EDITORIAL

Stands to Reason

When I first learned the rudiments of symbolic logic—"If p, then q" and all that—it seemed a revelation. Here was something certain to hold on to in this confusing and chaotic world, like Euclid's geometry. Subsequently, I found that formal logic should be used sparingly, at least in public. Raising questions about, or even saying, "the contrapositive" at a party was not such a good idea. Saying "necessary, but not sufficient" was better, because it sounds like a friendly compromise, and saying "dialectic" was always acceptable, if there was a guitar in the room.

Rudimentary formal logic can, however, be of some help in thinking about and presenting science. Simply putting things like data, results, inferences, and hypotheses in the form of propositions is useful. Doing so helps reveal and clarify your actual train of thought. It can be difficult to decide what exactly "p" and "q" are—each is itself a statement (proposition)—and you have to know whether each is true before you can deal with the compound proposition "If p is true, then q is true." (Thus, "If your friends jumped off the roof, should you do it too?" doesn't even qualify as a proper proposition. "If you keep making that face, it'll freeze that way" does, it's just false—I think.) Nonetheless, formulating your work as a sequence of simple and compound propositions can help you avoid confusing data with results and results with conclusions. All things considered, experiments always give exactly the data that they should. Raw data can be misleading, but only your presumptions, interpretations, and inferences can be wrong. The rules of logic can also help you avoid the pitfall of confusing the strength of the result with the strength of the argument.

Another way symbolic logic can be helpful is in suggesting experiments. The contrapositive ("If q is not true, then p is not true") is logically equivalent to the original proposition ("If q, then p") and may provide an alternate experimental approach to testing it. Also, once you know that "If p, then q" is true (e.g., "If there's a light cycle, the rhythm entrains"), it may be worthwhile to test the converse ("If q, then p") and the

inverse ("If p is false, then q is false"). It is remarkable how often people—e.g., administrators—assume the truth of the converse from the truth of a proposition. One example: The truth of the proposition "If someone is a highly regarded scientist, then she is likely to publish more papers than less well-regarded scientists" has led to the conviction that "If someone publishes more papers than most scientists, then she is (or will be) highly regarded." This notion is reinforced by the desire for objectivity, fairness, and the avoidance of lawsuits.

There are, however, serious limits to the usefulness of formal logic. First is that the truth of "If p is true, then q is true" does not mean "p" causes "q," or vice versa. (Consider "If it's noon, then it's daytime.") There are other reasons for such links—e.g., the truth of "p" and "q" may have a common cause, or the variable in "p" may be a component of, or a marker for, the variable in "q." Another limitation is that rudimentary logic deals with propositions that are either simply true or simply false: "The Law of the Excluded Middle," also known as "The Law of the Excluded Muddle." In our world, however, propositions may be mostly true, usually true, sometimes true, depending. Much of our effort is spent on determining exactly under what conditions, or with which restrictions, a proposition is true and exactly how general its terms should be. Finally, another serious limit to the usefulness of formal logic, or any kind of logic for that matter, is that, in practice, it doesn't seem to help disabuse anyone of their wrong-headed notions, nor convince them of the obvious and necessary truth of one's own ideas.

So what's a scientist to do? Accept the fact that active science, like the rest of the world, is confusing and chaotic, and consider alternative interpretations of "If p, then q" such as "If you're going to have a pint, you may as well have a quart." Logic, alas, does not reign supreme, nor should it.

Martin Zatz
Editor