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"I Knew There Was Something Wrong with That Paper": Scientific Rhetorical Styles and Scientific Misunderstandings

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Abstract

This selection unpacks scientific prose and claim substantiation for Nobel Prize winner, Stan Prusiner, in the transmissible spongiform encephlopathies field (i.e., mad cow disease). Applying linguistic strategies such as M. A. K. Halliday's "favorite clause type," the author examines argumentative strategies in dense scientific prose both in bold and cautious rhetorical styles and invented lexical changes in new scientific development.

The fine work of several scholars (Darian; Gross et al.; Atkinson; Halliday; Bazerman) has painted the tableau of twentieth-century scientific prose-its evolution, common features, and social and cognitive goals. Scholarship can now add detail and texture to this tableau by addressing issues that receive the faintest brush stroke in macro-analyses. Perhaps the most pressing matter for our attention is also what our field is most prepared to address: misunderstandings in scientific communities due to forces such as the following:

- Field-specific styles or social "indexes" (Atkinson 59-60);
- Problematically bold or cautious rhetorical styles;
- The relations between syntax and argument; and
- The rhetoric of scientific terminology.

We need not only identify productive discursive patterns, but also the destructive or misleading patterns that may derail scientific progress. Scientists are eager for scholars in communication fields to investigate what is often just as frustrating as failure in the laboratory-the failure to communicate, the failure to understand, the failure of language.

FIELD-SPECIFIC AND INDIVIDUAL STYLES OF SCIENTIFIC PROSE

Our knowledge of field-specific indexes is just beginning to unfold. Blakeslee tackles inter-field communication, revealing audience analysis as complicated and ongoing, often failing writers who seek adherence for claims outside their home fields. Subtly contrasting, field-specific styles of argumentation and presentation may complicate audience analysis. Promising investigation into the development and features of different indexes has begun. Examining writing in mathematics, Sarukkai proposes that local discourses, formed through the copying of global forms, alter those forms as they are applied and reapplied in local contexts. Social science discourses, according to Wignell copy patterns from both the humanities and the natural sciences, combining the drift toward abstractions practiced in the former with the drift toward objects found in the latter. Cognitive science discourses, according to Matthiessen construct the abstract-the mental states-conceived in folk discourses as technical and concrete.

What of other specialized field indexes? Biomedical rhetorics, even in basic science, must show relevance of research to health. Popular media play and the urgency of the health issues they address can press scientists in some fields of bio-medicine to justify their work as either introducing the bad news of a possible health disaster or providing the good news of treatment and prevention. National Institutes of Health (NIH) scientist Paul Brown, who studies mad cow disease (bovine spongiform encephalopathy), claims that his field, historically focusing mostly on veterinary health and basic science, experienced tremendous changes in communication patterns once the disease was discovered to be infectious and viewed as a threat to human health. In an interview with the author, Brown claimed, "Everybody in basic science is being funded on the basis of risk to human beings, and if you publish anything, interesting though it may be, that you don't relate to risk somehow, you diminish the chances of a career and funding." The "bad news," (in Brown's words) of emergent health problems is expected rhetorical justification for funding research. Brown insisted that even though "everybody doesn't totally ignore the fact that

implications of a discovery might not be bad news, you don't tell this to editors of journals because they're delighted when they show something is a problem because they're media, too."

PROBLEMATICALLY BOLD OR CAUTIOUS RHETORICAL STYLES

The question of whether or not individual scientists may develop observably individual styles of scientific rhetoric has been addressed for key historical figures such as Thomas Edison and others (Bazerman; Latour, "Pasteur"; Westfall, "Galileo and Newton"). But do individual styles of scientific prose even exist within the constraints of modern scientific discourse conventions? My modest contribution to this question, offered by contrasting two key AIDS researchers (Reeves, "Rhetoric") is that, at least in the context of controversy within AIDS research in the early 198Os, observable stylistic differences can be seen in the papers produced in both an American and a French laboratory-differences that are as much a result of personality as culture. The Americans' style (bold and definitive) misled audiences about the lack of their evidence, while the French team's style (cautious and conservative) misled audiences about the importance of their evidence. In another biomedical field examining transmissible spongiform encephalopathies such as mad cow disease, a bold style is clearly evident in the work of a key investigator, Stanley Prusiner, who won the Nobel Prize for his work in 1997 (see Reeves, "Orthodox"). Prusiner's critics, favoring the more cautious and conservative approach, accuse him of playing fast and loose with the evidence, of making bold claims without sufficient evidence. One critic, Dr. Byron Caughey, the laboratory chief at the NIH Rocky Mountain laboratories, complains:

> All those years where Prusiner was running around-and still is-doing these horrendous things, and just running roughshod over his field, all these scientists who had a different idea about it and a more careful idea about it, wanted to stick close to the evidence, there was nobody who had the charisma and the intestinal fortitude to stand up and really fight the battle. (Interview with the author)

Bold scientific rhetoric can also mislead lay audiences. The link between autism and early childhood vaccinations, publicized in the media and debated in Congress, persuaded countless parents to decide against vaccinating their children, leading to outbreaks of measles and other infections in several states. The bold rhetorical style employed in the original study (Wakefield et al.) possibly contributed to misreading of its findings by lay journalists who were incapable of assessing the statistical data or the interpretive methods that scientists in Wakefield's field saw as flawed. Wakefield eventually retracted his study (Wakefield).

More scholarship addressing the question of individual styles of scientific prose is needed. Do Nobel Laureates share certain stylistic proclivities? Naturally, successful scientists are successful communicators, but are their rhetorical choices designed to seem invisible or to stand out? This is open terrain that deserves exploration.

SCIENTIFIC SYNTAX AND SCIENTIFIC ARGUMENT

Several investigators have explained the cognitive and social advantages of scientific prose style and its grammatical and semantic features (Atkinson; Gross, Harmon, and Reidy; Halliday). Scientific prose exploits a linguistic universal Halliday calls "grammatical metaphor," the potential of our grammar to allow us to "reconstrue" our actions into things, a shift from verb groups to noun groups allowing us to theorize about our experience. Grammatical metaphor may be

exploited by writers not only "to extend the overall meaning potential" (Halliday 195), but also to extend overall argumentative and persuasive potential. The two statements below appeared in a 1982 review essay in Science (Prusiner) about research on scrapie-a disease similar to mad cow disease, but in sheep rather than cows. In this essay, Stanley Prusiner's grammatical shift serves his argument for a provocative theoretical shift.

Early in the essay, he writes, "Investigators have so far been unable to find a nucleic acid associated with disease in infected tissue" (emphasis added, 137). Later in the essay, the verb group "have been unable to find" becomes the noun group "the lack of nucleic acid," which, through grammatical metaphor, creates the aura of an uncontested or black-boxed issue: "The lack of nucleic acid associated with disease in infected tissue is reason enough to consider alternative processes involved in disease causation" (143).

Obviously, "unable to find" is not the same as "a lack of," yet grammatical metaphor allows the subtle shift from an inconclusive activity to a foregone conclusion. Prusiner not only exploits grammatical metaphor, as Halliday insists occurs, but he exploits his audiences' comfortable familiarity with a sentence style that normally conveys a black-box issue. Here we have a stylistic choice rendering an issue as if it were "black boxed" serving as an enlistment strategy (Latour Science). The aura of the "black box," created through the exploitation of nominalization through grammatical metaphor, allows Prusiner to initiate an alternative, even heretical, hypothesis that an infectious protein containing no nucleic acid, rather than a virus, causes scrapie.

Stan Prusiner's colleagues in the field of transmissible spongiform encephlopathies complain about his prose style. Dr. Sue Priolla, principle investigator at the NIH Rocky Mountain laboratories, describes her frustration with reading a paper from Prusiner's laboratory:

I knew there was something wrong with that paper. I kept rereading it and looking at the data, and then at how they explained their data, and finally, after days of pondering, I realized it was the wording in a string of sentences. It was easy to overlook because it was so subtle. (Interview with the author)

The source of the problem lies in what Halliday calls the "favorite clause type" (Halliday 206). A typical scientific sentence begins with a noun group (usually a nominalized verb or attribute) followed by a relator (usually a form of the verb to be) followed by another noun group: Thus,

"The lack of nucleic acid associated with disease in infected tissue

[noun group, notninalized processes, or qualities]

is

[relator]

reason enough to consider alternative processes involved in disease causation."

[noun group, nominalized processes, or qualities] (Prusiner 137)

Such a sentence conveys certainty or forcefulness even as it expresses speculation. This is the "favorite clause type" because such sentences are the "most critical in the semantic load that they carry in developing scientific argument" (Halliday 207). Are these features so much a part of the tacit knowledge of scientists that they do not even notice when they are being bamboozled?

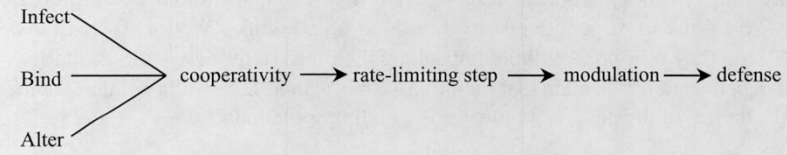
Writers may exploit nominalization in order to make arguments about unclear or hypothetical actions and agents. Because audiences are so familiar with the nominalized style, they may tolerate or overlook serious flaws in argument due to the exploitation of grammatical metaphor. Dr. Priolla complains that the papers from Stan Prusiner's laboratory are "very difficult to get through in an in-depth way, so I think most people just read through it and think, 'Well, OK, that looks OK', and they move on" without unpacking the prose (interview with the author). In a paper written by a team that included Stan Prusiner, Dr. Priolla pointed out the last sentence in the passage below as especially problematic:

If it is assumed that PrP conversion is a simple reaction, in which exogenous PrPsc infects the system, PrPc binds to protein X and is altered to PrPsc, and that either K(1+2+3) itself or a protein containing kringle domains is protein X, it can be postulated that cooperativity of interaction between PrPc and K(1+2+3) could become a rate-limiting step of PrPsc formation. Although the process of PrPsc formation is initiated by infection with exogenous PrPsc, conversion of PrPc to PrPsc within the system could be limited at low protein concentrations until the protein concentration reaches a level at which PrPc and K(1+2+3) bind cooperatively. Thus, modulation of local protein concentrations involved in prion pathogenesis (PrPc and a kringle-containing protein, in this case) may be an intrinsic defense mechanism against prion propagation under physiological conditions. (Ryou et al. 329, emphasis added)

The authors propose in the last sentence, a typical scientific clause, that modulating protein concentrations in our bodies may prevent the propagation of infectious protein particles (called "prions") that leads to diseases like mad cow disease. The problem with this paragraph, noticeable only through careful scrutiny, is that the proposition rests on a nominalization of a chain of hypothetical agents engaged in hypothetical relationships. If we "chart" the syntax, we identify the source of Dr. Priolla's frustration. Thus,

If we assume →
[1] that PrP conversion is simple →
PrPsc [infectious protein particle] *infects* the system,
PrPc [normal protein] *binds* to *protein X* [unknown protein postulated as a co-factor in infection] and is *altered* to PrPsc,
[and] [2] that either K(1+2+3) itself or a protein containing kringle domains is
protein X,
We can postulate →
that **cooperativity of interaction** between PrPc and K(1+2+3) could become a **rate-limiting step** of PrPsc
Thus **modulation of local protein concentrations** involved in **prion pathogenesis** (PrPc and a kringle-containing protein, in this case) may be an **intrinsic defense mechanism.**

Actions are transformed into things:



Nominalizations evolve from hypothetical actions that are hypothetically attached to the relationship between known agents and theoretical agents. PrP is well characterized in its normal form (PrPc). The exact nature of the abnormal form (PrPsc) [or Prion] is still unknown. Protein X

remains a hypothetical agent. The nominalization "modulation of protein X" builds a theory of the host's defense that rests upon the grand assumption of the existence of protein X! Since the whole argument rests on an assumption about actions and actors that may or may not exist-"If it is assumed that... "-the entire paragraph is actually theory based upon theory based upon theory, clothed in the armor of scientific syntax, requiring enormous reader energy to untangle. We can now see why Dr. Priolla re-read this paper several times before she was able to know what was wrong with it. Examining and explaining such misunderstandings may be one of the most valuable contributions our field can make to the study of scientific communication.

THE RHETORIC OF TERMINOLOGY

Specialized diction or terminology helps create and solidify subfields, promote and develop theories, stimulate research agendas, and maintain hegemony (of science over the public domain or of one hypothesis over another). Terminology is also a significant source of misunderstanding, as any scientist will assert. Columns on inappropriate or misleading terminology (see Gould; Heilbron; Konner) appear in journals throughout the scientific community. Ceccarelli has demonstrated that E. O. Wilson's use of the term "consilience" worked against his interests because its intended polysemy only led his audience to view him as equivocating (148-49).

Prusiner's use of language, particularly his coinage of new terminology, shows his understanding of how lexicons generally evolve (Darian 47-62) and how they function rhetorically to support new theory and networks of alliances among scientists. Prusiner's manipulation of terminology is a source of great consternation among his peers, yet few disagree that his machinations led to tremendous shifts in attitudes and research agendas (see Reeves, "Orthodox"; "Can Rhetorical"). Scientists studying mad cow disease and other related diseases now use the word "prion" to stand for the cause of the diseases. Introducing the term in 1981 to replace the traditional virus lexicon, Prusiner compacted two descriptors and a noun-"proteinacious + infectious + particle" = prion-to create an intentionally polysemous term:

1. An infectious protein particle with nucleic acid that has not been found
2. An infectious protein particle containing no nucleic acid.

Because of this polysemy, the term "prion" infected Prusiner's field due to its use by both proponents and opponents of the protein-only theory (see Reeves, "Orthodox;" "Can Rhetorical").

Prusiner also promoted both his theory and his new lexicon through a variety of linguistic moves commonly viewed as global lexical patterns rather than a local rhetorical choice. One example is his exploitation of linguistic distillilation, when a compacted term gets "reconstrued" as different grammatical elements:

Prionics Prion Science Prion Protein Prion Protein Gene

Eventually, the prion terminology enjoyed hegemony to such a degree that editors of major journals regularly advised authors to change their terminology to fit what had become standard. No grant funding is available to anyone who insists on using alternative terminology. But his terminological coup violated the conventions normally applied to the introduction of new terminology. His critics have long charged that he introduced a new term prematurely and that the

term is misleading because it renders objective status to an agent that remains uncharacterized; Prion does not refer to a quantified and characterized referent (see Chesebro). Terminology giving objective status to theoretical agents is fine for theoretical physics, but not for bio-medical science where diagnosis and treatment often depend upon an exact characterization of causative agents.

Several possible sources of misunderstanding in science have been presented here: conflicting field-specific styles or bold and cautious styles of scientific rhetoric, the relations between syntax and argument, and the rhetoric of terminology. There are obviously many more. Analogies and metaphors are likely culprits. Darwin's analogy between animal breeding and natural selection may have stimulated the unfortunate eugenics movement, which is a tremendous misunderstanding. Official discourse is another cause of problems. For example, the Columbia Accident Report describes how an official discourse invested in cost control, funding, and promotion of NASA hindered more effective communication between the scientists with the expertise and the managers with an interest in cost control. Those with the power to stop the mission misunderstood the engineers' early concerns about the foam strike because managers who translated the engineers' warnings used language that minimized the seriousness of the foam strike (CAIB). Misunderstandings appear in all scientific fields, frustrate all working scientists, and cause harm, even loss of life. Our efforts to understand misunderstanding will lead to new theories of scientific rhetoric as well as new solutions to these pressing communication problems.

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