INTRODUCTION

The Problem of Metaphor in Scientific and Technical Communication

A presentation at a recent meeting of the American Association for the Advancement of Science attempted to account for the factors affecting public perception of science, drawing no more tangible conclusions than that people are more likely to support scientific research if they know more about it. Even such a conclusion, however, cannot be directly credited to better science education (Pearson, 2005). The debate over cloning is an excellent example. After several years of debate, a United Nations legal committee has recommended that member nations ban all forms of human cloning, which includes research on cloning that could someday generate organs for those who need them to continue living. Some have suggested that scientists exploring cloning are playing God. If cloning is hampered and lives are lost as a result, then who, indeed, is playing God, those who clone, or those who prevent cloning? An examination of cloning reveals that no central metaphor has emerged that communicates cloning to the public. This book broadly recommends metaphors and analogies as an epistemological strategy that can be generative for the scientist, the engineer, and the lay audience, and specifically for metaphor and analogy to be taught in the scientific and technical communication classroom.

Metaphor and analogy have long aided and directed scientific thinking. In the seventeenth century Rene Descartes theorized that light was contained in a medium, which led to the theory of light as a wave. Newton's experiments with the prism later suggested that light was a particle, because the prism broke light into bands of color. Today, theory of light plays a role in developing technology, from eyeglasses to CRT screens to fiber optic cables. Metaphorically, industry thinks of light as a wave and as a particle, depending upon the application. In a fiber optic cable, industry thinks of light as a wave. For images to appear on computer screens, industry must think of light as a particle. So for an image to appear on the computer screen via the Internet, a wave of data encased in light must travel down the fiber optic cable to the computer, where the signal is translated into particles that appear on the screen. In either case, it was necessary for light's wave-like properties or its particle-like properties to be recognized in order for theory to be shaped into usable products. Theories of light from the seventeenth century until now have proceeded and advanced by means of metaphor, evidence that metaphor has long been important to scientific writing, which this book reads, and defends, as a type of technical communication.

Does the shift between metaphors of light mean that there is a type of negative tension occurring here? To the contrary, such tension is not at all negative. Rather, it is a sign of health and can be read as science's growing pains. The title of Thomas Kuhn's *The Essential Tension* (1977) suggests instead that such stress is necessary, especially for a paradigm shift to occur. A good example of yet another paradigm shift for theories of light happened in the early nineteenth century when Thomas Young performed the double slit experiment. Young allowed a beam of light to pass through a hole in a screen. On a surface where the light struck, he made two holes, and on a surface behind that, he expected to see points of light where it had passed through the two holes. Instead, he saw bands of light, which contradicted what he expected, at least according to Newton's theory. Hence, Young reverted to Descartes' wave metaphor. Einstein's theory of relativity allows for the comprehension of light's wave-like and particle-like properties.

The passing and shifting of metaphors over centuries and from one scientist to the other further calls to mind Kuhn's influential work in science studies. He has argued that science is a social construction and he has also carefully delineated the idea of paradigm shifts in science. Scientific metaphors are certainly further evidence of the social nature of science. As my study will indicate, it is difficult, if not impossible, to identify the coiner of the Solar System Analogy since, as I shall argue, it can be traced back to the ancient Greek atomists. As other theorists have noted, the value of studying metaphor in a scientific context is that metaphor is communal as it is passed from scientist to scientist, or from group of scientists to group of scientists, as the case study of the Solar System Analogy (SSA) evidences.

These examples demonstrate the value of metaphor to scientific thought, but what are the implications for technical communication, specifically in Information Technology (IT) and engineering? As a field, IT is rife with metaphors. E-mail and its accompanying desktop icons are obvious examples; and how is it that e-mail is sent, over the Internet, the Information Superhighway, or the World Wide Web? All of these are metaphors for tying down these abstract expressions of silicon and light.

Metaphor is important to engineering as well. A good example is John Smeaton's train of thought as he developed ideas for what became the Eddystone lighthouse. Prior to Smeaton's design of the Eddystone lighthouse, most lighthouses were built like Roman watchtowers, as wide at the bottom as at the top. Smeaton's journals reveal how he considered structuring the replacement lighthouse, the third one to stand on England's Eddystone reef. Two previous ones, the first built like a Roman watchtower and the second conical, had been swept away. Initially, Smeaton envisioned a lighthouse structured like a cradle, so that it would rock with storms. Then he considered structuring it like a ship so that the lighthouse could ride the waves. However, it occurred to him that a cradle can tip over and a ship can capsize, so he settled on an oak tree structure, wider at the bottom than at the top, but tapering more gradually than a cone. The cradle and the ship were analogies that suggested the next steps, and some might read them as having been dispensed with at that point, except for how they led to the metaphor that inspired Smeaton to build a lighthouse that then stood on the England's Eddystone Reef for over two hundred years. Smeaton's lighthouse finally had to be moved inland because the rock around it had eroded to a dangerous point. This lighthouse, which still stands today, is a testament to the concrete value of metaphor as part of the engineer's thinking process (Smeaton, 1953, pp. 90-100).

Of course, metaphor can be problematic in science when metaphor becomes myth, which can occur when a scientist has too much invested in a metaphor and resists a paradigm shift. Einstein never fully accepted quantum mechanics because the idea of probability contradicted the precision of classical physics, and as a result, he was regarded as somewhat anachronistic in his later years (Greene, 2003). Other nineteenth-century physicists discussed in this book such as J. J. Thomson, who is credited with discovering the electron, and Oliver Lodge, who did important early work in radio and whose work is presented as an example of nineteenth-century science writing, would not relinquish the aether, the substance thought to pervade outer space, much like a thin atmosphere. Just as the metaphors for light shifted between Descartes, Newton, and Young to the current understanding, Einstein, Thomson, and Lodge may not have been completely wrong with their adherence to classical physics. Today, string theory seeks to combine the atomic with the cosmological realms in a spirit of unity that hearkens to Scottish Natural Philosophy, which this study will also explore for its connection with metaphoric thought in science. Dark matter in outer space may also renew the aether metaphor.

With the importance of metaphor to science and engineering established, some definitions are in order. I begin with that distinction between scientific and technical communication and then move to metaphor and analogy.

DIFFERENTIATING BETWEEN SCIENTIFIC AND TECHNICAL COMMUNICATION

It is helpful to attempt to differentiate between scientific writing and technical communication since they are so often mentioned in the same breath. How might they be defined? W. E. Britton (1965) surveyed a number of other scholars who had attempted to define technical writing. Throughout his article "What is Technical Writing?" he uses the terms "technical writing" and "scientific writing" synonymously and often conjunctively referring to them as "technical and scientific writing" (p. 114), something that he does 12 times in this article. He notes that others such as Blickle and Passe (1963) have defined technical writing as "writing that deals with subject matter in science, engineering, and business" (Britton, 1965, p. 113). Another approach is from the linguistic perspective, in terms of syntax and vocabulary, which Robert Hayes (1961) has defined inductively to the extreme. According to Britton, A. J. Kirkman's approach differentiates between technical writing and creative writing by naming the writing belonging to the fine arts as "associative writing," while technical writing is "sequential writing" (p. 114). Britton himself defines technical writing by its transparency. As an analogy, he compares aesthetic writing to a symphony. However, "technical and scientific writing can be likened to a bugle call," which illustrates, according to Britton, the idea that technical writing should have one meaning and one meaning only. He concludes by recommending that those who teach writing to science students should encourage them to write about the work in their discipline because "such an assignment not only is a real exercise in composition but also taxes the imagination of the student in devising illuminating analogies for effective communication" (p. 116). Such advice has not been fully realized, unfortunately.

Britton's definition is an early one, published in 1965. In general, but especially on the topic of metaphor in technical communication, I do not agree with Britton's assertion that technical writing should be defined in terms of its transparency, especially when it is used for epistemological purposes. For a metaphor to be generative, and by generative, I am thinking of McMullan's (1976) idea of fertility, it must allow the scientist to develop the metaphor in conjunction with, or as, a model. It is interesting, though, that Britton recommends the writing of analogies, which supports the basic idea of my work. His support of analogy undermines his assertion of technical writing as transparent, because for a metaphor to be used as I have described, it must be used consciously, and the more consciously it is used, the better, since scientific theory is typically generated through careful thought and study. Smeaton's metaphors were far from transparent. Instead, his journals record him rejecting the ship and cradle metaphors before arriving at the oak tree metaphor that allowed him to build the best lighthouse. Granted, some metaphors, such as ones related to IT, are most valuable for their transparency, but such metaphors are used for communication and to allow a lay audience to use computers, not to generate scientific theory.

As technical communication textbooks evidence (and I examine them in the next chapter), some technical communication scholars argue against the use of metaphor in general because of how it can be misinterpreted. These scholars are clearly still supporting the idea of technical communication as a transparent medium, a concept that Britton's early definition does not contain.

Not all technical communication scholars would agree with Britton (1965) on the issue of transparency. For example, Carolyn Miller (1979) has questioned in general the extent that technical writing can be considered transparent. To describe the argument opposing hers, she poses the windowpane metaphor to illustrate how many scientists view writing as something that is most valuable when it is transparent. She posits that to accept technical writing as transparent is to accept the positivist tradition apparent since the Seventeenth-Century Enlightenment that pigeonholes technical communication as a discipline without a subject, an idea that harkens to Socrates' admonitions against the sophists apparent especially in Plato's *Gorgias* (1990). More recently, Miller has noted, this tradition's position may be described as reinforcing the idea that "if language is highly decorative or opaque, then we see what is really not there or we see it with difficulty" (p. 612). The idea of language that is "highly decorative" as problematic in terms of how it may stand between the reader and knowledge is an issue that this book addresses.

Though these aspects of technical communication are important, they still do not define technical or scientific writing. David Dobrin (1983) has offered a definition of technical writing as "writing that accommodates technology to the reader" (p. 242). He defines scientific writing as writing that makes truth claims that are responsive to the scientific discourse community, and he differentiates between scientific and technical writing in that technical writing can make truth claims relative only to a specific context. As an example, he poses, "'Nut A fits on bolt B,' does not refer to all the rest of the discourse. If the statement were found to be ineffective rather than invalid (but how would one invalidate it?), the rest of the discourse would still stand" (p. 231). For this reason, Dobrin contends that any connection between scientific and technical writing is weak. After differentiating between the two, he does not further pursue scientific writing, other than to note that, "In the scientific community, it would be considered an evasion of responsibility for a scientist to leave his or her writing to a scientific writer. (The only professional writing having to do with science . . . is science writing, a species of journalism)" (pp. 243-244). Given Dobrin's criticism of Britton and others who wrote technical writing definitions that make sweeping generalizations, it seems odd that he would ignore the many books and articles written by scientists and science writers each year that are intended for a general audience. However, his intent is to write a definition of technical writing, not scientific writing, so he does well to limit himself.

Both technical communication and scientific writing share a common goal to communicate to a specified audience. Though a technical communicator is more likely to write to appeal to a general audience, scientific writing can be aimed at a variety of audiences. It may have as its audience other scientists with highly specialized knowledge that allows vocabulary to create shortcuts that truly do communicate more effectively to an audience with a relevant background, but will be less meaningful, and often meaningless, to the general audience. The authors of these types of communications, which are most frequently journal articles, are usually scientists reporting on original research or raising questions through articles reviewing the work of their peers. However, science writing can also take the shape of articles designed to communicate with scientists in other fields but who do not have specialized knowledge. A molecular biologist may indeed be interested in a physicist's research, and of course, there are science journalists who specialize in communicating the discoveries of science to the general audience. The two case studies in this book deal with writing by scientists and science journalists. In terms of the work written by scientists, the articles studied here can be categorized as those written for other scientists with highly specialized knowledge in molecular biology and atomic physics; articles written for other scientists who lack the knowledge of these specialties; and articles written for the general public. Therefore, because of the breadth of the audience approached by these types of science writing, it is appropriate to discuss science writing in conjunction with technical communication. Because the articles in the case studies touch such a variety of audiences, they are appropriate to consider as manifestations of technical communication.

METAPHOR AND ANALOGY

This book uses the terms "metaphor" and "analogy" interchangeably. In some ways it would be more accurate to refer to the focus as "tropes and figures," as Fahnstock (1999) has carefully delineated. However, the term "metaphor" is so commonly played fast and loose in metaphor studies that this book refers to usages such as metonymy, synecdoche, personification, and many others, as metaphors, though each type of trope is discussed and defined within the appropriate context. The point is not to differentiate between how each plays out in an A:B versus an A:B::C:D structure, but to study how metaphor consciously and unconsciously affects science; this study argues that metaphor is epistemologically generative, but that science too often fancies that it has laid metaphor by the wayside like so much ornamentation. Unfortunately, a metaphor used unconsciously can misdirects science. In cloning research, for example, E. F. Keller (2000) has proposed that the metaphor "reprogram" may have misdirected research, especially when it is used as a verb with the cell's nucleus as its object rather than the genome, which is part of the chromatin, the material surrounding the nucleus and to which research has finally turned. Consciousness of metaphor usage can prevent such a problem. However, such a potential problem is not a mandate against metaphor. Just as a technical communicator would not write a set of chainsaw instructions without warnings, self-conscious use of metaphor can allow it to be a powerful tool.

SUMMARY OF CHAPTERS

This book presents the argument for teaching metaphor in the technical writing classroom because of the value that can be accorded to metaphor as an epistemologically generative tool. Scientists use metaphor quite freely, but largely unconsciously, as the case study of current cloning research indicates. As a result, they sometimes create problems for themselves when communicating with the public. More importantly, metaphor has epistemological significance, as the first case study of the role of the Solar System Analogy (SSA) demonstrates. In this case, the analogy drawn between the solar system and the structure of the atom was abandoned for reasons more cultural, I argue, than epistemological. If Niels Bohr (1913) and Ernest Rutherford (1911) had been more consciously aware of the role metaphor can play, then the SSA could have continued to play a role in the development of theories of atomic structure. Indeed, the SSA is still apparent in Bohr's metaphors after he largely dispensed with the analogy. The case studies in this book support teaching metaphor in the technical communication classroom because future scientists, engineers, and technical communicators could benefit from becoming aware of metaphor and learning how to use it consciously.

Chapter One introduces the topic by drawing on the historical and pedagogical. It examines technical communication textbooks to build a case for a disparity in what students may be currently taught about metaphor and its role in technical communication.

Chapter Two argues for teaching metaphor in the technical communication classroom. This chapter reviews the literature in technical communication from different technical communication theoretical perspectives.

The dialogue regarding metaphor in technical communication scholarship spans nearly 30 years. During that time, metaphor has been a humanities concern in technical communication, but for the technical communication classroom, it can be most closely related to the computer industry. Though J. S. Harris (1975, 1986, 1993) kept the discussion alive by publishing an article on metaphor in scientific and technical communication about every 10 years, his approach is largely inductive and touches only lightly on theory. An important point in this chapter is that the question of metaphor in scientific and technical communication persists. It could be reasonably questioned whether its discussion is only academic and a byproduct of scholarship with roots in the humanities, emanating particularly from those with degrees in English. However, the concept of metaphor is important to the computer industry in terms of saving time and money and communicating more clearly with customers, especially new ones, in addition to the way it contributes to scientific epistemology, the focus of this book's argument.

On the other hand, the range of instruction on metaphor provided by introductory technical communication texts varies widely. Why are there chapters on

"Definition" or "Description" but not on metaphor? Instruction in the use of metaphor would be valuable to students in life sciences, physical sciences, and computer science. My study creates reason to provide room for such a chapter.

Chapter Three reviews the literature on the changing conceptions of metaphor, which can be drawn from a number of disparate fields, including the philosophical, literary, and rhetorical. With those influences in mind, I begin with the substitutionists and proceed to interaction theory and then to metaphor as an epistemology. With such theory as background, I then explore the case studies in the next two chapters. The focus of this chapter, regardless of the field that the works it reviews are drawn from, is on the rhetorical, the most advantageous perspective because the roots of metaphor as a theoretical construction lie in rhetoric.

Because Aristotle (1991) was the first to place a theoretical emphasis on metaphor, the discussion must begin with him. Though later classical scholars misinterpreted his theory of metaphor as advocating a substitutionist perspective, his work was influential and is evidenced in the writings of contemporary scholars. When Aristotle's theory of metaphor is examined carefully, it is more relevant to contemporary concerns. Understanding its nuances points to its universality as a concern, one that has perplexed people for ages.

Aristotle philosophized metaphor, though he retained it as part of his rhetoric, but not of his science. When Newton sanctified probability as a way of creating scientific knowledge, rhetoric was elevated, along with metaphor. However, for about 2,000 years after Aristotle, metaphor was taught as ornament. Evidence of it is in the work of the anonymous author of the *Rhetorica ad Herennium* (1990), and further evidence of the substitutionist approach is in I. A. Richards' (1936) work, though he set examination of metaphor's interaction as a goal. Chaim Perelman and Lucie Olbrechts-Tyteca (1969) begin to examine the way metaphor works, but they acquiesce the final word to a language of science, and they fail to acknowledge mathematics as another metaphor. Conversely, Nietzsche (1989, 1990) recognizes all language as metaphoric, and his influence can certainly be noted in Richards (1936) and Weaver (1990) as well as Perelman and Olbrechts-Tyteca, who resist Nietzsche. Paul Ricoeur (1975) corrects our notion of metaphor as a noun (an object) rather than as the verb (an interaction) that Aristotle intended, which sets the stage for the interactionists.

Before the interactionists are addressed, the tensionists are considered as a bridge. Their approach is perhaps best realized in the work of M. C. Beardsley and D. Berggren. Beardsley (1962) names the metaphorical moment in his identification of the metaphor's "twist." Berggren (1962/1963) is interested in this moment as well, but he disparages Beardsley's call for case studies, despite his lack of direction for research. The tensionists' work is but a prelude to that of the more fully realized interactionists.

Max Black (1962) is credited, and rightly so, with bringing the interactionist approach to the study of metaphor. Kuhn (1970) further contributes to metaphor's veracity by including it as another facet of the social construction of science. Black's focus on the verb as fertile ground for metaphor and the sentence as an organic whole sets the stage for a contemporary discussion of metaphor's philosophical dimensions that are explored epistemologically.

For metaphor as an epistemological construction, Karl Popper (1972) asserts that when a science such as psychology cannot cast a hypothesis that can be later borne empirically, that science is a pseudoscience. Its continued existence and appeal, then, become rhetorical. However, Popper's claim of such a science as psychology is not meant to be a searing indictment of its efficacy. Such a rhetorical stance can be epistemological since Popper recognizes the pseudo-science's value and contribution to society. On the other hand, this type of science cannot participate in verification through falsification, and the danger is if a pseudoscience becomes a dogma, or what Mary Hesse (1970) and others would call a myth. Metaphor, however, is part of the comparative nature of human thought. So long as it does not become dogmatic, it can be valuable as an epistemological tool.

Arbib and Hesse's (1986) approach to the epistemology of metaphor represents an important aspect of the current state of metaphor studies. Their research into artificial intelligence focuses on the layering of metaphors whose interaction creates a scenario where background knowledge can interact with metaphors in a structure with epistemological potential.

In addition, Hesse (1970) has noted the value of the role of historical research as it relates to a philosophy of metaphor, as has McMullan (1968, 1976), who also has differentiated between the *U*-fertility (unknown-fertility) and *P*-fertility (proven-fertility) of metaphor. All of these voices enrich the study of metaphor as a rhetorical act with epistemological significance. With epistemology, metaphor reaches the climax of its development in terms of its importance to science and philosophy.

Inconsistencies found in these voices lead to the impetus for the examination of the case studies in the next two chapters. Two questions emerge. One concerns whether or not mathematics is metaphorical. As an invented language, it would be interesting to know if it contains metaphors. Richards, along with Perleman and Olbrechts-Tyteca, posit that mathematics is not metaphorical. Deciding upon this issue has bearing upon the next question, which concerns whether or not all language is metaphorical, for Richards (1936), Black (1962), and Perelman and Olbrechts-Tyteca (1969) have declared all language to be metaphorical, but each insists upon breaking the metaphor down into two parts: a metaphorical part and a literal part. If there needs to be a literal part for the metaphor to be a metaphor, then there is a literal use of language that is not metaphoric. These questions are important because if all language is metaphorical, then the case for teaching metaphor in the technical communication classroom is strengthened.

Chapter Four is a case study that focuses on the analogy drawn between the solar system and the structure of an atom. Such a study is appropriate because it begins with a metaphor emerging into an analogy and ends in mathematics, as Black (1962) would have it, so it allows an exploration of whether or not mathematics is metaphorical. The study is drawn from the writings of three pairs of mid-nineteenth to early twentieth-century physicists as they attempt to determine the structure of the atom. The roots of metaphor in the work of these physicists are examined in light of Scottish Natural Philosophy. This case study illustrates how the metaphor serves a descriptive, explanatory, and predictive function that guides scientific theory and practice as well as serving as a teaching tool to disseminate scientific ideas to the public.

This particular slice of the history of science is important because this metaphor as it specifically relates to the structure of the atom has a definite beginning in the work of W. Thomson (Lord Kelvin) (1910) and J. C. Maxwell (1986) as the metaphor begins to take shape as the "vortex atom." Then it is followed in the work of J. J. Thomson (1907), who first proved the existence of the electron, and Oliver Lodge (1924), a physicist better known for his early work with electricity and radio but who extended the solar system metaphor to a concept he referred to as "atomic astronomy." Next, I examine the work of Rutherford (1911), who theorized that an atom contains a nucleus and quite a bit of empty space. Rutherford passed his work along to the young Niels Bohr (1913), who finally dispensed with the SSA when he felt the model could no longer contain ideas such as the leap of electrons from one orbit to another.

Examining the development of the SSA in the work of Kelvin (1910), Maxwell (1986), J. J. Thomson (1904), Lodge (1902), Rutherford (1911), and Bohr (1913) allows observation of the development of this analogy. Though it is more frequently referred to as the "Bohr Atom" or as the "Rutherford-Bohr Atom," but less often as the "Thomson Atom," Thomson worked with the SSA more frequently and over a longer period of time than either Rutherford or Bohr. Lodge contributed to its explication since it may be discerned in his work earlier than it appears in Thomson's. The SSA's nascence was ferreted out in the writings of Kelvin and Maxwell, whose educational experiences prior to Cambridge were influenced by Scottish Natural Philosophy. The Cambridge wranglers valued metaphor and analogy as well.

With Rutherford and Bohr, a cultural schism becomes apparent. The fact that they more readily rejected the SSA is indicative of a scientific cultural perspective that did not weigh metaphor with the same value accorded it in the British Isles. Certainly New Zealand was a British possession during Rutherford's time there, but it was far removed geographically from the environs of Cambridge, as well as the influences of Scottish Natural Philosophy. Bohr's intellectual influences regarded analogy as an aspect of a suspect materialism, and his dispensation of the SSA was regarded by many (Heilbron, 1985; Kuhn, 1993) as heralding a new science that dealt with quantitative expression without recognizing the quantitative as yet another metaphor, much less the more traditional application of metaphor. As a result, metaphor was swept aside as an anachronism.

Chapter Five examines the use of metaphor in articles published shortly after the announcement of the cloning of the sheep Dolly. Focusing on metaphors associated with cloning allows a consideration of whether or not all language is metaphorical. In this case, there is no central metaphor such as, "light is a wave," associated with cloning. However, a good metaphor would be helpful for communicating with the world outside of science, which is important in terms of securing funding as well as furthering theoretical and popular understanding of the phenomenon. Instead of conjuring the vision of the mad scientist in the lab, a good metaphor could create a context for cloning that could place it more effectively and less controversially in the public eye. There are, however, a number of tropes making the transition from metaphor to dead metaphor, which indicates the metaphoric nature of language.

An examination of secondary-school textbooks reveals no metaphor for cloning, unlike the examination of these texts related to physics that yielded not only the SSA as the most frequently used metaphor to describe the structure of the atom, but the most nearly accurate one. As a result, it may be concluded from its absence that there is no coherent, central metaphor for cloning, at least not one in popular use. If there were one, then, like the SSA, it would be reasonable to expect it to appear in a textbook.

With the cloning case study, a variety of tropes and figures are witnessed as scientists and science writers seek to express cloning's ramifications. Though no central metaphor emerges, technical metaphors affiliated with the computer industry are observed, and I am able to demonstrate other emerging metaphors that are transmogrifying into dead metaphors, which indicates the metaphoric nature of language.

I continue the examination of cloning by studying articles heralding the cloning of Prometea, the first cloned horse. What is most remarkable here is that she was cloned from a skin cell of the mare in whose womb she was then nurtured. These articles are examined for metaphoric usage to determine what changes might have occurred for the metaphors describing cloning in the six years after the publication of the articles on Dolly. The relevance of these studies is illustrated through the way that cloning is currently playing out in the international arena, where motions have appeared before the United Nations to either ban human reproductive cloning or to ban cloning altogether. The latter choice would inhibit research that would explore how to clone a single organ to replace a failing one.

In Chapter Six, I consider the implications of the theoretical literature, the two case studies, and the technical communication literature. I draw conclusions for the implementation of metaphor into the technical communication classroom.

This book offers evidence for why metaphor should be taught in the technical communication classroom as a rhetorical strategy. It contends that avoiding metaphor is a disservice to students who are preparing to become scientists, engineers, or technical communicators. Such scholarly exposition casts metaphor in both a contemporary and historical context that can strengthen the case for teaching metaphor in the scientific and technical communication classroom.