THE RHETORICAL SITUATION OF THE SCIENTIFIC PAPER AND THE "APPEARANCE" OF OBJECTIVITY

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Mention the words *rhetoric* and *science* together, and many people see an intrinsic contradiction. After all, two hallmarks of modern science are objectivity and empirical method, whereas rhetoric bears the marks of a long and sometimes sordid history of sophistic oratory and biased argumentation. Gerald Holton describes this distinction: Rhetoric is often perceived as the art of persuasion, while science is generally seen as the art of demonstration (173). This idea implies, to use a figure of speech, that rhetoric and science should not be seen together in public. The distinction between the two, however, is probably more fabricated than genuine. Scholars, especially during the last several decades, have argued that scientific practice and discourse do have rhetorical and persuasive elements.

Published scientific papers bridge the gap between a scientist's work and the public's knowledge of that work. Research that goes unpublished, to use an image from Robert Day, is like a tree falling in a forest when no one is around—there is no "sound" without an audience (1). In order for this knowledge to be received and accepted by the intended audience, generally the scientific community, the research or experimental report must follow certain conventions, not the least of which are methodological validity and pertinence to the existing body of scientific knowledge. The authors of scientific papers must demonstrate the validity and objectivity of their findings and make them seem interesting and relevant to already-established conclusions. In effect, this is a rhetorical situation: a speaker (the author) communicates knowledge about a particular subject to an audience via the scientific paper, intending, on some level, to persuade that audience.

What is most interesting about the rhetorical situation of the scientific paper is that the writer persuades his or her audience largely through the *appearance* of objectivity. Many people, as Charles Bazerman points out, think that writing based on scientific premises is not really writing at all (14), that it is an unbiased vessel for transmitting truth. But in this essay, I analyze Renske Wassenberg, Jeffrey E. Max, Scott D. Lindgren, and Amy Schatz's article, "Sustained Attention in Children and Adolescents after Traumatic Brain Injury: Relation to Severity of Injury, Adaptive Functioning, ADHD and Social Background" (herein referred to as "Sustained Attention in Children and Adolescents"), recently published in *Brain Injury*, to illustrate that the writer of an experimental report in effect creates an exigence and then addresses it through rhetorical strategies that contribute to the appearance of objectivity.

Scientific Inquiry and Objectivity

It would seem that the objective nature of modern science precludes any possibility of rhetoric's entering into scientific writing. The assumption is that writing is interpretive and science is not. This notion results from an apparently sound connection: scientific writing is scientific; science is objective; therefore, scientific writing is objective. Objectivity certainly is one of the key goals and primary assumptions of scientific practice and writing. Nevertheless, it is inaccurate to think that the subjective human element can be completely eliminated through even the most objective scientific method. As Peter Medawar suggests, "There is no such thing as unprejudiced observation. Every act of observation we make is biased. What we see or otherwise sense is a function of what we have seen or sensed in the past" (230).

While the historic public face of science may exude objectivity, there is a pervasive, if less openly discussed, subjective side. Even if scientists were able to collect data in a purely objective way, Brent Slife and Richard Williams contend that "we cannot ignore the necessity of *interpreting* the data yielded by scientific method" (5, emphasis in original). Although computer programs may seem to be doing unbiased interpreting in some cases, human beings must ultimately give meaning to data, however raw they may or may not be. For example, an experiment that measured the brain waves of laboratory rats under certain conditions might yield a group of numbers, a data set. That data set would be virtually meaningless (i.e., it would not tell the researchers what they had found) until it was organized in some coherent way. But what kind of organization would be most coherent? A graph, a table, perhaps a qualitative description? Each organizational approach might produce different findings, but many approaches will be equally valid. The choice of methods and organization of data will ultimately depend on the point of view of the person doing the interpreting and the specific needs of the project. A computer might flawlessly organize data a particular way, but that computer was programmed by someone. The point is that ideas outside of the actual data set must be projected onto the data set before it means anything. As Slife and Williams explain, "in this sense, data can never be facts until they have been given an interpretation that is dependent on ideas that do not appear in the data themselves" (6).

This type of evidence leads to Bazerman's assertion that the "popular belief of this past century that scientific language is simply a transparent transmitter of natural facts is . . . of course wrong" (14). Medawar goes even further, declaring that the scientific paper gives "a totally misleading narrative of the processes of thought that go into the making of scientific discoveries" (233). One of his points is that there is a creative side to science, a side often sacrificed to an assumed objectivity. Creativity is more subjective than objective, and so alternative interpretations exist.

Experimental Papers and Persuasive Argument

Despite attempts to influence the reader, the type of rhetoric involved in scientific writing does not, as Kristine Hansen emphasizes, involve "bombast, flowery phrases, or appeals to emo-

tion, all aimed at deceiving" (xvi). Rather, contend John Schuster and Richard Yeo, "scientific argumentation is essentially persuasive argument and therefore is rightly termed *rhetorical* in the sense defined by students of 'the new rhetoric,' where 'rhetoric' denotes the entire field of discursive structures and strategies used to render arguments persuasive in given situations" (xii). As scientists write reports of original research, all the while conforming to certain accepted structures and styles, such as logic, clarity, and empiricism, they still give a rhetorical shape to their writing. Gerald Holton describes this process as a "proactive rhetoric of assertion"—when a scientist becomes convinced of something, he or she hopes to persuade others about that same idea or phenomenon when the work is published (176).

There are practical motivations beyond contributing to scientific knowledge for using scientific rhetoric to emphasize the importance of publishable research. Scientists, according to Day, are primarily measured by and known for their publications (ix). In the competitive world of academics and research, scientists need to publish to gain prestige and promotions. Poorly written, nonstandard, or unconvincing papers are naturally less likely to be chosen for publication.

The Rhetorical Situation and its Exigence

According to Lloyd Bitzer, rhetoric is always situational; it is a pragmatic response "to a situation of a certain kind," functioning "ultimately to produce action or change in the world" (3). The rhetorical situation, according to Bitzer, has several key features, but my primary concern is with exigence, which is central to understanding scientific rhetoric. An exigence, as defined by Bitzer, is "an imperfection marked by urgency; it is a defect, an obstacle, something waiting to be done, a thing which is other than it should be" (6). An exigence such as winter or death that cannot be altered through rhetoric or through any other means is not a rhetorical exigence (6). This understanding of exigence is further elucidated by Bitzer's definition of rhetoric:

> In short, rhetoric is a mode of altering reality, not by the direct application of energy to objects, but by the creation of discourse which changes reality through the mediation of thought and action. The rhetor alters reality by bringing into existence a discourse of such a character that the audience, in thought and action, is so engaged that it becomes mediator of change. In this sense rhetoric is always persuasive. (3)

This concept of rhetoric and exigence is exemplified in many of the speeches and writings of Martin Luther King, Jr. King believed that the racially inequitable social conditions around him could be altered through speech and subsequent action. King helped to change the reality of racial inequality through rhetoric, including his famous "I Have a Dream" speech. His discourse engaged, and continues to engage, his audience, often prompting people to action. King did not himself rewrite legislation or policies, but his rhetoric contributed to the actions of those who did.

In a scientific paper, the reality being altered is the accumulating knowledge of the scientific

community. The rhetorical exigence is, in Lawrence Prelli's words, the "gap in the collective body of knowledge" (23). Simply put, a scientist performs an experiment to better understand a law, principle, or phenomenon and then creates and publishes a scientific paper to communicate the results to the scientific community. In a sense, the scientist is "fixing" a problem—he or she has come to a better understanding of something than anyone else and is therefore able to fill in that "gap" in knowledge. As Prelli suggests, "[a] scientific orientation inclines one to define rhetorical situations in terms of the presence or absence of objectively verifiable information and the consonance of new evidence with already-accepted knowledge" (23).

Prelli seems to imply, justifiably, that scientific rhetoric is secondary to scientific knowledge and practice. If the new knowledge cannot be scientifically verified and reconciled with traditional knowledge, the rhetorical aspects of the paper alone, the strategies used to make the new knowledge seem like an answer, are useless. The scientist must first have identified a problem in order to propose the answer he or she has found. Experimental reports, Bazerman says, are special in this way because they describe "an event created so that it might be told" (59). Scientists formulate problems, according to their methodologies, in order to solve them—in essence, they create more than discover the rhetorical situation because they construct an exigence.

In "Sustained Attention in Children and Adolescents," the authors express their exigence when they state the study's primary objective: "To examine the relationship of child and family psychosocial variables and traumatic brain injury (TBI) severity as it relates to sustained attention" (751). The driving question is clear: What, if any, is the relationship between psychosocial variables and TBI? This question certainly is compelling and worthwhile, but was it discovered or created? The authors imply a creative process of arriving at their exigence:

> Attention problems are commonly reported after TBI in children. There is little known about the effects of TBI on specific attentional components: orienting to sensory stimuli, executive functions and maintaining the alert state. The focus of this study is on sustained attention (i.e. the capacity to maintain arousal and alertness over time). According to Dennis et al., sustained attention is a regulator of cognitive activities needed for academic tasks, adaptive functioning and social interactions. A deficiency in sustained attention may, therefore, have a significant impact on the child's development in the acute and chronic stages of TBI. (752)

As this paragraph from the introduction illustrates, the authors created an exigence by building upon previous research and their own insights and by constructing a logical hypothesis (eventually an entire study) to address that exigence. In essence, they arrived at their research question through inference. The exigence, however valid, was essentially created through a careful, thoughtful, and creative process. The authors' review of the literature did not inevitably lead to their hypothesis. They creatively took two factors (pre-TBI psychosocial variables and post-TBI

sustained attention) and postulated a relationship between them. Yet, the connection is scientifically valid: many of their ideas have been discussed or established in previous research, and they can test their new ideas empirically.

Rhetorical Strategies Used to Shape the Persuasive Paper

In effect, the authors of experimental papers address the exigence of the rhetorical situation through a carefully crafted rhetoric. The writing, as Bazerman says, "appears to hide itself" (14). This subtle approach is a specific rhetorical strategy: there seems to be no style—hence, no rhetoric—when in fact there is one. The writing style in most experimental reports intentionally deemphasizes creativity and human voice. The general choice is to use rhetoric that is persuasive through emphasizing logic and objectivity over creativity. Such rhetorical aspects of scientific writing tend to be subsumed or hidden by the larger goal of conveying meaning clearly and impartially.

For example, the passive voice, whereby the writer can easily omit the agent (the "doer" in the clause), is more prevalent in scientific writing than in most other genres. The editors of *Merriam Webster's Dictionary of English Usage* point out that while the active voice is generally preferable, "a few [usage] commentators find the passive useful in scientific writing (one even believes it to be necessary) because of the tone of detachment and impersonality that it helps establish" (721).

The authors of "Sustained Attention in Children and Adolescents" definitely agree with this remark about the importance of the passive voice. An analysis of the first 118 or so lines of the article (the introduction and part of the method section) attests to the author's careful choice of language: over one-third of the verb constructions are passives (about 26 of 70). For most nonscientific published writing, passive constructions tend to be around 10 to 15 percent, a ratio that the article noticeably surpasses (*Merriam Webster's* 720) The significance of this frequent use of passives is that actions and findings (i.e., non-human elements) are emphasized over human elements. The agent is noticeably missing in the following passive sentences from the article:

- The Paediatric Assessment of Cognitive Efficiency (PACE) was used in this study to test two types of deficits, inattention and impulsiveness. (752)
- Inattention and impulsiveness were not further elucidated because the two error measures, omission and commission errors, were not independently analyzed. (752)
- It was hypothesized that children with severe TBI will produce significantly more errors on the PACE than children with mild/moderate TBI. (753)
- No differences were found between the Mild/Moderate and Severe TBI group in regards to demographic characteristics. (754)

For each of these actions, there must have been an agent, someone using the assessment, choosing not to further elucidate certain factors, hypothesizing, and failing to find differences. The

authors' use of the passive voice to emphasize the action and deemphasize the agent (the authors omit the agent in nearly every passive construction in the first 118 lines) certainly does create a "tone of detachment and impersonality," even one of objectivity.[1]

The standard organization of scientific papers is another way to emphasize the factual and objective over the interpretive and subjective. The organization helps portray the paper's information logically and persuasively. The modern research paper, as Day explains, has the basic universal form of IMRAD–Introduction, Methods, Results, and Discussion–because this form is "so eminently logical" (11). Holton dubs this rationale the "well-tested machinery of logic and analysis, the direct evidence of the phenomena" (174). Plainly stated, the scientific paper is structured according to a scientific ideal: the method is set forth, and the results are reported, analyzed, and discussed. The organization by sequential sections is logical; the analysis is scientific because the discussion (the possibly non-scientific human element) is kept separate from the results. This type of organization, Medawar argues, implies an inductive process of unbiased observation leading to generalization (229). While the accuracy of this method may be questioned, it is logically convincing because, as Louis Pasteur purportedly told his students, it makes the results seem inevitable (Holton 174).

"Sustained Attention in Children and Adolescents" strictly adheres to the IMRAD method of organization. The report contains an introduction; a methods section, which is further broken down into six subsections; a results section; and a discussion. The authors could have chosen another method of organization, but doing so would probably have reduced the likelihood of their getting the article published, and had it been published in a novel format, frequent readers of research reports would likely have been put off to some degree. As it stands, readers of "Sustained Attention in Children and Adolescents" waste no time getting to the crux of the study—it's right there in the introduction and discussion—but all the technical evidence is still available. One interesting aspect of this particular study is that it is essentially part of a "soft" or social science. The variables in the study are all centered on human beings, studied according to various psychological tests. The patently scientific organization of the paper, however, seems to leave no question that this study was done according to "hard" science principles.

The same type of logical persuasion exemplified in the IMRAD organization is common in the introductions of many papers, a part of the report designed to emphasize the relevance and necessity of the particular findings to preexisting scientific evidence. John Swales found that scientists tend to use a very specific rhetorical strategy, what he termed the Create a Research Space (CARS) communication move schema (Golebiowski 1). After analyzing dozens of research paper introductions from various fields (e.g., physics, biology and medicine, and social sciences), Swales and subsequent researchers found that nearly every one of them contained three to six rhetorical organization "moves" aimed at making the paper seem important and relevant.

Swales' CARS model consists of three principle communicative moves: Move 1–establish centrality within the research; Move 2–establish a niche within the research;

and Move 3–occupy the niche with the present research (Golebiowski 1-2). These moves help the author clearly state the exigence (the lack of knowledge) and the proposed solution (the present research). Scientists can use the introduction of the scientific paper to relate their research to others and to show how important the present findings are to the corpus of scientific knowledge. Findings that are relevant and timely should indeed be welcomed and accepted by the larger community, and so carefully introducing one's topic makes all the more sense.

These principal CARS communicative moves are central to the introduction of "Sustained Attention in Children and Adolescents." The authors establish centrality within their research area, Move 1, by briefly discussing traumatic brain injury (TBI) in children and adolescents and by stating that "childhood TBI [is] a significant public health problem" because it "is the leading cause of child deaths in the US and one of the most frequent causes of interruption to normal child development" (751). The authors also discuss previous research, eventually building up to their own research, and thereby establish their study's relevance through the implication that they share the same central assumptions and information base.

The authors establish a niche within the research, Move 2, primarily by indicating a gap in the research and by claiming that they will build upon the research of a previous study. After reviewing the general topic of TBI, the authors claim, "There is little known about the effects of TBI on specific attentional components: orienting to sensory stimuli, executive functions and maintaining the alert state" (752). They immediately move to occupy this niche, Move 3, by stating, "The focus of this study is on sustained attention (i.e. the capacity to maintain arousal and alertness over time)" (752). After identifying sustained attention as their primary area of interest, the authors continue moving from general to specific and from Move 2 to Move 3. They review the literature dealing with sustained attention and then, in the last paragraph of the introduction, identify one study in particular from which they will proceed: "The present study aims to extend the findings of Taylor et al. in several ways" (753). The authors' intention seems clear: find something new without radically departing from what other researchers have already established.

Conclusion

Indubitably, scientific reports further our understanding of the world and the phenomenon around us. James Watson and Francis Crick's famous paper that established the double helix structure of DNA, for example, radically altered biological studies (and in many ways, society at large). In "Sustained Attention in Children and Adolescents," the researchers found that people treating children with traumatic brain injury need to "consider pre-injury child and family psychosocial characteristics in addition to severity of injury" (751). While not as revolutionary as Watson and Crick's paper, the authors point out that their study helps fill a dearth of medical knowledge. Their findings are probably very important to those affected by TBI and those treating them.

It is important, however, to recognize that just as all scientific data are interpreted, this experimental report, like all written accounts, is an interpretation, subject to creativity, convention, form, and style. For example, the very tests used in the research and the results of those tests may not really show what the authors understood them to show. The authors inferred a connection between the tests and the test results and their eventual interpretations. The tests themselves are fundamentally based on theories, as are all scientific methods, but are essentially treated by the authors as being objective (at least if they are administered under ideal circumstances). A "soft" science experiment, this study is reported in "hard" science fashion.

Writing experimental reports is an especially provocative practice because through these studies today's hypotheses and theories become tomorrow's scientific facts and laws. In Sundar Sarukkai's words, "The writing of science is not only a representation of the ideas of science; it is also integral to the creation of new meaning and truth claims" (1). In one sense, the "creation of new meaning and truth claims" implies a rhetorical situation, where the writing is meant to persuade. Certainly, scientists and researchers should be aware of embedded rhetorical strategies. But given the profound and pervasive influence of science in Western culture, we should all—scientist or not—be attentive to how our knowledge is shaped.

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Notes

[1] By way of comparison, James Watson and Francis Crick's famous article in *Nature* proposing the structure of DNA contains about 24 percent passive constructions, markedly fewer than "Sustained Attention in Children and Adolescents'" approximate 37 percent. Subtract the passive constructions in Watson and Crick's article that include the agent and the number drops to around 17 percent. The comparison between the two articles is useful because it shows that using the passive voice is a choice–a strategy to create a certain ethos, in this case, one of objectivity.

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