

Giving a seminar: Suggestions for graduate students

CAVEATS AND DISCLAIMERS

Public speaking shares some features with making love. There's no absolute standard of how to do it well, but there are universally accepted ways to do it badly. What passes for excellence in one situation may be inappropriate in another context. People who do it well won't tell you how and people who are eager to help are often failures in practice. Even your best friends won't tell you when you do it badly ---they will just avoid coming back to repeat the experience. (Don't miss the metaphor here – this is deep.)

Expert public speakers may not be able to tell you why they succeed and eager advisors may not know what they're talking about (a caveat to the readers of this essay). What follows below is one person's opinion, not the final answer. It's a collection of ideas to consider while developing a style of your own. The opinions presented are strongly held, but change regularly. This is intended for graduate students, but all are welcome. I hope it works for someone.

WHY WORRY ABOUT SPEAKING? – (Your life may hang in the balance.)

Altruism and enlightened self-interest

Giving a seminar (like writing and teaching) is a peripheral area of the scientific endeavor that requires work and dedication. Putting effort into speaking and teaching is often viewed as altruistic behavior, fine for irremediable "do-gooders" but avoided by fast-track, "cool" scientists. If altruism haven't motivated you to invest the work, you should consider the possibility that successful exposition may be essential to your long-term prosperity. As outlined below, your reputation as a scientist depends on having people understand your work and ideas and their importance. In describing this work, you are teaching -- and your life depends on it. It's worth your

while to be good at both teaching and speaking.

Treating your public talks as a teaching endeavor

One way to get your priorities straight, when giving a scientific talk is to consider your audience as students and yourself as a teacher. In general, you'll be talking about what you know best. You have all the advantages --- you know why you did the work, what the questions are, how the experiments were done and the conclusions that you think can be drawn. Almost any audience has something to learn from you and they're coming to learn it. They didn't come to find out how cute, smart or hard-working you are (see below). They came to enhance their own minds and have some fun doing it. If you aren't teaching, you're a failure.

Set up the topic as you would a course lecture. Why should the audience be interested, concentrate, pay attention? Why are the questions deep and meaningful? Why are the answers important? What's in it for the listener? These questions become especially important when you don't have the threat of an exam or a grade to hold over their heads. You have to sell your arguments on their merits. Make sure that each point is being learned. Watch for audience reactions and adjust your behavior accordingly. Solicit questions. These are points we'll bring out below.

Fringe benefits of teaching

Effective writing and speaking (teaching) requires the ability to sift data, emphasizing information that is critical to the development of your subject and discarding less central details. By teaching, you learn to see how detailed facts and relationships fit into the broader scientific landscape. This lets you develop "scientific taste" which is the key to becoming a successful scientist. For your own good (i. e. fame, fortune, grants, promotion, satisfaction) it is best if you can

address your work at central questions and not peripheral trivia. This requires having "taste", which you can develop through teaching.

Skill in exposition is central to grant writing. You need to "teach" the grant review panel about the importance of basic questions that are being addressed and communicate efficiently to them how your proposed experiments address those questions. Without these central elements, a grant is painful to read and evokes in the reviewer a desire to extract revenge (which can be painful to you).

Your independent lab will function better if people who work with you feel they are continuously learning and growing under your influence. After all, **you** didn't choose **your** thesis advisor because you wanted to help make that person rich and famous, but because you thought you would get an education. By the same token, the lab you run later will function best if you are an effective teacher, concerned with the success of your students and coworkers. The students who will work with you aren't laborers sent to you by God to develop your career. The student/mentor arrangement works when everyone derives a benefit.

Most scientists work not for fortune or popular public acclaim but to enhance their reputation among the cognoscenti or experts in their field. To build a reputation, you must, of course, produce high quality, insightful science, but you must also convey this information to the scientific readership (and listenership). Your audience is swamped with papers and lectures on lots of topics; you need to get your message across through a blizzard of competing information. The need to communicate effectively is also important if you work in private industry. Your reports and talks to colleagues at your company may determine your ability to influence decisions, get promoted or even maintain employment. Learn to write and speak effectively -- it's an investment in your future.

Convincing everyone you're smart (and how not to do it).

We need face a sordid fact (usually unstated) that part of your personal goal in giving a talk is to convince the audience of your skill, creativity and general insight -- more bluntly, you want to prove how smart you are. (Someone once said that intellectual activity of all kinds is simply one brain's way of ranking itself vis a vis other brains – the war of the computers). Assuming this is one of your (if hidden) reasons for speaking, you should be aware of an insidiously seductive short-cut that leads to a disastrous pitfall.

At first glance, obfuscation looks like a good strategy for making yourself look smart. The reasoning runs as follows -- "If I talk very fast, use lots of jargon and skip steps in the reasoning, the audience will get lost, feel dumb and inadequate and assume that I (the speaker) must be the brightest person around" --- Wrong. The many who follow this reasoning in their written work, often put out tightly written material that is, finely reasoned and extremely compact. (Constipation comes to mind.) The reader endures a joyless, time-consuming task, even when the content is excellent. In lecture form, this approach is frustrating and the listener either gets angry or falls asleep hearing a seminar that could have been fascinating. Another form of this short-cut is to include every single glorious experiment and exactly how it was done until the audience drops from the sheer tedium, while waiting for an idea, a question or a puzzle. Obfuscation (and ponderous impressiveness) inflicts pain on the audience and no one loves pain; no one likes feeling dumb. They came to learn and you treated them like dirt. They won't be impressed.

Switch to your teaching mode. When you give a talk or write a paper, you're teaching. The ideas conveyed are your heart and soul, the product of your hands and intellect. If you can teach the intellectual message to your audience, your information becomes part of their general body of knowledge. They will remember with pleasure that they gained some insight from you; they got

smarter and improved. If the material is clever, they will appreciate your intellect for being able to solve a problem and for being able to convey the message clearly. If you can make your story clear even to non-specialists, you've broadened your audience and spread your message to even more people (putting a higher exponent on the information growth curve). Alternatively, if you baffle them, they'll just think you're a jerk and avoid your next paper or seminar; you've thwarted your own plan to expand your reputation and advertise your brilliance. ---- Take home lesson – TEACH 'EM; DON'T DAZZLE 'EM.

Summary: Every invitation to speak is an opportunity to practice an important craft. The potential payback for doing it well is enormous, but be careful ---- a risk is involved.

SCIENTIFIC TALKS – A RISKY OPPORTUNITY

The chance to give a live talk is a rare opportunity. In our current global information glut, no one reads enough to cover critically the entire relevant literature. Those who encounter your written work are likely to give it a quick scan and read it carefully only if they find it directly relevant (or exquisite fun). In contrast, a public lecture attracts a less specialized collection of people that don't know exactly what's going to happen. They make a commitment to invest time in hearing your message without any assurance that it will be either relevant or fun. (The implied contract is below.) Once they sign up (and sit down), the people at a seminar don't have anything else to do but listen.

Verbal communication is an immediate, personal ("mano a mano") form of communication. You can pull out all the stops to convey your message, and they can't escape (very gracefully). This is your chance to strike --- you've got them for an hour -- more time than they're likely to spend

reading a paper outside their field. In this immediacy, danger lurks.

The risk of speaking is that people tend to remember the main impact of whatever happens at a seminar. This makes public speaking a potentially dangerous way to communicate. If you are effective, you get your message across and may even recruit new friends, admirers or enthusiasts for you and your kind of science. If you do a bad job, listeners may take away only resentment and the conclusion that you are a jerk. Thus, in accepting the opportunity to speak, you take the risk of hurting yourself. This risk is less with writing because a disgusted reader will just turn the offending page without generating memorable resentment. (Speaking is like crossing a deep canyon by tight-rope – it's an effective short cut in your destination, but there's no net if you slip.)

The seminar contract

(To be read aloud with hand on heart):

“We, the audience, by going to your seminar, agree to take on the risk of pain and suffering. We do this on the off-chance that we’ll learn something new and get practice at thinking about something amusing.”

“I, the speaker, agree to do my level best to teach in a clear and engaging manner the material that I know well and to avoid being the thoughtless, abusive jerk that you have come to expect from seminar experiences.”

When this contract is fulfilled, the audience will ask questions, offer suggestions and go away happy, thinking you are a hero. If the contract is broken, the listeners snore, play chess on their iPhones and plot revenge.

The take home lessons-

- a) Accept every invitation to speak - its an opportunity to enhance your skill and reputation
- b) Recognize the risk - Work seriously on each presentation so as minimize the risk and realize the opportunity.

A BASIC PHILOSOPHY FOR SPEAKERS

The suggestions for seminar presentation that follow are based on some philosophical considerations. These principles may be helpful even if you disregard the rest of the advice (to follow) and implement them in your own way. After you've heard the principles, we'll consider some devices to implement them and help you develop a good speaking style.

Remember why you sometimes skip a seminar? Remember how you have felt when leaving a seminar that has been poorly prepared or presented? My dominant feeling is pain and rage at the amount of time wasted in discomfort -- time that could have been better or more enjoyably spent doing **anything** else. The magnitude of the pain inflicted by an incompetent seminar-giver can be estimated by considering the product of the time spent (usually an hour) times the size of the audience. A painful one-hour lecture to eighty listeners inflicts an aggregate amount of pain equivalent to that suffered by one human being tortured eight hours a day for TWO WORKING WEEKS. That is cruel and unusual punishment. This metric should give you a fair idea of why it's important to give a good talk, especially to a large group. Think back to your outrage (as a member of the audience) at having wasted an hour of your precious time at a bad talk -- multiply this rage times the size of the audience.

An audience that comes to hear you speak has taken a considerable risk (see the contract

above). They have given you the power to hurt and maim them without any guarantee of their own safety. They do you a great honor by showing up -- you should treat them with the respect and consideration they deserve. Think of yourself as their guide for a risky trip. The audience is naturally apprehensive that they'll be led astray -- they've been led astray before. You need to reassure them that you have their best interests at heart and are going to make it worth their while. Be solicitous of their physical and intellectual welfare; convince them of your capabilities. Pay attention to their body language (as well as your own).

Creature comforts come first.

As any capable host, you should start out by being sure that your honored guests are physically at ease. Can your guests hear, see the board or screen? Are there enough chairs? Is the room too hot? Your audience will pay better attention if you spend a moment making a few adjustments to the microphone or the seating arrangements, opening a door, turning on the board lights. Give them a chance to volunteer some suggestions -- "Is the microphone working? Can everyone hear?" Use these same philosophical attitudes regarding the "comfort of guests" to guide you in constructing and presenting your seminar.

Encourage participation

The most entertaining part of attending a seminar is having a chance to think about something new -- to try your own brain out on an unfamiliar puzzle or set of questions. You give your audience a chance at fun if you allow them to participate. A conversation with give-and-take is more fun than a formal lecture received passively. You can approximate a conversational atmosphere, even with a big audience, by inviting interruptions.

Try starting out by saying "If you have questions or don't understand something, interrupt me during the talk." This is a breathtaking offer to someone like me who has trouble picking up all details in a talk and can often be kept on track by a minor clarification. Like the matador at a bullfight who turns his back on the bull and walks toward the spectators – you assure the audience that you are in supreme control and are worthy of their trust. The worst thing that can happen (the bull charges) is that you get some pest who starts trying to show off by asking questions designed to show off his or her knowledge, not to clarify the presentation. This isn't very common, but if it happens and it threatens to take you overtime, you need to regain control and call a halt. Perhaps you could say, "That's a reasonable point, but it gets us off my main topic; we can discuss it later" or even "Gosh, I'm getting behind, let's stick to clarifying questions until the end."

You can stimulate participation during the talk by interjecting invitations between sections. For example, "We've just described the basic experiment. Before we get into the results -- do you understand the basic idea? Any questions before we proceed?"

Catering to short attention spans

Some wise person once said that the attention span of the average human adult is about 15 minutes. This is unfortunate, since seminars usually last an hour. You can reset their clocks by building interruptions into your talk. That's one advantage of soliciting and getting questions as described above. A question stops the formal flow of the talk. It takes the pressure off. Everyone can take an intellectual breather and the tension between speaker and audience is broken by a few words of relaxing banter. This helps them reset their attention-span-time-clocks.

STRUCTURE OF THE TALK

The first and most important step – Analyze your audience

The most important aspect of designing your talk is to evaluate your audience. This requires a very complicated skill -- the ability to “listen” to your own (as yet unspoken) words and to imagine how they will impact other people. It means putting yourself mentally into their shoes and “hearing” the words you are proposing to use. What do they all know can serve as a starting point? What is most interesting to them that you might want to emphasize most strongly? If your talk is about a chemical mechanism, the biochemists in the audience will take for granted that this is an important subject – they won’t require a sales pitch. The population biologists may think a mechanism is excruciating overkill – you need to give them the reasons why a mechanistic understanding is important to evaluating the biological usefulness of the function or even its evolutionary origins.

If you can “hear” yourself through their ears, you’ll be able to spot information you are assuming the audience knows. What words are used in your lab environment, but must be defined for a more general audience? What techniques are familiar? (It only takes few words to explain PCR well enough to satisfy the few neophytes.) If your audience at a medical school includes some MDs, toss them a fish and point out the medical relevance of what you’re talking about. It’ll be interesting for everyone and may keep the “docs” in the room.

It is difficult to provide missing background information so your audience can understand you. The biggest problem is the heterogeneity in your audience. If you get too simple, you waste valuable time and some people get bored. If you skimp on the background, some won’t understand your message. Max Delbrück was reputed to have advised seminar speakers, "Assume that your audience is infinitely ignorant -- but infinitely intelligent". In following his advice, one starts at the beginning, but does it at a rapid pace, including only the essential points. An infinitely intelligent

rank novice could, in principle, learn all the necessary background on the fly (if you give all the essentials); a partially informed audience (the usual case) appreciates the review, fills in their knowledge gaps and isn't bored as long as things move quickly. The professionals will be interested to see what you identify as the essentials of material they know well.

Outline your talk

Before you start, put up a brief outline on the board or on a slide. Go through it quickly, spending just a few moments (one minute maximum). Don't dwell on details they can't understand yet. This outline assures the audience that you've got a plan and are likely to be a competent guide. By reducing their apprehensions, you elicit their trust. As you go through the talk, refer to your outline. E. g. "We've gotten through the background section and have posed the major question. Now we'll proceed to describe experiments that are designed to approach an answer." This is another device for punctuating your talk, breaking the tension and allowing people to reset their attention span as described above.

Sell the question before trying to sell the answer

A good principle of teaching is "never provide answers to questions that are not in the mind of the student". Why should they care about the answer, if they don't know the question? Facts are only interesting if they answer a question that is in your mind or leads you to an even bigger mystery. In seminars, you need to teach the question immediately after the background material and then, only then, proceed to describe how your experiments are directed at finding the answer.

Sell the answer before the experimental data.

Once you've established the question, it's not a bad idea to tell them where you're taking them. For example, "I just explained to you the importance of knowing the composition of the moon. Next we're going to consider a series of experiments designed to address this important question. Through these experiments I'm going to try and convince you that the moon is composed completely and solely of green cheese."

By doing this, you set up a concept against which the listeners can measure all that you are about to say. Each experimental result can be evaluated for its contribution toward achieving the stated goal. You make it easier for them to frame objections or recognize progress than would be the case if they didn't know where they were headed. They can start to anticipate what experiment you might do next. They can see where they're going -- always comforting to those on a dangerous journey.

The extreme example of an undirected talk is called a "Who-done-it" in honor of detective stories that lead you through lots of detail (some relevant and some not) and provide an answer only on the final pages. In a "Who-done-it" talk, one presents an experiment without telling what it's intended to show. The audience hears a lot of experiments and a lot of results before learning what has been concluded or why the experiment is being done. They must keep all this information in some sort of mental buffer and be able to recall it when conclusion time arrives. Their recall must be perfect if they're going to evaluate your evidence critically. This is tough to do and it demands an audience of saintly geniuses. While it may seem more honest not to prejudice the audience with the conclusion, in fact, listening to a talk is too hard for this purist approach. It's better (if you have a sharp conclusion) to tell them the answer up front, just after posing the question.

Data versus ideas

You're most likely to be talking to scientists. This audience loves problems, thinking, ideas, games, hypotheses, models, paradoxes. Make sure these features dominate your talk. A recitation of facts and huge piles of data are only interesting to the extent that they establish or support some engaging notion. Complete gear-heads will love to see how clean your gels look, but even they will be grateful if this doesn't go on too long. Remember, it may have taken you 6 months to figure out the deeper meaning of some pattern of bands on a gel – how can you expect the audience to do it in a few minutes.

Most audiences aren't very impressed by hearing you tell them you're a hard-working dude -- they're hard-working too. It is a very common mistake to list the "labors of Hercules" and believe you can make people gasp in awe -- that gasp you perceive is actually a stifled yawn made with a hope you'll soon get to an idea, make a conclusion or eliminate a model. You may even drive them to wonder why you weren't smart enough to find a less labor-intensive route to the answer.

When you have a lot of data, but can't make much of a conclusion, you have a serious problem. The facts can at least be arranged around an idea or a model. You can spend more time establishing the question or the difficulty of the question. Stress the explanations that are eliminated by your data and the ones that are left as possibilities. Keep tying the data to an idea, a hypothesis or a model and don't ever let the data take over.

Questions are more interesting than facts.

If you have a classy audience, they're eager to "lend you their minds" and try to second-guess where everything is going. If you give them a chance to think, make suggestions, get involved, they'll love you forever. This will be true even if your conclusions are shaky and some more experiments are still needed.

You might think that the ideal talk is one in which the question is interesting and important and the data is extensive, clear, complete and persuasive --- that is certainly the goal of many speakers. However, in practice such “ideal situations” can be pretty deadly. The audience feels abused or overwhelmed by the huge burden of evidence. They’re forced kicking and screaming to a conclusion. They didn’t even get a chance to participate – you force-fed them like the foie gras goose. Force-feeding is a drag even when the corn is tasty and nutritious.

It’s better if you can still let the questions lead. Present the main question clearly. Take them through sub-questions as you progress. Make clear what questions remain open. Emphasize what is still mysterious. Give them a chance to play.

Minimalism in data presentation

Frequently one does a lot of work that doesn't lead to a conclusion before finally coming up with the meaty experiment that tells the story. Spare them the first experiments (no matter what it costs you in anguish) and spend adequate time explaining the critical experiment fully. Every experiment you set up takes time to explain. Give the big ones the attention they deserve. (If you only talk about critical experiments, they'll think you're a genius whose every experiment breaks new ground.)

Avoid distracting side-routes. Experiments frequently suggest new ideas and pose novel questions. Avoid pursuing these. Stick to the central question you posed at the beginning of your talk. Be brutal in suppressing your own clever tangents; make sure that the basic goals of the talk are completely and effectively discussed.

Avoid the "Grant Proposal Coda"

This is the hateful little trailer that follows many seminars. In this section, the speaker tells what the next experiment is going to be, how it will come out and the cosmic conclusions that will be drawn. (Basically they're selling their next grant application.) Interpreting experiments that have not been done is like saying "If my grandmother had wheels, she'd be a roller skate." The audience didn't come for science fiction or to hear you tell them directly to their faces how smart you think you are for thinking up these devilishly clever (undone) experiments. They just want to have fun (Translation: to think and learn.) and they really don't care how cute and smart you are. Save the grant application for NIH where the exercise may (or may not) pay off.

It's not all about you (really)

There's a strong tendency (once the speaker has control of a podium and an audience) to start a self-centered history of his or her thought processes and how he (or she) did this first and then this this other thought arose, etc etc. This is self-aggrandizement that a classy audience will resent. I even hate the seemingly polite starting phrase ---"I'd like to thank the organizers for inviting me to speak to you." This sounds like courtesy but it's really blowing you own horn. It's saying, "Dear listeners, I'm great because your brilliant organizers chose me out of the millions of other possible speakers." It might be more reasonable to say to the audience, "Hello. I'm honored that you came today and I hope I can keep you from falling asleep". Thank the organizers in person after your talk is over. Organizers get their real thanks when members of the audience tell them later how much they enjoyed your talk and how insightful it was to invite you.

Overlapping loops - the importance of redundancy

Spoken communication is inefficient because the audience has attention lapses. They worry

about dinner, the car repair, how to solve a problem they have in the lab, a sick dog, their itchy scalp etc. etc. Worst of all, people don't synchronize their lapses. Because of this, they can get lost even when you give a perfectly logical presentation with each step serving as an essential link in a perfect chain of evidence. They can fall off the train of logic, when they have an attention lapse and miss a critical jump.

You can help them by having your talk follow a set of partially overlapping loops. Speak for three jumps, then recap jumps number two and three and add number four. Next you recap three and four and add five etc. In this way everything gets restated and you keep everyone in the game. This looping train of exposition would look terrible in printed material, and it isn't needed there. When you read a book, you can back up and reread a section you missed during a lapse. Notice how often you do that when reading scientific material. You can't "re-read" what is missed in a talk, but you'll be grateful to the speaker who builds in some loops and gives you a break.

Time your talk carefully

Don't ever go overtime. Remember, in the philosophy section we described the audience as a bunch of apprehensive travelers who took on the risk of a journey (attending your seminar). They contracted to risk an hour of their time (no more) and to try out your ability as a guide. Regardless of how well you speak, if you go overtime, you violate the contract. They honored you by agreeing to listen for an hour and you forced them to give even more. (They signed up for a float through the Grand Canyon and you dragged them all the way to the coast, kicking and screaming.) No one is ever angry when talk is too short -- everyone hates being kept overtime.

Never give the same talk twice (tune the talk to your audience)

When presenting the same material to a different audience, try a new approach each time. There are lots of ways of giving your talk and each audience is a bit different. Couch your talk in a different framework. Make the order of presentation different. The content may not change much, but it'll keep you interested and freshness is everything. You'll be surprised how often you get a new research idea while reorganizing your talk. If you get bored with your own talk, the audience won't be far behind.

Summarize at the end

A final recapitulation helps those that just barely stayed with you (and those that slept through the whole thing). The former types get a restatement of what they heard so they can confirm and solidify the pictures they had established in their minds. The sleepers get a party-favor so they don't go away completely empty-handed.

MECHANICAL DEVICES TO EXPLOIT (and ABUSE)

Before you start -- Use of the lights

Darkness is for sleeping, not for concentrating on ideas and information. Many apprehensive speakers hide from their audience by turning out the lights at the first opportunity. If a speaker's first words are "Lights out, first slide", you can be sure that you're about to be subjected to a painful hour. These words tell you that the speaker is terrified, insecure (worst case: unprepared, incompetent) and want to hide in the dark. Low light, a warm room, a humming projector are wonderful inducements to inattention and sleep. A big advantage of chalk talks (or PowerPoint, done right) is that you keep can keep the room bright. (Occasional loud noises might also help.) If you need to put the lights down to show a microscope image – just turn them back on again. The flashing lights actually

contribute to keeping them alive.

The “talking head” syndrome.

A speaker with this disease looks the audience in the eye and makes the presentation without any visual aids at all. Listeners must stare into a flapping mouth for one solid hour. I realize that in some disciplines this is the standard form of academic discourse and it’s literally true when a speaker says, “I’m going to read a paper at next weeks conference.” They actually read every word. For scientific talks, I can only imagine how painful this must be for everyone. In biology we’re usually talking about things that may be difficult to visualize or hard to describe verbally. Things have multiple moving parts that must all be kept in mind simultaneously. Describing biology in “talking head” mode has a hypnotic effect on the listeners and also on the speaker. (Try staring at someone face-to-face for a few minutes and you’ll know how tense it can be – you could even be arrested.)

The advice is to always use some kind of visual aid to avoid this face-to-face confrontation. When you use the board (or projection screen), you can join your audience while together you consider the impersonal image. You’re all on the same side and with goofy gazes focused on the ideas and not on each other’s face. You want to be with your audience for a teaching exercise.

Chalk Talks or PowerPoint

Chalk talks are part of the tradition of work on phage and bacteria. Several of our most distinguished founding fathers liked them and the tradition was established. I have been (and still am) a big proponent of chalk talks, but in the Age of Microsoft, people either don’t know what chalk is, or don’t have access to a room with a suitable board. The chalk-talk tradition was never universal – cowards always liked slides or overheads -- but the coup de grace came from PowerPoint

with its relatively quick way of producing projectable images. This technology has become so pervasive that many new lecture rooms, especially at medical schools, don't even have board for writing (e.g. University of Utah, Huntsman Cancer Center). Despite this change, I can't resist describing the beauty of chalk talks, if only as a way to suggest how PowerPoint can provide some of the same advantages.

The advantages (and difficulties) of chalk talks. To keep people's interest and convey information efficiently, a chalk talk is hard to beat. The main advantages are the following:

- Drawing on the board avoids the "talking head syndrome". While speaking, you either draw continuously or point out aspects of previously constructed diagrams. You can even make lists of key points (no long sentences).
- The tip of your piece of chalk (or marker) serves as the focus of attention and minimizes distractions. They follow the line you are drawing, as you speak. The diagram can gain complexity slowly and before their eyes as you lead them through it.
- The time required to draw by hand limits the complexity of any diagram you generate while speaking. The drawing forces you to present only the essentials and leave out the irrelevant detail. Each new element can be added progressively as you make a your points.
- Stepwise development of a diagram at the chalkboard avoids the mass of detail frequently revealed all at once by a projected image. A complex image forces you to discuss one part while the audience is looking at bits you haven't gotten to yet. This distracts them from what you're saying. They lose out on your guidance for one part, while struggling, unguided, to understand the rest.

- With a big board, you can draw a diagram as you discuss it. Then you can leave it in place, and make a second diagram, moving across the board. All material visible on the board has already been described and can serve as a reminder or as an aid to those who had an attention lapse. This isn't possible when one projected image replaces the previous one.
- In a chalk talk, you can change course seamlessly if things don't going well. You can answer questions on the fly. Make new diagrams that you didn't plan initially. It's better to drop your plan and teach them something (even if it takes you astray) than it is to follow to the bitter end a well-intended talk that proved impenetrable. If you've set the stage properly, their questions will let you to make it a clear talk, but you've got to stay focused and be ready to roll with the punches.
- The biggest advantage of a chalk talks is that it provides the ideal teaching environment --- you and your audience are on the same side looking at an impersonal third object (the board). In this situation, they're more likely to formulate questions for you and think about the problem with you. In the adversarial situation, with you talking AT them, they're more likely to be defensive, fight against your (obvious and beautiful) conclusions or give up and think about something completely unrelated.

Problems of chalk talks

To succeed at a chalk talk you have to know what you're doing and have the topic under complete control. This is easy to do when you are describing your own work because no one in the world can possibly understand it as well as you do. After all, you've been thinking about it more or less full time; the audience is hearing it for the first time. If they can out-think you in this situation,

you've got problems that won't be solved by visual aides.

You need to be able to think on your feet (Translation: walk and chew gum). A question may prompt you to modify a diagram or come up with an alternative. In order to do this, you have to listen very carefully to questions, understand the point (hopefully, one you have anticipated), and be ready to fill in the missing parts.

When done right, a chalk talk looks effortless and seems to be something that you threw together casually. In actual practice, giving a talk this way requires more preparation and forethought than any other style of seminar. You need to plan the outline, plan what diagrams you're going to make and exactly how you'll stage them. After doing all this you may – it has happened to me – hear complaints that, “you didn't care enough to prepare PowerPoint slides”. When a chalk talk goes well and you still get this as a criticism, find a better class of audience --- they violated their side of the contract.

Despite the challenges, a chalk talk is the high road of speaking. It keeps people's attention just to realize that you are out there alone (on the high wire without a net). It is a more intimate form of communication, without technical devices between you and the audience. (A live concert as compared to recorded music.)

PowerPoint and you

By now you've considered the arguments for chalk talks; you may have found it all vaguely amusing, but you decided to cave in to the onslaught of technology and use PowerPoint. If this assessment of the situation is correct (sigh), I recommend that you read the last section again before going on. If I've still failed to convince you, read on and start planning your slides. (If you must know, I've mostly caved in too.)

Keep detail on the screen to a minimum.

Put on the slide only material you need for your argument. Anything extra is distracting and falls in the category of trying to impress the audience with what a drudge you are for collecting irrelevant data.

Five numbers on a slide constitute a discussible amount of information; fifty numbers are too many. If you diagram a process, stages of a mechanism, or a series of crosses, then you are morally obligated to lead the audience through every detail of the slide. If you don't, they can't possible grasp all the details and you are being deliberately confusing. Rather than confuse them, leave the slide at home or design a simple slide with only the relevant material. Either a slide is valuable and therefore deserves a **complete** guided tour, or it's a distracting ostentation. Dazzling the audience with a mass of unexplained details is the ploy of speakers who think they can make themselves look brilliant by making the audience feel dumb. I once had a colleague (name supplied upon request) who advised his graduate students to take this approach and deliberately try to baffle their audiences. It never works and is in no way conducive to education. (If audiences could pool their aggregate annoyance, they would be more likely to kill the speaker than to applaud; we can thank God, audiences are not able to pool their displeasures.

Degassing your slides.

Slides are made at a computer keyboard, where there is a strong tendency to use lots of words in small type fonts and put lots of space between elements of the drawing. This is terrible when projected because the small fonts aren't legible. Try to fill the space on the screen. Use **HUGE** type fonts, **BROAD** lines, and a **MINIMAL** number of elements. Basically you're squeezing the "air" out of

the slide and filling the space with bold informative, legible symbols. Label each line of a graph.

Don't use text slides. These slides are popular with speakers because they're easy to make, but they are universally annoying to audiences. If the audience wanted to read your message, they could have gone to the library. It is particularly insulting to an audience when you put up a text slide and then read it to them. You imply that either they need help reading or you don't know what you're talking about without reading it yourself.

Staging your slides to make PowerPoint resemble a chalk talk.

You can construct slides so they act like a chalk board. If a diagram is initially minimal, you can discuss it as if it were a few hand-drawn lines on the board. Next you put up successive slides, each with one more added feature (You can do this with the “animations” feature of PowerPoint if you're willing to personally do battle with Bill Gates' minions, but I've found the feature pretty unwieldy and usually make duplicate slides with the added features.). Discuss each added feature in turn, just as you would in a chalk talk. Make each new slides identical to the preceding one with only one new feature. Audience attention is directed to the new feature, just as you describe it. A diagram that would have been hand drawn in a chalk talk, may appear as a developing series of 10 PowerPoint slides as complexity is added.

Abuse of real animations.

Uncle Bill (Gates) and his minions (knowing that their product will mostly be used by snake oil salesmen) have also added lots of features for fading in and out, sliding lines of type onto the screen, adding sound effects when something hits the screen. This is tempting but be careful..... A little bit may be nice, but once is probably enough – and may be too much. I saw one of Frank

Stahl's first forays into PowerPoint. (He's a famous advocate of chalk and very clear lecturer.)

Frank had clearly read all of the Microsoft documentation on effects. As usual, the talk was brilliant but the pyrotechnics of sound and light left everyone diving for cover. I remember mostly the effects. If you aren't careful, the audience will concentrate on the slide-show instead of the message. Worse, they get annoyed at the cutesy distractions.

Abuse of color and shadings.

Power point is designed for corporate executives trying to sell you something shoddy and/or overpriced (DON'T FALL INTO THE TRAP !!) It's designed to make nothing sound like something. That's why all the artsy colors and shading are there. It's all intended to confuse the audience and dazzle them with slides of very low information content. Unfortunately (for the speakers), most audiences have figured this out. They know when they're being conned. The color and shading won't help make your data look better and it may even alert the audience that they're in for a rough ride.

Advantages of power point

- 1.** It's easy to make new slides (before the talk) or to update old ones so as to eliminate out-moded bits.
- 2.** The audience can see what you project better than what you write on the board. This is especially true if your handwriting is poor or you tend to write things on a small scale.
- 3.** If you design clear slides with large type, it's possible to run the show with the room lights ON.

4. New video projectors are usually quiet enough or far enough away that the fans don't drown out the speaker
5. (For those who are determined to fail) – With PowerPoint, you can make endless bulleted lists and actually kill off a whole audiences single-handedly.
6. Biggest advantage is that PowerPoint can help you do many of the things that are provided by a chalk talk.

PERSONAL BEHAVIOR

Speaking is an interpersonal activity and because you are the center of attention while speaking, many minor aspects of your personal behavior become magnified, obvious and distracting. This goes beyond the well-known bad impression made by picking your nose, scratching body parts and spitting. Even minor tics and mannerisms become striking when you give a talk, because the audience sees you repeat them again and again and again. If the audience gets fascinated by the performance, they may stop listening to the message.

Mannerisms James Watson is famous for mannerisms. His contributions to science are enormous, but his contributions to public speaking are largely as a model to avoid. I once watched him being interviewed on television by Dick Cavett. In the course of the conversation, Watson started digging in his left ear **using is right hand** by extending his right arm across behind his head. (Try it, it's possible.) The scene was so grotesque and continued so long than it was hard to concentrate on anything being said. He's also famous for leaning against the blackboard while lecturing and slowly

sliding downwards until his elbows are in the chalk tray and his legs are extended far out toward the audience. Apart from being distracting, this activity gets your clothes covered with chalk and you look like some kind of plasterer as you finish the talk with white smudges all over the back of your head and clothing. Another of his mannerisms is making a punctuated hissing/sucking noise by drawing little puffs of air inward across closed teeth. This makes you look like a threatened, and has a frightening effect on the audience. I think you get the idea. Pay attention to what you're doing with your body and hands while speaking (or get your friends to watch you speak and point out physical mannerisms.)

More common distracting mannerisms are verbal, such as saying "Uhm" or "Aaah" or "Let's see now" or "You know?" or (heaven forbid} "Like, man....." or otherwise separating informative sentences with sound bits. Silence is better. Think quietly (or during a practice run of your talk) so your verbal utterances are all directed toward the message you want to deliver. If you need to think, do it without flapping your mouth or twitching. There's no shame in a moment of silent prayer during a seminar.

Don't be cute when nervous

All speakers are nervous about standing before a group. A frequent response of beginners - is to curry favor by being "cute". This means making giggly, silly, sometimes self-depreciatory remarks in the hopes of getting the audience to love you because of your sweet, cuddly self and not because of any message you have to offer. This technique works great for pre-school children and used to be encouraged behavior for women (when our society was young). However it is still used frequently by science graduate students of both sexes. Examples are giggling at mistakes made or "Silly me, I forgot the critical slide" or "Shucks, I never get that right" or "I don't know the answer

to that questions..... Dr. Jones (the research advisor who's in the audience), can you explain that for little old me." FIGHT THIS.

When you speak, be serious; be all business and make it clear that you are in control of the proceedings and you have an important message to convey. Why should the audience care if you don't appear to care? By asking help of someone in the audience, you loose control of the talk and things fall apart rapidly. You are being evaluated as a scientist and a teacher ---- not as a potential adoptee or as a date to the prom. It is essential that the audience take you seriously. Humor has a definite place in speaking, but you should not make yourself the object of the laughter -- this behavior makes you such an object.

The "talking head syndrome" revisited

When you face an audience and they face you, a sort of tension is set up. (Stare directly into someone's eyes for a while and see if it doesn't get tense.) If you do nothing but stand there and speak directly to the audience and they stare back while listening, this tension gets palpably hypnotic. Above, we called it the "talking head syndrome". Listeners can't stand it very long without looking away, feeling weird or having their attention lapse. You can break this tension in a variety of ways, some of which were mentioned above.

One trick is to move your eyes around the audience. Pick out several people, well-dispersed through the audience and address remarks to them for a while before switching to someone else. (Give yourself a break and pick people who are awake and trying to follow the talk.) You can even walk around a bit, but don't overdo it.

Use of the board is great for breaking this tension. You become one with the audience and join them in considering a diagram that is unfolding below your chalk. You move to the next

point on the board. You turn to the audience and back to the board. Pointing to projected slide is OK, but be sure the lights are on so they can see you as well as the pointer you're using.

Interruptions in the narrative help break the tension. Example: "So you can see the problem we're trying to address. Are there any questions before we go on to the experiments?" This breaks the mesmerizing tendency of flowing words. It's a paragraph mark in a verbal flow. The concentration is relaxed for a moment and you're ready to reestablish contact for the next section.

When English isn't your native language (this includes all Californians)

Trying to speak in a second language is difficult for the speaker and can be horrible for the audience. English is a plastic language and native speakers are actually pretty good at understanding imprecise pronunciations IF YOU SPEAK SLOWLY. Slower speech gives the audience a microsecond to sort out the language problems. If you use some incorrect words or pronunciation at a high delivery rate, the difficulties can overwhelm the audience. There's a tendency for some non-native speakers to speak English even faster than normal English speakers. I suspect this happens if their native language has a large number of syllables per second and a lower number of ideas per syllable than English. They speak English so the tone rhythm sounds right to them and the resulting idea flow rate in English is very, very fast.

While speaking slowly may help the audience understand individual words, slow speech can be incredibly boring if the text has low idea content and lots of filler words. You need to compensate so as to keep the flow rate of ideas up to par. Speech that is low in idea content is OK when a native speaker is speaking rapidly; the redundancy helps the audience keep up. However if you slow your speech down to increase work understanding, don't use the inefficient filler words and empty phrases that are used by native speakers. When speaking slowly, use very information-dense

sentences, so the ideas keep flowing at a reasonable rate. (Read Lincoln's Gettesburg Address some time for an example.)

These suggestions are difficult to follow and require a lot of practice. However, based on the experience of foreign students in my lab, I think they are generally correct. They are worth the effort, because being able to communicate clearly in English is important to your success here.

Below is an added note of warning ----

Just because you (as a non-native English speaker) communicate easily with English-speaking members of your English-speaking lab, don't assume that your lab language will work with a group of strangers. Your closest associates get used to your linguistic imperfections. In a sense, they learn your private dialect of English and can therefore build a personal vocabulary and set of pronunciation allowances to use when listening to you. Just because your English works well within your lab doesn't mean it will work well in a talk to strangers. Strangers haven't heard you speak before and don't know how to make these adjustments. For them, you need to speak a generally understandable form of English.

THE LAST WORD

While the foregoing may sound preachy and condescending, it is meant to help students do one important aspect science. I apologize for the irreverent tone – it was meant for the students. I apologize to those I insulted here; I only named people I admire. The first version of this essay was written before PowerPoint conquered the world.