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English 131

2 February 2006

Give Me Technology: Rhetorical Strategies in Scientific Writing

In order for scientific breakthroughs to directly impact the general public, abstract ideas, theories and discoveries must be effectively transformed into real technologies which, when applied, benefit everyday life. Similarly, scientific literature uses the conventions of rhetoric to translate sheer unintelligible data into a wide understanding of its meanings and implications. The public's complete awareness of innovative science is necessary for its acceptance and incorporation into daily life. As technology progresses from initial discovery to real world application, its broadcast through various forms of literature changes as well. Experimental scientists, writers of academic journals, and the media work together in a network to increase science's comprehensive scope. The communication of new ideas is dependent upon this network of writers. At one end lie the scientists who are responsible for developing experiments, collecting data, interpreting it, and then formulating conjectures and conclusions from their research. At the opposite end of the spectrum lie the journalists and reporters who focus their writing on the significance and implications of new science for the public. Each group has a different persuasive purpose and caters to a vastly different audience. In order to relay information accurately from their sources to their readers, these groups employ appropriate modes of rhetoric in their writing. Rhetoric serves as a translational tool that modulates the information that a writer takes in and recasts it for a specific reader.

Through various texts, scientific information is shaped and molded as it makes a progression from direct observation in a lab to public awareness in the media. In other words, information in the realm of science flows from a small and highly concentrated source, then seeps out and is redistributed through the literature to an extensive target audience. Academic journals such as *Science* interpret data and report it to the scientific community. The author of an article in such journals, usually the scientist who made a particular discovery, plants the first informative seed—he or she takes the first step in transforming "brute facts" into general knowledge. Magazines and newspapers such as *The New York Times* then take this growing seed, examine it, reevaluate it, and then distribute its contents to the public. Writers of these texts must not only comprehend their subject matter, they must also be able to draw conclusions from it that might affect their own audience. The media has to filter the highly concentrated scientific text without diluting its value in order to make it appealing to the public.

If the authors of both of these forms of scientific literature are able to present ideas clearly and effectively, then their audience can be directly influenced by their writing. This is the end goal of any author of science within the spectrum—to influence and persuade a reader of the validity of his or her argument. Whether through the organization and presentation of experimental data, or by the powerful emphasis of the effect of technology on the world, both scientists and journalists seek to convince their audience of the importance of a specific discovery, idea, or conjecture. In his article *Rhetorical Analysis* Alan Gross describes the dependence of scientific texts on rhetoric:

> We live in an intellectual climate in which the reality of quarks or gravitational lenses is arguably a matter of persuasion; such a climate is a natural environment for the revival of a rhetoric that has as its field of analysis the claims to knowledge that science makes. (363)

In a time where scientific invention is vastly complex and abstract, effective communication becomes ever more important. In order for the public to accept, understand and agree with an intricate theory presented by a scientist, the initial evidence has to be interpreted and then transformed into something meaningful. "'The brute facts' themselves mean nothing; only statements have meaning, and of the truth of statements we must be persuaded" (363). The relevance of newly found scientific data or "discovery" is wholly dependent on its meaning as an idea or theory. Numbers, charts and data plots *alone* do not enable the free outward flow of scientific information. Only the interpretation and credible presentation of these elements encourages a reader to accept them as truth. Acceptance is the first step in making scientific innovation useful. Thus, if an invention or discovery is not presented clearly, then it has no chance at serving a purpose in the future. Scientists must take on the responsibility of being the first interpreters and announcers of their discoveries. Through academic papers, scientists shine the first light on their ideas and attempt to elucidate them for their peers.

An interesting example of a topic on which scientists have written influential papers is the study of volcanically activated glacial floods. These extremely complex natural events require a great deal of observation, analysis and interpretation through mathematical modeling. Since seismic, glacial, and flood activity occur on such a massive scale, the amount of data that these systems generate is far beyond the comprehension of a typical layman. A paper in the journal *Reviews of Geophysics* by Matthew Roberts assesses data from observed floods in Iceland called Jokulhlaups, and stresses the importance of developing models in order to better predict such events. Experts such as Roberts base their life work on the careful collection of data that has the potential to impact the scientific, and later the civil communities. In his paper *Jokulhlaups: A Reassessment of Floodwater Flow Through Glaciers*, Roberts introduces the problem that "in glaciated catchments, glacier-generated floods put human activity at risk with large, sporadic jokulhlaups accounting for most flood-related fatalities and damage to infrastructure" (1). His goal is to reassess how floodwater flows through glaciers and to represent the complexity of these events in "mathematical form" (1). Roberts concludes that "such an approach would lead to more accurate, predictive models of jokulhlaup timing and intensity" (1). By publishing advanced papers based on physical data, authors at this end of the scientific spectrum present their research to their peers and aim to convince them of its validity. These writers must give an objective and logical presentation of their ideas and must structure their arguments and evidence carefully. Without this structure, their evaluation of sheer data—hypothesis, conjecture and theory development—is lost in the midst of huge amounts of meaningless noise. In his article, Gross comments on the necessity of a logical structure in scientific papers. He asserts that in order for the author to effectively relay important information to his or her peers, the paper must have a "persuasive purpose" and be formatted in a way makes this purpose clear:

> A scientific report is forensic because it reconstructs past science in a way most likely to support its claims; it is deliberative because it intends to direct future research; it is epideictic because it is a celebration of appropriate methods. (Gross 368)

A scientist aims to incorporate these three elements into his or her paper. Because developmental science rests on the foundation of old discoveries and already accepted beliefs, an author must base his arguments and even his own research on previously completed work. Scientists frequently paraphrase and cite the research of their peers throughout their papers and dedicate sections such as "Background and Research Perspective" to previous findings (Roberts et al. 1). Papers such as Roberts' also include "Future Research Priorities" and proposed directions for continued work (17). A suggested course of action that might enhance completed work is generally provided within the text. Most central in scientific papers however, is the correct use of tools such as mathematics to analyze rough data. Geophysicists, for example, can construct complex sets of differential equations that "describe the rudimentary physics of a conventional jokulhlaup. In its simplest form the revised model explains exponentially rising discharge from a subglacial ice-dammed lake by melt widening of a single, preexisting conduit" (Roberts et al. 3). Scientists employ accepted methods of interpreting data such as modeling in order to make an objective initial conclusion about their findings. If sufficiently accurate, this nonverbal form of rhetoric is the least obvious and can be the most convincing.

Scientists subject the validity of their claims to the ability of experimental data to fit a formulated mathematical model. They suggest the implications of their findings and base their theories on the way that conventional analytical methods explain natural phenomena. Gross again explains that although these interpretive methods seem purely scientific and not at all subjective, they are actually forms of rhetoric. Although "science is an activity largely devoted to the fit between theories and their brute facts…in no scientific case do uninterpreted brute facts—stellar positions, test-tube resides—confirm or disconfirm theories" (368). Figures, observations and other data do not independently demonstrate their significance. The scientist must do this through his own description of the data:

> The brute facts of science are stellar position or test-tube residues *under a certain description;* and it is these descriptions that constitute meaning in the sciences. That there are brute facts unequivocally supportive of a particular theory, that at some point decisive contact is made between a theory and the naked reality whose working it accurately depicts, is a rhetorical, not a scientific convention. (Gross 369)

Scientific analysis and tools such as Roberts' mathematical models are "sources for the arguments" (369). They do not stand alone; they are simply the first step in the transformation of observed fact to interpreted conclusion by the scientist. Statistical data that is drawn out and organized in a model helps scientists develop their hypotheses. In his paper, Roberts describes how “field measurements of floodwater temperature at glacier termini *confirm* that during all types of jokulhlaups, floodwater temperature remains at the pressure-determined melting point of artesian discharge. *Therefore* sheet-like flow across large portions of glacier bed *is required to explain* linearly rising jokulhlaups” (7). Scientists employ this method of analysis and interpretation in their texts. Because they are the first to formulate inferences and conclusions, those such as Roberts enjoy the privilege of being the initial shapers of scientific information. Although the modulation of pure fact in these texts is incredibly subtle and objective, it clearly illuminates the author’s conclusions. When the portrayal of a certain theory is effective, the theory’s validity is more generally received. After the scientific community accepts such an idea and broadcasts it as a significant “discovery”, the likelihood that the media will continue its transmission to the public increases.

In the mass media, writers often take scientists’ conclusions and show how their implications might affect the public directly. At this point in the transmission of scientific information, the validity of a scientist’s claim has already been established by his or her community of peers. The logical description and presentation of sheer data is suddenly not as important as it was in the scientist’s initial claim. Because a journalist’s general audience is usually less informed of science’s procedural intricacies and is usually more concerned with the potential effect of new technology on daily life, he or she must present the scientific information accordingly. For example, in her *New York Times* article Amanda Haag begins by stressing the impact that glacial flooding in Iceland has on its inhabitants. Although she cites and quotes Matthew Roberts several times within the text, Haag does not address his mathematically complex analysis of glacial flooding. Instead, she focuses her writing on devastation that jokulhlaups themselves cause:

> Parts of he southern coast were formed some 9,000 years ago, when meltwater spilled out from under Iceland's cloak of glacial ice and galloped forward in violent surges called jokulhlaups, or glacial outburst floods…The occur with almost predictable regularity today, and they may pose great risks to life and property in Iceland. (1)

Haag introduces jokulhlaups not as subjects of scientific study, but as dangers to Iceland's population. She carefully presents a threat in her article and plays off the reader's emotional response to the natural disasters that have been so common within the media lately. Haag uses dramatic phrases such as "gritty as burned toast" and "pockmarked by glacial craters" to describe the landscape of Iceland's flood plains (1). Her initial goal within the article is to employ *pathos* and make her readers feel concerned about the situation that she so meticulously describes.

Haag then forms a substantial tone shift within the article in order to persuade her audience that there exists a solution to the problems that Iceland faces. She presents the potential that technology holds as a means to "head off catastrophe" by predicting floods. In addressing the comments of experts in the field of glaciology such as Matthew Roberts, and through a detailed description of newly developed technology, Haag makes her purpose clear. She argues that science offers the resolution to the dangerous problem of glacial flooding.

> Geologists and civil engineers here have developed an extensive, exquisitely sensitive monitoring system intended to provide early warnings of floods. It has issued 16 accurate forecasts since 2001…[and] consists of a network of instruments strung along the countryside like Christmas lights. (1)

At this point in her article, Haag aims to ease her readers with the comforting idea that science and technology can save lives. She gives the reader confidence in the "exquisitely sensitive" instruments that are designed to predict glacial floods. This conclusion is Haag's reinterpretation of the scientific information that she received from sources like Roberts. She appeals to her specific audience by focusing her article on the elements that impact it the most such as disaster prevention and personal safety. Rhetoric is essential in this process. Haag and other journalists must be both informative and attractive as writers for the public. In order to convince their readers of a certain position, they balance a credible presentation of fact with an appropriate amount of emotional appeal. Rhetorical strategies enable these writers to transmit scientific knowledge to the public, and at the same time, provoke an emotional response from the reader.

All authors of scientific writings use rhetorical strategies in order to share their knowledge and understanding with an audience. Their goal is to relay information from the lab to the public in the most effective way. In order to do this efficiently, writers of science pay close attention to the reader’s interests and structure the content of their articles in a way that is most appealing. As scientific information passes to larger audiences in larger communities, the scope of each text shifts to accommodate these interests. “The rhetoric of science” reconciles the disparaging gap between the scientific community and the public (Gross 375). It is the instrument that scientists and journalist use to make the complete conversion of “brute fact” into vital news. Just as the steady development and application of science depends on effective communication among researchers, the steady progression of scientific information depends on rhetorical interpretation and redistribution of that knowledge to the public. Therefore, an excellent use of rhetoric in texts that discuss science can lead to awareness, understanding, and perhaps acceptance of new technology.

Works Cited

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