

Woman Physicist's Speaking Guidelines Resonate with Readers

I'm a male reader, but I sneaked a peek at Heidi Newberg's "The Woman Physicist's Guide to Speaking" (PHYSICS TODAY, February 2005, page 54). I especially liked her advice that during the question-and-answer session you should "make sure you understand the question—sometimes by repeating it." This is particularly important when speaking to the lay public and in spaces with poor acoustics.

As an amateur astronomer who occasionally gives public talks, I have in mind two speaking aids not mentioned in Newberg's guide: humor and enthusiasm. Although it sometimes requires imagination, opening with a witty quip or humorous anecdote can focus your audience's attention. As for enthusiasm, after content it is the most important ingredient in any talk. For keeping your audience glued to the presentation, nothing works better than radiating genuine enthusiasm.

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To Heidi Newberg's advice on speaking, let me add a note on the need for intelligibility. With old age I have become more conscious of the voice quality and diction of speakers.

Until about World War II, college graduates usually had some training in public speaking and how to project the voice. With today's public address systems, that is no longer deemed necessary. Unfortunately, too many speakers confuse loudness with intelligibility.

To increase intelligibility, voice control and pace are needed. If the room has echoes, one needs to speak even more slowly and distinctly. From my observations, most speak-

ers tend to push their voices when addressing a large audience, even with a public address system. In doing so, the tendency is to use the head tones, which produces a harsher and more nasal voice quality. And as Newberg points out, women's voices tend to be softer than men's, so their head tones tend to be more prevalent. With a little care and a little practice, a speaker can learn to use chest tones, which not only provide greater power but also a more pleasing voice.

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Heidi Newberg's article hits the mark. I have some additional comments.

Teaching experience is excellent training for presentations of almost any kind. People who haven't taught professionally might consider a part-time teaching position to gain such experience.

It's a good idea to move around on the stage, if possible, such as by changing the overhead slides yourself or pointing at the screen. Movement helps hold attention and projects energy.

In my opinion, visuals that consist solely of text should be used sparingly. Audiences tend to read word-visuals at the expense of what the speaker is saying. The best bets for visuals are pictures, including data plots, graphs, and the like, chosen to complement the presenter's spoken words and to explain the same thing in a different way.

In the talk itself, explaining the same things in different ways is often called for. Not surprisingly, the more original the material, the greater this burden. After all, if a new technique or idea was obvious, someone would already have thought of it. Scanning the audience makes it possible to discern the level of understanding. It sometimes pays to back off from covering all the material in favor of covering, say, the most important 80% really well.

Here is a final tip: At your next conference or meeting, watch the speakers and evaluate their presen-

tation skills. Choose the best, and consider adopting their best techniques. Keep in mind, though, that one style does not fit all; you will have to develop your own.

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Of Mass and Reference Frames

In his Reference Frame piece "Whence the Force of $F = ma$? II: Rationalizations" (PHYSICS TODAY, December 2004, page 10), Frank Wilczek levels a critique against the zeroth law (conservation of mass) in an effort to dispel the culture of force. As it stands, his assessment falls short of a complete description of mass. Ironically, the problem is related to reference frames.

If the zeroth law is to apply solely to the Newtonian concept of mass, then it should be abolished, as Wilczek suggests, particularly since it is related to the more fundamental laws of conservation of momentum and energy. But Newtonian momentum is not simultaneously conserved in all inertial reference frames.

A more inclusive view is that energy and momentum are but two aspects of the singular beast we call four-momentum, which is conserved in all inertial reference frames. The importance of this notion comes from the fact that mass is the magnitude of the four-momentum vector. Thus, although "Newtonian" mass may *not* be conserved in all inertial reference frames, the broader concept of mass as the magnitude of four-momentum *is*.

In the most general terms, the zeroth law is perhaps not as expendable as Wilczek might have us believe.

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Wilczek replies: Ian Durham is correct in observing that four-momentum is conserved under very general circumstances. It is not the

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case, however, that this entails conservation of mass. Although the mass of an isolated particle can be determined from its four-momentum, that connection does not apply to multiparticle states. And since particles do interact, and even decay, a result that is only valid for single-particle states does not allow one to draw general conclusions. That is why the many specific manifestations of nonconservation of mass I discussed in my column can be—and are—perfectly consistent with special relativity in general, and with the conservation of four-momentum in particular.

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Determining Longitude: A Brief History

It was a pleasure to read Fokke Tuinstra's letter (PHYSICS TODAY, December 2004, page 16) on Ole Rømer's proof that the speed of light is finite. Perhaps an account of the reasons that led him and other scientists to study so precisely the moons of Jupiter (the system Rømer used for his result) would help com-

plete that nice piece of history.

After Christopher Columbus's 1492 trip to America, ships, mostly Spanish and Portuguese, crossed the Atlantic Ocean in increasing numbers. That migration forced a qualitative change in coastal navigation techniques, since mariners sailed without visible land or fixed points of reference. The determination of geographical longitude became an urgent need—at sea for navigation, and on land for more precise cartography and settlement of territorial disputes.

The need led Spanish King Felipe II (1527–98) to offer a substantial reward to the inventor of a method to “find longitude.” The reward amount was increased years later by his successors, and greater rewards were promised by other countries as they began their own oceanic navigations. The British government, for example, offered £20 000 in 1714 to whoever could provide a satisfactory method of finding a ship's position to within half a degree.

What has this circumstance to do with the abrupt and almost obsessive dedication to the study of Jupiter's moons?

When Galileo discovered Jupiter's

first four satellites in 1610, he realized that comparing their eclipse times with local times at a ship's position could be a key component in determining longitude. In 1612, and on three occasions thereafter, Galileo tried unsuccessfully to convince the Spanish monarchy of the usefulness of his method. Although his idea proved to be impractical at sea, it did eventually work on land. For example, the difference in longitude between Paris and Uranienborg, Denmark, was calculated on the basis of the eclipse times taken by Giovanni Cassini, Jean Picard, and Ole Rømer in 1671.

Clockmaker John Harrison won the British prize by developing, between 1735 and 1764, increasingly precise and practical mechanical chronometers, including the one used by James Cook in some of his expeditions.

Rømer's work is probably the first measured Doppler effect; that is, he discovered that the value observed on Earth for the period of Jupiter's moons depends on Earth's velocity relative to Jupiter. It is also noteworthy that today's global positioning system solution to the old problem of finding longitude requires the use of general-relativistic corrections to