Frames of Reference

Bob Colwell

An amazing thing happened recently: A nonengineering person publicly praised what our profession has accomplished.

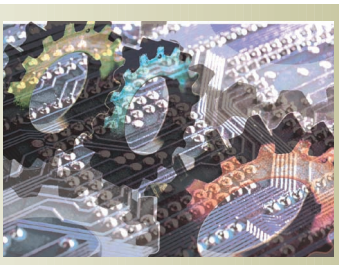
Marilyn vos Savant writes a weekly column for *Parade* magazine, part of the Sunday newspaper for many people in the US. Vos Savant reportedly has the highest IQ ever recorded. Even if you believe that IQs don't mean much, vos Savant corroborated her brilliance when she stated in her 1 May 2005 column that engineers are most responsible for our technological society and as a group are underappreciated. I *knew* I liked her.

THE ARTS/SCIENCE CHASM

A few weeks ago, William Wulf, president of the National Academy of Engineering, came to town and delivered a lecture. Wulf commented that he had been pondering C.P. Snow's famous "two cultures" lecture from 1959, in which Snow pointed out the chasm between practitioners of the arts and the sciences. Most people can easily see that there are value differences between these two groups.

Artists take it as a given that there are no absolute points of reference in music, sculpture, or painting, and artists, their peers, and the buying public must make value judgments. Artists who try to "follow the rules" too closely tend to need part-time jobs in the service industry—as do artists who break too many of them.

Scientists find the prospect of relative truth utterly distasteful and believe their ultimate arbiter is Nature. Indeed, they've learned this lesson the hard way: There are many instances in the history of science in which various fields went astray because of the influence of scientists whose opinions simply were wrong—Blondlot's N-rays, for example. Within the scientific realm, scientists are entirely correct to aspire to something more than peer approval for confirmation of their ideas.



Different words invoke different frames and cause listeners to think in much different ways.

While both groups are correct—or at least mostly consistent—from within their respective frames of reference, finding value from their mutual diversity has been an elusive goal. More than 40 years later, firefights are still being waged over which of these two camps needs to grow up and learn the other's language.

There have even been guerilla actions. Alan Sokal, an NYU physicist, became convinced that the issue wasn't just reference frames, but a simple lack of intellectual discipline. To "prove" his point, Sokal submitted a bogus article to a cultural studies journal, the chief attribute of which was to flatter the editors' preconceptions. If C.P. Snow thought he had stuck a pole into a hornet's nest, Sokal must have felt like he'd knocked it down, kicked it around, and then superglued it to his head. And those he infuriated from the softer sciences would have had no sympathy for him.

What Snow noticed was that the gap wasn't just vocabulary, although that often was (and is) a contributing factor. Snow realized that there were differing frames of reference at work. Effective communication requires that the transmitter have some model in mind for the receiver.

When I write about engineering in this column, I presume that my readers understand a lot about the computing field, its aims, limits, and place in society—as well as technology, science, and many other things. With those assumptions, I can safely refer to events or ideas without having to offer extensive preliminary explanations. I write *from* a certain frame of reference and *to* a certain frame of reference, and because those frames are closely aligned, I can try to convey ideas in an efficient and—if I do it right—generally unambiguous fashion.

A BLEEPING MOVIE

But if a Camp A person wants to convey a subtlety to a Camp S person, it is by no means safe to make such assumptions. This point came home to me recently while I was watching *What the Bleep Do We Know!?* (www.whatthebleep.com), a movie that is an odd concoction of quantum physics and New Age mysticism.

During the first half of the movie, the heroine moves dreamily through a disjointed plot that seems mostly to serve as a tenuous scaffold on which to hang

quantum vignettes and mini-sermons on how weird physics is. I rather liked this part because quantum physics *is* weird, weird in ways most people can't even imagine. It's fun to watch your fellow viewers get that stunned "No *way*!" look on their faces when they realize the physicist isn't kidding about how things work.

My approval of the film abruptly ended about three-quarters of the way through, however, when I noticed that in between the physicists talking about entanglement, one particular interviewee kept reappearing, and I couldn't make heads or tails out of what she said. Eerily, she was precisely mimicking the physicists' intonations, facial expressions, and utter confidence, but to me she was speaking utter gibberish. It suddenly dawned on me: She wasn't a physicist—she was some kind of New Age mystic who had borrowed the physicists' language and was happily doing free-association between quantum physics and her personal religious beliefs.

I don't begrudge this person her opinions; she's entitled to hold them. But I don't think she's entitled to inflict them on unsuspecting viewers as if they're every bit as valid and well-supported as what the physicists were saying.

Quantum mechanics is one of the finest achievements of the human mind. Einstein, Bohr, Fermi, Feynman—some of the smartest humans ever born spent their entire lives teasing out some of Nature's best-hidden secrets. That they were geniuses doesn't mean they were right. But the fact that I'm typing this on a computer that works as advertised means that if they were wrong, it's not by much.

When the physicists in the movie were explaining a concept, the ideas they were describing represented the collective mutual understanding of whole generations of scientists—it wasn't just their personal speculations. I believe the scientific process elevates quantum mechanics to an entirely different plane than one person's random opinions.

The issue here isn't whether pure science and practical engineering are "better" than the soft stuff such as spirituality, cultural studies, and the arts. I'm not even sure that's a useful issue to try to nail down, although I remember disposing of huge amounts of time in college trying to do so.

Facts by themselves don't mean anything at all.

The issue is that a Camp A denizen, no matter how well intentioned, should not attempt to reach across the chasm and begin using terms from the other camp without also adopting Camp S's reference frame. This would have precluded the mystic from saying what she said in the movie, but that's my point and C.P. Snow's point as well: The words don't work in the absence of a suitable frame of reference. Borrowing words without the frame does not constitute communication—it constitutes provocation.

UNDAUNTED COURAGE

They say never to argue politics or religion with people you don't know, and with the above discussion I have probably just walked perilously close to the religion part. To prove that I don't know when to quit, I will now plunge into the politics arena with the same combination of derring-do, aplomb, and well-meaning dumb luck.

Many US citizens were surprised by the outcome of the 2004 presidential election—it seemed to them that most voters had inexplicably voted against their own best interests and that no facts to the contrary would dissuade them.

In his book titled *Don't Think of an Elephant! Know Your Values and Frame the Debate* (Chelsea Green, 2004), George Lakoff attempts to analyze what happened and to explain the inexplicable.

Lakoff says that most people intuitively believe that when well-meaning opponents argue an issue, the facts will emerge, and the right thing to do will become apparent from the way those facts stack up. But Lakoff says that belief is wrong. He points to results from research in the cognitive science community indicating that facts by themselves don't mean anything at all. The words used in describing those facts do, and those words invoke frames.

One of Lakoff's examples is, "What do you call it when an existing tax rate is lowered?" The term "tax cut" might come to mind, and the US government has in fact used that term at various times, especially in the Reagan era. But nowadays, lowering the rate is called "tax relief."

Whether lowering the tax rate is a good idea or not isn't at issue here—the issue is that renaming the process invokes a new mental frame. Where a "tax cut" might or might not be a good thing—after all, most people do realize that the government uses tax monies for essential services such as defense—"tax relief" is like "pain relief." It's automatically favorable unless there are extenuating circumstances. Same reality, but the different words invoke different frames and cause the listeners to think in much different ways.

Moreover, argues Lakoff, if one side in a debate has successfully invoked a particular cognitive frame, the other side must be extremely careful in how they respond. If the response uses the opposing side's frame, the words and facts that follow won't matter: The listeners will discard any facts that aren't congruent with the frame. Instead, the debaters must invoke their own frames and get the listeners to follow them in transitioning from one to the other.

If you voted for George W. Bush, you might not want to read Lakoff's book. He goes far beyond intellectual discussion of cognitive frames into political agendas that aren't appropriate to this column. Everyone else, read it—it's short, and it packs a punch.

I found this book profoundly depressing because I'm not sure a democracy can ultimately survive when manipulation has so thoroughly taken the place of reasoned discourse. Yet if manipulation is the only effective tactic, how can we avoid using it?

WE MUST MAKE THE FIRST MOVE

Bill Wulf says one of the tasks of the National Academy of Engineering is to "speak truth to power." I'm both reassured and troubled when I hear Wulf say that most public servants he has had contact with, and *all* of those in the highest levels, are well-meaning as well as extremely intelligent and capable. Reassured, because even when they do really stupid-looking things, at least they're trying. And troubled for exactly that same reason.

When we stop questioning our truth, it has become dogma, and we have betrayed the scientific process.

I felt like throwing my car radio out the window a few weeks ago when I heard a local school board official expressing his views on whether creationism ought to be taught in schools along with evolution. He said, "Evolution is only a theory. It's not a fact. Creationism is a theory too. So therefore it follows that we should present them together as just two theories."

If the people in charge of education have such a poor grasp of science, how can they possibly make intelligent decisions, no matter how hard they work and no matter how well-intentioned they are? When Wulf says that engineers "speak truth," he means scientific truth—truth as best we know it. That's all the truth we'll *ever* have in this world, but when we stop questioning it, that's when our truth has become dogma and we have betrayed the scientific process. That all scientific truths are in some sense provisional is a *strength* of the process, not some kind of weakness. We must not allow ignorance of that fact to devalue it.

Wulf recounted several instances in which an Academy of Engineering study had produced results that were, er, "imperfectly aligned" with prevailing administration policies. Global warming, for example. Had Wulf's analysis teams come up with a conclusion that global warming wasn't real, the Academy would have been lauded as heroes—and in all likelihood the policymakers wouldn't have questioned it. Instead, the Academy's study concluded exactly the opposite and engendered the usual denial, anger, ineffective refutation, and disregard.

But Wulf is still hopeful that eventually the administration will come around. Speaking truth to power isn't always immediately appreciated by power. One cool thing about science is that when you get it right, it stays right, even if it takes people some time to come around. The not-so-cool thing is that we don't have an indefinite amount of time to puzzle this out.

Meanwhile, forewarned is forearmed. We in the technology business must realize we're all in the service of truth, an absolute truth that must be guarded, developed, and continually explained to people who need our knowledge and intuition but who may not have the frame of reference needed to understand it. Someone must learn the other side's frames and bridge that gap, and the Camp A folks can't do it without the technical training that they don't have and don't realize is necessary.

If the arts/science gap is to be bridged, it will be we technologists who bridge it. ■

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