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Twelve Bad Words

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Almost everyone has encountered the problems of acronyms and other technical jargon. Those of us who teach or give public presentations learn to avoid most such specialized technical terms, or else to define them carefully. Somewhat less well understood is the problem of using familiar words in unfamiliar ways. Here the dangers of miscommunication are actually greater, because the listeners (or readers) may think they understand the term when they do not. It is relatively straightforward to ask questions or look up a word when someone uses jargon that we are not familiar with. More pernicious are situations where we think we are communicating but are not.

In this note I discuss a dozen words that are often used by astronomers without recognizing that they are already in the vocabulary of students or lay listeners, under very different meanings. We can't purge these words from a textbook or lecture by using a spell-checker the way we can pick up most technical jargon. These words look normal. But they are actually just as much a part of our specialized jargon as the unfamiliar terms and acronyms. And they are more dangerous in their potential for misunderstandings.

believe: The primary dictionary definitions deal with faith or having convictions, especially religious convictions. Yet almost all of us speak of believing a particular scientific result or theory (see "theory" below). This usage has the unintended result of associating scientific results with a religious or philosophical belief system. It is usually more accurate to say I think, or I conclude, or I understand a scientific point, rather than I believe it.

body: This word is a part of everyday English. The first four definitions in my dictionary all relate to an organism or living thing. Often it means someone who is dead. Yet I frequently see astronomers referring to comets or asteroids as bodies. Most people think this sounds silly. And believe me, adding as explanation that we mean a "heavenly body" does not help!

brightness: It is a challenge to describe anything to do with surface brightness or reflectance in lay language. The technical term "albedo" is often used without a definition, ensuring failure to communicate. "Reflectance" or "reflectivity" are better but still unfamiliar. In my experience, most people understand

brightness to mean surface brightness or something like it. They also sometimes use the word "color" to mean surface brightness or reflectance, as in describing a carbonaceous meteorite or the lunar surface as having a "dark color." I have no recommendation here other than to tread lightly and realize how difficult it is to communicate these concepts effectively.

dense: One common meaning of dense is stupid, ignorant, impenetrable--something students may be more likely to associate with their textbook rather than with the ratio of mass to volume. Density as used in science requires definition. We should also recognize that in common language, the terms "light" or "heavy" are used to characterize density. When you pass around an iron meteorite in class, your students will say that is heavy, not that is dense. A puff pastry is described as light, not of low density.

finite: In many scientific contexts, the opposite of finite is infinitesimal. We speak of something as having a finite value (such as the mass of a neutrino) as opposed to a value of zero. But for the public, the opposite of finite is infinite, at the other end of the size spectrum. It is no wonder we get blank looks when we use "finite" to describe something that is very small but larger than zero.

limb: This word is firmly ensconced in ordinary English with two meanings: an arm or leg, or a branch of a tree. Trying to introduce a third unrelated meaning to your students is nearly hopeless. Yet I hear and read references to the limb of the Sun or the limb of a planet very frequently from astronomers. Usually "edge" or "disk" works fine, depending on context. The only usage where I can't think of a good alternative is in "limb darkening," but this is a subject of interest only to professional astronomers in any case.

magnitude: The ordinary meanings of size or quantity will never lead a student to understand the astronomical magnitude scale, especially since small magnitudes indicate large brightness, which is the reverse of common usage. Equally problematic is one of our favorite expressions, "order of magnitude." I first encountered this phrase in junior high, when reading Fred Hoyle's Frontiers of Astronomy. Not finding a definition anywhere, I guessed that perhaps an order of magnitude was a factor of 2.512--logical, but wrong. It was three years later that I finally found the definition. Please don't place your students in the same frustrating limbo.

mean: Everyone knows the common adjective (poor, shabby, stingy, base), but almost no one outside of the sciences is aware of the mathematical definition, which is unrelated to normal usage. In general, people understand "average" but not "mean" or "median." Speak of a mean value, and they may think you are talking about small or stingy amount.

model: A model can be a miniature representation (such as a model airplane), a prototype or pattern, a design (as in a model year for cars), a person who displays clothes, or someone who poses for a portrait. None of these familiar meanings corresponds to the concept of a scientific model, especially today when models tend to be abstract and computationally intensive, like a model of a stellar atmosphere. The term is best avoided unless we are willing to take the time to describe carefully what a scientific model is and how one is calculated.

radiation: This is one of the most often misunderstood terms, even among scientists in different disciplines. To the public, and even to most scientists, radiation means ionizing or high-energy radiation, usually associated with radioactivity. Except in treatment of cancer, radiation is bad and should be avoided. But astronomers say that the function of telescopes is to collect radiation, and that we spend our time studying radiation. It is no wonder that farmers have objected to having radio telescopes near their

ranches, collecting dangerous radiation! The same sort of confusion has pervaded the public discussion of possible health effects from the radiation emitted by cell phones. Virtually the entire public and most reporters think this means that cell phones are radioactive, and the misunderstanding may even be shared by some health-care workers. Even if we are aware of the public confusion between radiation and radioactivity, I suspect most of us don't recognize that our colleagues in the biological sciences also equate this term with ionizing radiation. I have heard a NASA astronomer and a NASA biologist speak together about solar radiation, neither realizing that one was talking about light from the Sun, the other about solar cosmic rays!

reduce: In English, this word means to decrease or make smaller. What, then, is a lay audience to make of an astronomer who speaks of reducing data or reducing observations? If anything, this may seem to indicate that we are throwing away some of the data. In any case, it won't make sense to most audiences. It seems to me that this phrase is also outdated as a technical term, since modern processing and calibration are very different from the nineteenth-century "reduction" of observations to a small number of averaged data points in advance of performing laborious calculations.

theory: Widely misunderstood, this word has multiple meanings for both the public and scientists. It derives from the Greek for beholding or speculation. The generally accepted meaning is speculation or guess. I recently read a report by a journalist that was explicit, writing "My theory is that .... If this hunch is correct....." In contrast, the scientific meaning is an acceptable general principle offered to explain phenomena--a unifying concept that ties together many observations or experiments and has been widely tested and validated. The two meanings are poles apart; hence the confusion that leads to the common assertion that "evolution is just a theory." Less frequently, relativity also suffers from the "just a theory" criticism. We need to face this confusion directly, or we are likely to be communicating precisely the wrong message to students and the public, who may conclude that in gravitation, electromagnetism, relativity, or evolution, scientists are just guessing or following their hunches.

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