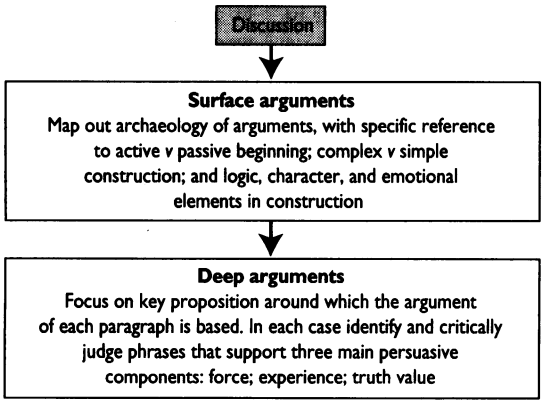
Eurogast study: "Our results show a statistically significant relation between *H pylori* infection, as determined by serum antibody positivity, and gastric cancer mortality and incidence. This finding adds further weight to the hypothesis that *H pylori* infection is a risk factor for gastric cancer." In the first sentence the proposition, in its simplest form, is that *H pylori* infection is related to gastric cancer. The authors can use any of three techniques to convey this proposition to the reader: the force with which the proposition is made (what linguists call modality), the experience of the writer in making this proposition (transitivity), and how the truth of the proposition is encoded in the sentence (semantics) (figure).[8]



Scheme for linguistic analysis of discussion section of research paper

In this instance force is conveyed by the verb "to show," since show implies a visual clarity in the results that should be apparent to the reader without need for additional explanation; moreover, no qualifying phrases, such as may, might, or probably, are used. Experience is transmitted by use of the first person as narrator: the results were discovered by and belong to the authors. The authors send a strong message about the truth value of the sentence by emphasising the methodology chosen in the study—positivity for *H pylori* antibody—and that the relation is significant.

The second sentence in this same paragraph can be examined in the same way. In particular, readers might consider the persuasive effects of a switch to the third person narrative, the use of an adjective, a metaphor, and the verb "to add," and the causal implications of the phrase "risk factor."

Conclusion

The text of a scientific paper is not an atlas that offers readers several equally appealing routes through terrain mapped out by the authors. Rather, the text describes a specific path, carefully carved by the authors, through a complex undergrowth of competing arguments. By examining this path more closely, we come to see the authors' intention and the means by which they convey this intention. Such textual criticism of scientific discourse is a crucial and largely missing component of peer review.

The time in science when an observation could be held to speak for itself has long past. Interpretation is a key part of research as scientists now deal less with demonstrable facts than with probabilities. Hence the writings of researchers are increasingly decorated by their own values and biases. In the humanities the practice of textual interpretation is called hermeneutics. Although in medicine we talk of "critical appraisal" when evaluating evidence, the importance of a linguistic perspective when discovering meaning in a paper convinces me that a clinical hermeneutic approach would be a step forward in the peer review process.[9] Should authors have unrestrained freedom in their use of language when interpreting their results? Such freedom fosters an adversarial trend in research communication, which may make good journalism but which may also diminish the practice of science.

So should authors own their own words? Clearly, there are dangers in this freedom. Whether editors should enforce an idealised form of scientific presentation—for example, a simple rather than a complex, structured discussion—is worthy of debate. This issue is perhaps even more important in evaluation of the arguments and opinions presented in review articles that give no indication of how primary data were selected for inclusion. Even if authors retain their proprietary rights over their text the reader should at least be equipped with the basic tools to decipher the often unconsciously encoded intentions of the author. You could begin with this article.

This paper is an edited version of an article published in *CBE Views* (1995;18:3-5).

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(Accepted 23 January 1995)

Commentary: Scientific heads are not turned by rhetoric

Trisha Greenhalgh

Dear Dr Horton,

When I read a scientific paper, either for its own sake or when wearing an editorial hat, I usually drink in the introduction (to whet my appetite for the subject matter), skim the methods, eyeball the figures and tables, and then read every word of the discussion. Then I go back to the methods and results sections and weigh the rhetoric of the authors' conclusions against my own assessment of the objectivity and general value of their work. Why do I do it that way? Because if I concentrated on the structured and measurable bits to the exclusion of the rest, I would be flat out, dead, under the table from boredom.

The reason that your paper worries me is that, having drawn attention to the "'spin' that authors place on their work," you then entice the reader into the unjustified assumption that this spin is necessarily evil, insidious, and the last remaining bastion of caprice in the otherwise objective terrain of scientific publication. What sort of a word is "spin"? What

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exactly do we doctors do when we talk or write about our own research? We enthuse, we speculate, we harp back to yesterday's theories, we formulate tomorrow's hypotheses, and we pat ourselves on the back for working so hard. But do we spin? Is the order of our sentences, or the tense we use to present them, able to distort seriously the intelligent reader's interpretation of our data?

The example you cite in support of your hypothesis is unimpressive. I found nothing in the authors' discussion that redressed for me the palpable gap between their result (that in population studies *Helicobacter pylori* infection is associated with an increased prevalence of gastric cancer) and their conclusion (that the one probably causes the other). The fact that such flagrant disparities often appear in print, even in reputable, peer reviewed journals, is evidence not of the persuasive power of rhetoric but of the fact that editors and their staff do not read scientific papers as thoroughly as they should do before publishing them. The Eurogast Study Group's overzealous interpretation of its results is evident not just to the discerning reader but to anyone with a basic scientific training who does more than skim through the abstract.

The crucial piece of evidence that your own paper conspicuously lacks, and which I challenge you to produce, is a single, clinically important instance of scientific heads being turned by rhetoric and rhetoric alone. To my mind it is not surprising that medical scientists, selected for their visuospatial, mathematical, and retentive skills and put through a training programme that hones these skills at the expense of just about everything else, tend to generate resoundingly unconvincing rhetoric.

The linguistic spin which you propose to wrest from the grasp of authors and replace with your structured discussion (and, no doubt, the soon to follow structured introduction and structured acknowledgments) is the essential element of scientific communication. Linguistic spin is what draws us around the world to conferences, where those oh-so-dry figures, tables, and structured abstracts can be discussed face to face over a beer, and the emotional and intellectual batteries that drive our research can be recharged. Scientific papers stripped of spin will be science without its buzz, a brave new world where technicians input data and computers generate scientific papers while we remain bent over our whirring instruments.

I suspect that you agree that the level of literacy of the average medical student, not to mention the average medical graduate, is a disgrace to the profession. You would probably say that improving the linguistic abilities of doctors would lead to less spin in the scientific papers that they write and that that will improve the quality of science. I say that such an approach would produce even more spin and that *that* will improve the quality of science.

It is of course more difficult to disprove a theory than to prove it. I have offered you no evidence that scientific heads are not turned by rhetoric, and I acknowledge that a single cogent example to support your hypothesis would invalidate the arguments I have advanced here. I repeat my challenge to you to produce one.

Richard Horton replies:

Like Trisha Greenhalgh, I too enjoy observing and taking part in the lively discussion that follows publication of new data. All readers project personal biases on to their interpretation of research results, a process that is largely beneficial in the iterative pursuit of scientific understanding. Here, linguistic "spin" is indeed the stuff of debate. However, to sanction and even to celebrate this approach in the primary resource medical literature is not only cynical but also dangerous. To strive for "buzz" in writing a scientific article is to condone a practice that will cause incalculable harm to the reputation of medical science and its investigators as well as to patients.

Greenhalgh asks whether there is a single clinically important instance of scientific heads being turned by rhetoric alone. Yes, such examples exist, and I will cite only the most recent, well publicised case. Earlier this year, Dulioust *et al* reported that embryo freezing caused subtle alterations in morphology and behaviour in subsequent offspring, although no major anomalies were discovered.[1] In their discussion the authors emphasised a different interpretation. They wrote that "substantial arguments support the hypothesis that embryo freezing can have delayed consequences [that] could perhaps justify a more limited use of this technique in clinical practice." Despite their largely reassuring data this more alarming conclusion was the one reported widely in the lay and scientific press, and this led to calls to ban all freezing of human embryos.[2] A subsequent statement from the Centre National de la Recherche Scientifique (France's national centre for scientific research) corrected the misleading rhetoric of Dulioust *et al*'s statement. Has this instance of linguistic spin been of such value that it "will improve the quality of science"?

Moreover, Gore and colleagues have shown that conclusions drawn in research reports often fail to match the data on which they are based.[3] And Schulz *et al* have cautioned readers of randomised trials to "be wary of the potentially misleading information currently provided."[4] Why concern ourselves only with scientific heads? The way research is reported in the press either from the original report or from a press release steeped in hyperbole is equally important.[5]

Finally, Greenhalgh dismisses the significance of structure in scientific writing by taking it to its logical, and laughable, extreme. But the structuralist approach offers considerable value. For instance, Taddio *et al* found significantly improved mean quality scores with structured abstracts compared with their non-structured counterparts.[6] Structure can improve clarity and eliminate rhetorical bias and is now being applied to consensus statements[7] and clinical trials[8,9] with both enthusiasm and success. None of these innovations will suppress debate yet they will help to curb literary obfuscation.

Scientific writing is by definition rhetorical. The analysis of rhetorical devices deserves serious attention by authors, readers, and editors.

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