

Introduction

It was very long ago when Richard Feynman had felt nervous at having to give a seminar.... Since then he had developed into an accomplished and inspiring teacher and lecturer, who gave virtuoso performances full of showmanship, humor, with his own inimitable brilliance, style, and manner.¹

–Jagdish Mehra

In terms of hours spent, scientific presentations are costly. Even for presentations given on site, the audience members devote valuable time to attend, and the speakers give up valuable time to prepare and deliver. For presentations that require travel, the costs rise dramatically.

Although expensive, scientific presentations are important. The information communicated in presentations is often only a few days old, sometimes only a few hours old. Conversely, the information in a professional journal at publication is typically a few months old. For some areas of science and engineering, advances occur so often that scientists and engineers cannot wait for a publication cycle to learn the latest news. For instance, at Pratt & Whitney, the principal means of communicating new advances about gas turbine engines is not documents, but presentations.² There, laboratory and computational results are sometimes directly incorporated into new engine designs.

The way that you present your work can significantly affect your career. Consider the case of the physicist Paul Chu who was searching for a superconductor at a temperature above the boiling point of liquid nitrogen. To help him in this search, Chu brought in his former student, Professor Maw-Kuen Wu of the University of Alabama-Huntsville. Chu, who was a professor at the University of Houston, had already identified a host

of compounds that offered promise to be such a superconductor, but he needed help testing those compounds.

When Wu and his graduate student Jim Ashburn discovered that one of those compounds was a superconductor, they contacted Chu, and the three held a press conference in Houston. Chu, being the best speaker and the leader of the team, spoke at the news conference that announced the finding. Although Chu clearly acknowledged Wu and Ashburn's contribution at the news conference, the press latched onto Chu's name. In many of the newspaper and journal articles about the discovery, Chu's name was the only one mentioned.³

Interestingly, an even more dramatic scenario played out a year later in the same field when Zhengzhi Sheng, a postdoctoral researcher at the University of Arkansas, discovered another superconductor at an even higher temperature. Because Sheng was not a good speaker, the department chair, Allen Hermann, spoke at the press conference. Although Hermann repeatedly acknowledged the contribution of Sheng, Hermann was the one who received most of the accolades, even though all of the scientific work was clearly Sheng's.⁴

Even more important than the credit that we as individuals receive from a presentation is the understanding that we collectively as scientists, engineers, and technical professionals impart to our audiences. If we do not present our work effectively to specialists both in our field and in other fields, then those scientists and engineers will not likely build upon our work. Likewise, if we cannot communicate our work to managers, then those managers likely will not make sound decisions about our work for the institution.

Finally, if we cannot effectively present our work to the general public, including politicians, then those people will not be in a good position to use our work in their decisions. Politicians, in particular, are an important audience, because they create legislation that addresses complex problems in energy, health, security, and the environment. Although these problems and their solutions are grounded in scientific principles, few politicians have backgrounds in science or engi-

neering. Of the current 535 members of the United States Congress, fewer than 10 were educated in science or engineering. For these politicians to make sound decisions that concern science and engineering, we must communicate our work to them.

Excellent scientific presentations are marked by content, passion, and a keen sense of the audience

Stricken with amyotrophic lateral sclerosis at age 21, the Nobel-Prize winning physicist Stephen Hawking has been unable to follow the standard presentation advice for voice, stance, and movements. Yet Stephen Hawking fills auditoriums whenever he speaks, and the main reason is his content. What Hawking has to say is well worth the time that the audience spends listening.

Now you might consider it unnecessary to list valuable content as an essential trait of an excellent scientific presentation. However, many scientific presenters routinely sacrifice content in their presentations by burying key findings in a sea of extraneous details or on busy slides with ornate decorations. For a scientific presentation to excel, the audience has to understand, believe, and remember the content. Simply put, content is king in scientific presentations and must not be sacrificed.

If valuable content is the first trait of an excellent scientific presentation, then communicating that content with passion is the second. Personifying this trait is Hans Rosling, a professor of global health at Sweden's Karolinska Institute. Rosling is a mesmerizing speaker, and perhaps what is most engaging about him is his passion for his work.⁵

Now, not all of us reveal our passion for our subjects with the same exuberance that Hans Rosling shows, and it would be disingenuous if we tried. Moreover, when presenting an idea that cuts against the grain of what audiences believe, even the most charismatic presenter will soften the voice and adopt a

quiet, but earnest, delivery. Despite this change in delivery, the sincere passion that the speaker has for the subject is clear.

Although not all of us will reveal our passion with the charisma of a Hans Rosling, all of us can reveal genuine enthusiasm for our work. In fact, we have to, because if we do not show the audience that we care about the subject, then how can we expect our audience to care, especially when the content becomes challenging to understand?

The third essential trait of an excellent scientific presentation is a keen awareness by the presenter of the audience: who they are, what they know about the work, why they are listening, and what preconceptions they have. An exemplar for this trait is Jane Goodall. Whether she is giving a paper in London, speaking to potential donors in Nebraska, teaching school children in Singapore, or negotiating with tribal chiefs in Tanzania, Jane Goodall has an acute sense of to whom she is speaking. Without a keen sense of the audience, even a dynamic speaker with valuable content is prone to miss the mark. Achieving this keen sense of audience is not easy. In fact, most of this book is devoted to achieving this goal.

If we have content that is worth the attention of the audience, if we reveal our passion for that content, and if we have a keen sense of what our audience knows about that content and what about the content will engage them, then we are in position to excel in our presentations. The rest of the details such as organizing our thoughts, choosing the words to say, creating effective visual aids, and delivering are a matter of effort.

When speaking, you should seize upon the advantages of presentations and downplay the disadvantages

Before deciding how to make a scientific presentation, a good first question to ask is, Why not just write a document? Depending on the situation, writing a document or creating a web page might be a better way to deliver the information. Even when we are already committed to make a presentation,

understanding the advantages and disadvantages of a presentation in relation to a document is valuable so that we can seize upon the advantages and downplay the disadvantages.

1. Presentations allow speakers the chance to field questions from the audience. In a document, the author imagines what the audience needs and then writes accordingly. For instance, the author selects the concepts to be covered and then imagines what background and depth are needed to convey those concepts. In a presentation, though, the speaker does the same selection beforehand, but can adjust the presentation during the performance to respond to cues from the audience.

Certainly one cue given by the audience would be questions. From the questions posed by the audience, the speaker can essentially revise the scope and depth of the original presentation. A key here is that the speaker allots time for questions. In many cases, particularly in shorter presentations, the audience is best served by delaying questions to the end. However, in other talks, allowing questions to be posed throughout serves the audience better.

2. Presentations allow speakers the chance to read audience expressions. During a presentation, the audience continually sends the speaker non-verbal cues such as facial expressions for agreement, understanding, confusion, boredom, or disagreement. To make use of these cues, a key here is for the speaker to be watching the audience during the talk and to be flexible enough to make needed adjustments. During a presentation to mathematicians, Patrick McMurtry, a fluid mechanics researcher from the University of Utah, noticed from the blank looks of his listeners that they did not understand the term “laminar flow.” McMurtry asked to borrow someone’s lighter, clicked it on, and gave the audience an example. The smoke just above the flame rose in distinct streamlines. Such a flow was laminar. However, well above the flame, these streamlines of smoke overlapped in random turns and curls. Such a flow was turbulent. Because understanding the

difference between laminar flow and turbulent flow was crucial to understanding the work, McMurtry salvaged the presentation with this on-the-spot revision.⁶

3. *A presentation's delivery is a means to emphasize key points.* In a document, a writer can use repetition, placement, and formatting for emphasis. A presentation, though, not only allows for those strategies in the talk's organization and visual aids, but also allows for strategies from a perspective that documents do not have: delivery. For instance, a speaker can pause before an important point. Also, for effect, a speaker can speak more loudly or reduce the voice to a whisper. Moreover, a speaker can provide additional emphasis by gesturing or moving closer to the audience.

4. *Presentations offer more variety for visual aids.* So far, the advantages of a presentation have centered on the interaction of the speaker with the audience. A different type of advantage of making a presentation concerns the visual aids that one can use in a presentation. Essentially, a printed document is limited to an illustration that fits on a page. However, a presentation can incorporate not only the still images of a document, but also the sequential images of a film. Moreover, a presentation can incorporate color into those images more easily and less expensively than a document can. In addition, the presenter can include demonstrations and models, which not only allow the audience to see the work, but sometimes allow the audience to hear, touch, smell, and even taste the work.

5. *Presentations ensure that the audience has witnessed the information.* A fifth advantage of a presentation is of a legal nature. With some presentations, such as the evacuation procedures for a tall building, the presenter might want to ensure that the audience members have witnessed the information. For such a presentation, the presenter can have the audience sign in when entering the room. This arrangement has advantages over a document, which might lie unopened.

Perhaps a better way to view the advantages of presentations is to imagine a world in which they do not exist. Such was the world of Lise Meitner when she worked at Berlin's chemistry institute in the early part of the twentieth century. Because of rules forbidding women to participate, she was not allowed to attend the chemistry seminars. Meitner, who later helped discover nuclear fission, had such a strong desire to learn chemistry that she sometimes sneaked upstairs into the institute's amphitheater and hid among the tiers of seats to listen.⁷ Almost 30 years later, a parallel situation existed at Oxford for Dorothy Crowfoot Hodgkin, who later won a Nobel Prize in Chemistry for discovering the structure of insulin. The chemistry club at Oxford did not permit women, even if they were on the faculty, to attend meetings. Unable to interact with others in this way, Hodgkin had difficulty attracting students until a student organization invited her to speak.⁸

Although presentations have several advantages over documents, they also have several disadvantages, as shown in Table 1-1. Understanding the disadvantages of presentations is as important as recognizing the advantages.

Table 1-1. Advantages and disadvantages of making a presentation.

Advantages	Disadvantages
1. Chance to field questions from audience	1. One chance for speaker to talk; one chance for audience to hear
2. Chance to read expressions of audience	2. Difficult for the audience to look up background information
3. Chance to use delivery to emphasize key points	3. Audience restricted to pace of speaker
4. Ability to incorporate many types of visual aids	4. Success dependent on speaker's ability to deliver
5. Assurance that audience has witnessed the content	5. Difficulty in assembling speaker and audience

1. *Presentations offer speakers only one chance to speak correctly and allow audiences only one chance to hear.* In a document, you have the opportunity to revise a document. However, in a presentation, you have only one chance to say things correctly. Simply forgetting a word from a sentence in a presentation can trip an audience, especially if that word is important—the word *not*, for example.

Likewise, if the presentation triggers an idea for someone in the audience and that someone contemplates that idea for a few moments during the presentation, then that person misses what the speaker has said during those moments. A document, on the other hand, allows readers the chance to review a passage as many times as needed.

2. *Presentations do not allow audiences time to look up background information.* If in a presentation the speaker uses an unfamiliar word, such as *remanence*, and does not define the word, then the audience is stuck. If the presentation's format does not allow for questions until the presentation's end, then members of the audience sit frustrated wondering what *remanence* means. With a document, though, the reader has the chance to look up *remanence*, which is the residual magnetic flux density in a substance when the magnetic field strength returns to zero.

3. *Presentation audiences are held captive to the pace of the speaker.* Unlike the pace of a document, which an audience controls by reading as slowly as is needed for understanding, the pace of a presentation is determined by the speaker. If the presenter goes too quickly for the audience, the audience becomes lost. Likewise, if the presenter goes too slowly for the audience, the audience becomes bored.

4. *The success of a presentation depends upon the delivery of the speaker.* A poor delivery can make a presentation appear weaker than it actually is. If the speaker is so nervous that he or she cannot communicate the ideas to the audience, the

presentation will not succeed. Other aspects of delivery can also bring down a talk. Niels Bohr, for instance, undermined his content with a voice full of hesitant pauses and distracting hisses that made it difficult for audiences to understand him.⁹ An exceptional delivery, on the other hand, can have the opposite effect. Linus Pauling, for instance, had the charisma to make a presentation appear stronger than perhaps it actually was.

5. The audiences for a presentation can be difficult to assemble. A final disadvantage of presentations is one of timing: how to gather everyone at a particular time to attend the presentation. Granted, teleconferencing can often overcome this problem, but even with the best connections, the energy during a videoconference does not rival that of a performance in the same room. Video recording is even less effective, because video recording loses one of the main advantages of presentations—namely, the interaction with the audience.

Another issue with timing is the attention span of the audience. Although some people can listen attentively for long periods, many people become tired and restless after only 20 minutes. When the technical subject is complex and deep, the task of communicating that subject solely with a presentation becomes difficult.

So far, this discussion has centered on the effects of presentations upon the audience. What about the effects of presentations on the speaker? Certainly, one positive effect on the speaker is that when fielding questions from different audiences, the speaker can obtain new perspectives and ideas about the work. Those new perspectives often occur when the audiences come from different disciplines. A second positive effect on the speaker occurs during the preparation of a presentation. As with writing a scientific document, preparing a scientific presentation can help solidify one's ideas and even lead to new insights. For instance, Richard P. Feynman claimed to have experienced such moments of discovery.¹⁰

As this book will explain, the focus and insights that one obtains in preparing a presentation depend greatly on the approach that one adopts. For example, the common approach is for the speaker to list the topics and subtopics of the presentation. A different strategy is the assertion–evidence approach, which calls on the speaker first to specify the assertions, insights, or results that he or she wants the audience to take away from the talk. Then the speaker matches those assertions, insights, and results with the evidence that the speaker has. As this book will show, the assertion–evidence approach, although more time-consuming, leads to presentations that are not only much more persuasive, but also much more focused.

Analyzing presentations from different stylistic perspectives is important to improving your presentations

When critiquing the presentation of a colleague or even yourself, you will make that critique much more valuable by analyzing the talk from different stylistic perspectives: speech, structure, visual aids, and delivery.

Speech, a first perspective of style, is what you say in a presentation. Structure then is a second perspective that encompasses the organization, transitions, depth, and emphasis of those words. A third perspective of style in presentations is visual aids. While visual aids include projected slides, models, writing boards, films, and demonstrations, this book focuses on projected slides, because that is currently the visual aid of choice for most meetings, conferences, and classrooms. Presentation slides receive much emphasis in this text because slides affect not only the audience’s comprehension of the content, but also the speaker’s preparation and delivery. The final perspective of style is delivery, which is your interaction with the audience and the room.

In presenting these four perspectives, this book anchors its advice with scores of examples gathered from conferences,

symposia, and meetings. In essence, this book pursues a similar study to the one that Michael Faraday undertook as a young scientist when he examined the different styles of presenters.¹¹ As with Faraday's study, this book's study seeks to determine what makes one scientific presentation strong and what makes another weak.

Many of the examples chosen are from famous engineers and scientists. Some of these are considered excellent presenters, while others are not. Certainly, such characterizations are inherently imprecise. For one thing, not everyone is an excellent presenter every single day. In your career, you are likely to have at least a few presentations that are not well received. Also, some individuals, such as Maria Goeppert Mayer, were excellent presenters in front of colleagues and friends, but shy and stiff in front of strangers.¹² Moreover, not everyone is in agreement about who was an excellent presenter and who was not. For example, the opinions about the presentation skills of the engineer Willard Gibbs varied widely.¹³ Having a wide variety of opinions about the effectiveness of a presenter is not uncommon—to see such a spread, one simply has to read a set of teaching evaluations from a large course.

Although the circumstances and variety of opinions make it difficult to draw conclusions about the effectiveness of many historical presentations, the effectiveness of other past presentations is clear. For instance, Richard Feynman's lecture series on freshman physics at Caltech received so many glowing reviews and had such a profound effect on so many people that this series was undoubtedly a success.

While analyzing presentations from these four stylistic perspectives is valuable, such discussions can skew the overall effect of a presentation. After all, a presentation that has weak slides might be strong enough in the delivery that the overall effect is positive. Still, if any of these areas is so weak that it distracts the audience from the content of the presentation, then the presentation has not reached its potential.

One perspective of presentations not considered in this book is content. An assumption in this book is that the technical

content of the presentation is worthwhile. Otherwise, the logic of the structure, the clarity of the speech and visual aids, and the smoothness of the delivery are moot, because without content the presentation is doomed.

Interestingly, in engineering and science, there exists a deep-seated distrust of a noticeable style, what many refer to as “glitz.” Certainly, style without content reduces to entertainment. If you are going to dazzle the audience with only one aspect in a scientific presentation, you should do so with your content (your ideas, insights, findings, and conclusions) rather than with your style (the way that you present that content). However, that is not to say that style is unimportant—quite the contrary. Style is the vehicle for communicating the content. Presentations without attention to style often leave little of value in their wake. Granted, the content has been presented, but not in such a way that the audience understands it or realizes its importance. Strong presentations require both content and style. Content without style goes unnoticed, and style without content has no meaning.

Notes

¹J. Mehra, *The Beat of a Different Drum* (Clarendon Press, Oxford, 1994), p. 482

²A. Kohli, engineer at United Technologies Corporation, Pratt & Whitney, personal communication to author, 4 Dec 2000

³R. Pool, Superconductor credits bypass Alabama. *Science* **241**, 655–657 (1988)

⁴R. Pool, Feud flares over thallium superconductor. *Science* **247**, 1029 (1990)

⁵H. Rosling, New insights on poverty. Presentation at TED.com, Monterey, Mar 2007

⁶P. McMurtry, Professor of Mechanical Engineering at the University of Utah, personal communication to author, Mar 1988

⁷S.B. McGrayne, *Nobel Prize Women in Science* (Citadel Press Book, Secaucus, 1998), p. 37

⁸*Ibid.*, p. 236

⁹D.H. Frisch, private communication to Abraham Pais, *Reminiscences from the Postwar Years*, in *Niels Bohr: A Centenary Volume*, ed. by A.P. French, P.J. Kennedy (Harvard University Press, Cambridge, 1985), p. 247

¹⁰R.P. Feynman, *Surely, You're Joking, Mr. Feynman!* (Norton & Company, New York, 1985), p. 166

¹¹M. Faraday, letter to Benjamin Abbott on 11 June 1813, *The Selected Correspondence of Michael Faraday*, ed. by L.P. Williams, R. Fitzgerald, O. Stallybrass (Cambridge University Press, Cambridge, 1971), pp. 60–61

¹²S.B. McGrayne, *Nobel Prize Women in Science* (Citadel Press Book, Secaucus, 1998), p. 181

¹³M. Rukeyser, *Willard Gibbs* (Doubleday, New York, 1942), p. 320