16. This speaker has become involved in a heated argument during his postseminar discussion session. Do not lose your composure when antagonistic questions are being asked, but handle them calmly and diplomatically.

with it. Because this is a very complicated issue, which may lead to a long debate, it is perhaps better if you and I get together afterward to discuss it."

Sometimes an unanticipated question can be more than awkward. When I studied toward my doctorate at the University of California at San Diego, I had to defend a research proposal outside my actual thesis project as one of the requirements of the program. The committee consisted of three professors. One, a Nobel laureate, stared out the window during my entire, very carefully prepared presentation. Occasionally, his head nodded and he seemed to doze off. I suspected that he found my efforts very dull and that I had put him to sleep. The other two committee members started firing questions. No problem! Then, suddenly, when I thought it was all over, the silent professor spoke up: could he ask one small question? It was a killer. He had put his finger on a basic flaw in my hypothesis. We are not often confronted with such unanticipated, brilliant questions, but it has happened to me more than once and I have learned the hard way how to deal with these situations.

Difficult, unanticipated questions require a moment of thought. One way for the speaker to buy extra time before answering is to ask the questioner to please repeat or clarify the inquiry. If a question cannot be answered easily, it is a mistake to feign knowledge or talk around the issue. I have seen many speakers dig themselves deeper and deeper into a hole because they were not prepared to say simply "I am sorry, I don't know." This, or a statement like "This is a very interesting point. I have not looked at it this way before, and I would have to think about it for a while. Why don't we discuss it together afterward" are usually the most face-saving. Unlike the reply to an aggressive adversary exemplified earlier, this proposal should be sincere. It is of real

importance for the speaker actually to follow up and seek a solution to the problem by discussing it with the person who asked the question. This way the speaker can be prepared for the same question, should it come up again during a future seminar.

Evaluating the Critics: How Did You Really Do?

Only one thing is worse than being asked a brilliant, unanticipated question: that is, not being asked any questions at all. We may like to flatter ourselves that everything was so clear that nobody could think of anything to ask, but it is unlikely. It is far more likely that we lost the audience. Our graduate students are privileged to receive honest, constructive feedback from their mentors after each of their presentations, but frank criticism is hard to come by in the real world. The nature of the questions or the lack thereof gives us some information about the perceived quality of our presentations.

Absence of compliments can also be disheartening. On the other hand, praise may not always mean much, and in the end, we have to be our own judges. One colleague of mine will eagerly run up to any speaker and tell him "You were magnificent! This was the best talk I ever heard!" Afterward most people will say that they "enjoyed your seminar," whether this is true or not. Many years ago I gave, by my own admission, a mediocre lecture on benzodiazepine receptors. A famous scientist who is a member of the National Academy came to my seminar and fell sound asleep in the front row. He did not wake until the modest applause disturbed his dreams. That evening he was among the faculty members who took me out for dinner. As he sat down across from me and unfolded his napkin, he said, "You were magnificent! This was the best talk I ever heard!"

Finally, let it be of comfort to the reader to know that the perfect speaker is rare indeed. I recall only a handful of seminars that defied any form of improvement. All we can aspire to do is learn from our errors and get better with every experience. The guidelines discussed in this book will help the reader to explore and master the art of oral scientific presentation. But, eventually, one must move beyond the rules. The most important advice to remember is to *communicate* with your audience and convey *enthusiasm* about your work. Then, if you are armed with a coherent story based on solid data, you can enter the scientific arena, flourish your words of wisdom, and dazzle 'em with style!

IMPORTANT POINTS TO REMEMBER

- Genuine enthusiasm accounts for 90 percent of a speaker's success.
- Slowing down is a remedy for 90 percent of most speakers' problems.
- Monotony is the greatest enemy of a scientific presentation. Avoid the rising intonation and place emphasis by modulating the volume and intonation of the voice, through the use of pauses, repetition, eye contact, and gestures.
- Use a microphone whenever one is available.
- Talk *to* the audience, not merely *in front of* the audience.
- Articulation and eye contact are the two most important components of voice projection. Take the time to articulate every word of each sentence clearly while maintaining eye contact with your audience.

- Nervous, hurried speech often leads to inaccurate articulation. Take your time and do not speak faster than your normal conversational speed.
- As with written text, the end of a sentence designates the "stress position." It is here that the audience expects to be provided with the most important information, and this information should be delivered clearly and emphatically.
- It is worthwhile paying special attention to the consistent use of either the emphatic or rising intonation during rehearsals with a colleague or by listening to a taped practice talk.
- Foreign speakers who have severe language problems but nonetheless have to give scientific presentations in English should: (1) Rehearse often, preferably with a friend who is a native English speaker, and (2) Structure slides in such a way that the images convey most of the story by themselves, even if the delivery is difficult to understand.
- Restating conclusions or reminding the audience of a conclusion reached earlier in the talk, which serves as a basis for additional arguments, is an effective means of emphasizing important aspects of the presentation's content.
- Be aware of your stage presence. Eye contact and posture contribute crucially to charisma and presence. Gestures can underscore spoken language. Avoid distracting mannerisms, talking to the screen, or turning away from the audience.
- Always answer questions briefly and to the point.
- It is advantageous to repeat questions before answering them.

- When answering questions, avoid polemics. Be polite and gracious. Defer potentially contentious conversations to private discussions after the presentation.
- The most important advice to remember is to *communicate* with your audience and convey *enthusiasm* about your work.

Appendix A

Checklist for Presentations

One Month Before the Presentation

- ❑ Contact your host and verify that the room has any equipment you require, including a computer-assisted projection system, an online connection, blackboard, microphone, and pointer. Verify that your PowerPoint version is compatible with their set-up and that you will be able to connect to the projection system directly using your own laptop computer.
- ❑ Ask your host how many people are likely to attend your presentation and what their interests are. As a courtesy and to facilitate the introduction for your talk, you might wish to attach an updated curriculum vitae to your e-mail message.
- ❑ Browse the website of your host institution and get a feel for the research interests of faculty who are

likely to attend your presentation. Also consider individuals at sister institutions or research affiliates located in the vicinity.

- ❑ Construct an outline for your presentation and prepare your PowerPoint images, keeping in mind the interests of your audience.
- ❑ Ask a colleague with whom you have a comfortable rapport or your mentor whether he or she would be willing to listen to a practice presentation. Make an appointment for a specific day and time at the person's convenience.

Three Weeks Before the Presentation

- ❑ Prepare an evaluation sheet for use by the person with whom you will be rehearsing (see the following example).
- ❑ Rehearse the presentation with your colleague. Ask him or her to time the presentation and to make note of the coherence of the presentation, its logic, the style of delivery, and quality of visual images. Ask for written feedback to be given on the evaluation sheet, emphasizing that constructive criticism, not compliments, would be most helpful to you.
- ❑ After the practice talk, examine each visual image together with your colleague to identify areas where the image or logic of the presentation could be improved.
- ❑ Adjust your presentation based on the practice talk. Ask whether the same or another colleague would be willing to listen to you deliver the revised version.

Two Weeks Before the Presentation

- ❑ Practice the presentation alone and with your colleague. Receive additional comments and make final adjustments.
- ❑ Let the presentation rest in your mind. Don't practice it again, so next week you can give it a fresh look.

One Week Before the Presentation

- ❑ Practice your presentation again to make sure you are satisfied with your performance. Even if practicing the talk on your own, pay particular attention to delivery style and posture. A mirror may be helpful. Imagine you are talking to an audience.
- ❑ Make sure that you have multiple backups of your PowerPoint presentation in the form of either a thumb drive device or a CD. You may consider sending the PowerPoint file by e-mail to your host and yourself. In the event of an unforeseen problem, it can then be retrieved electronically from a remote location.

Two Days Before the Presentation

- ❑ Practice the presentation one last time. Don't practice it again. Relax. By now you should feel well prepared and confident to deliver a successful talk.

The Day of Your Presentation

- ❑ Dress appropriately, keeping in mind that you may have to accommodate a portable microphone.
- ❑ Double-check that you have your presentation and notes.

- ❑ If your presentation is at lunch time, try to have a light snack, such as a granola bar or an apple, before your talk so you will not be hungry.
- ❑ If possible, view the room before your scheduled presentation time. Imagine where you will be standing and how you will be establishing stage presence in that location.
- ❑ If needed, make sure there is a glass of water for you at the rostrum.
- ❑ Make sure ahead of time that the computer connection and projection works correctly as anticipated. In case of problems, do not get upset. It is your host's responsibility to solve them.
- ❑ Make sure you have a pointer.
- ❑ It might be helpful to give your host a summary of biographical bullet points to facilitate the introduction.
- ❑ Relax, smile, project enthusiasm, and . . . dazzle 'em with style!

Appendix B

Evaluation Form

I. Structure of the Presentation

1. Did the speaker place the presentation in the perspective of a major issue of overarching significance?
2. Did the speaker provide an outline of the presentation and establish a clear line of thought?
3. Did the speaker zoom in to the major focus of the presentation?
4. Was the presentation focused and coherent?
5. Did the speaker include distracting details that were irrelevant to the mainstream of the presentation?
6. Was the presentation appropriately targeted to the particular audience?
7. Did the speaker use excessive professional jargon?

8. Were the conclusions clearly stated?
9. Did the speaker clearly separate hypotheses from scientific evidence, and were limitations and caveats appropriately identified?
10. Did the speaker zoom out to the major principle from which the presentation started?
11. Was the conclusion concise and clear?
12. Did the speaker follow the rule "Tell 'em what you're gonna tell 'em, then tell 'em, then tell 'em what you told 'em?"

II. Use of Visual Aids

1. Were the images clean, large enough, and easily viewable?
2. Did the images have a uniform background and design, and did they have sufficient contrast?
3. Would certain images have benefited from PowerPoint effects, or did the speaker use excessive PowerPoint effects?
4. Did the speaker include visual images that were not functional in the storyline?
5. Did the speaker introduce complexity in images step-by-step?

III. Delivery Style

1. Did the speaker maintain eye contact with the audience?
2. Did the speaker speak "to" instead of "in front of" the audience?

3. Did the speaker use a rising intonation?
4. Did the speaker speak too slowly, too fast, or too softly?
5. Did the speaker make appropriate use of the pointer?
6. Were sentences well articulated?
7. Did the speaker effectively place emphasis on appropriate segments of the presentation?
8. Did the speaker project enthusiasm?

IV. Handling Questions

1. Did the speaker maintain his or her stage presence while fielding questions?
2. Did the speaker repeat the questions to involve the entire audience?
3. Did the speaker answer questions briefly and to the point?
4. Did the speaker respond respectfully to inappropriate or ill-conceived questions?
5. Did the speaker handle difficult questions without getting flustered or confrontational?

V. Additional Comments

Indicate any other comments that may help the speaker improve the presentation.

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