THE CONSTRUCTION AND FUNCTIONS OF VALUE ARGUMENTS IN SCIENTIFIC LITERATURE OF THE SARS AND COVID-19 PANDEMICS

Delia Savin | Emory University

The scientific community is a unique rhetorical ecosystem in which scientists argue for the value of their work to the larger scientific community through writing. Michael Carter developed a classification system for value arguments and compared the rhetorical moves used in scientific writing across a sample of various fields and journals ("Value Arguments"; "The Construction of Value"). In this essay, value arguments in fifteen papers, each from scientific literature published during the SARS and COVID-19 pandemics, were rhetorically analyzed to investigate the effects of public health crises on scientists' communication strategies. Though both the pandemic literature and Carter's corpus rely mainly on implicit value arguments, the pandemic literature uses more value arguments that situate the research topic within the larger crisis and also includes reverse semi-explicit value arguments, a new category that was absent in Carter's corpus. This investigation suggests that the nature of the rhetorical situation profoundly impacts scientific value arguments. These insights have the potential to further an understanding of the ways scientific knowledge is constructed and improve the rhetorical education of novice and seasoned scientific writers alike.

INTRODUCTION

The scientific community is a unique rhetorical ecosystem that has long been a subject of rhetorical analysis. As rhetors, scientists are responsible for communicating the results of their investigations to an audience of other scientists hoping to learn from their discoveries. Sociologist Michael Overington summarizes the lifecycle of scientists as rhetors in several steps: first, young scientists are transformed into speakers in the rhetorical community through education; then, they conduct research and argue for the validity of their conclusions to a scientific audience; and finally, over extended periods of time, scientific audiences pass judgment on the worthiness of the research to become part of the accepted body of scientific knowledge (154). Acceptable scientific knowledge is typically published in academic journals and eventually cited by subsequent research and, in this way, serves as a foundation for future scientific inquiry.

In academia, there are high financial and professional pressures on scientists to produce meaningful results. Frequent publication is

one of the most important ways for scientists to win funding and build a reputation in the field, and publication history is one of the most important metrics used by the committees that determine the hiring and tenure of faculty (Rawat and Meena 87). Beyond the possibility of earning fame and fortune through publication, scientific discoveries must be shared with a wider audience so that other scientists can build on previous work; if critical information remains unpublished, the research it could inspire can never be performed. However, journals and editors have limited time and resources, so the successful publication of a paper demonstrates that a scientist's work is significant enough to be accepted by the larger community. Scientists must compete to persuade the larger scientific community of the value of their research to further their careers and contribute to the field as a whole.

In this process, scientific rhetors aiming to publish their work are writing for an audience of journal reviewers, a position in which fellow scientists give feedback on submitted papers and ultimately recommend whether they be published or rejected by the journal. In a case study tracing the publication process of two biology articles, rhetorician Greg Myers studied the feedback given by the authors' colleagues and reviewers and the ways that each author responded to their audience. While the authors attempted to argue through writing that they deserved credit for a new discovery, the reviewers were most concerned with situating the claim within the existing body of research, thereby fitting the importance of the claim to the journal's readers (Myers 597). Myers found that the revision process was a negotiation between the authors and the reviewers over the status that the scientific community at large should assign to the text's knowledge claim (627). In the end, the authors and reviewers needed to agree about the value of the arguments made in the paper drafts and their fit in the targeted journal and field in order to publish each of the papers.

Since only the papers that are deemed valuable are published, successful authors must make successful arguments for the value of their work through writing—that is, published research papers must contain a sufficiently persuasive argument for the value of their authors' research that the larger scientific community is convinced to accept the work into their body of knowledge. However, during public health crises, the stakes of their research can seem more urgent, and the usual pressures to communicate science both quickly and believably are intensified. When disease spreads over the course of days, lives depend on scientists' ability to present their research in a way that convinces an audience of fellow scientists to accept their conclusions.

To understand how scientists convince each other of the value of their work during public health emergencies, I examined published research papers from two recent public health crises. My case studies include the SARS epidemic, which spread around the world between November 2002 and July 2003 (Cherry 262), and the COVID-19 pandemic, which was first discovered in November 2019 and spread throughout the world until the press time of this article ("History of COVID-19"). While these diseases are caused by similar pathogens and originated in the same country, the two outbreaks occurred almost twenty years apart, which provides the opportunity to

compare scientists' rhetorical responses to crises over decades.

In this essay, I explore value arguments in the scientific literature on the SARS and COVID-19 pandemics and classify them according to a model developed by the rhetorician Michael Carter. In the sections that follow, I provide a detailed discussion of previous work concerning the rhetorical situation and the role of the audience in scientific rhetoric in order to contextualize Carter's value argument classification system. Then, I offer a case study of value arguments in a selection of papers published during the early stages of the SARS and COVID-19 outbreaks and compare the frequencies and patterns of value arguments in the pandemic literature to those of the papers presented in Carter's studies. I argue that, ultimately, scientific literature from both the SARS and COVID-19 pandemics relies mainly on implicit value arguments, which serve to frame the research as addressing the larger health crisis despite a temporal separation of decades between pandemics. These similarities reflect continuity in the scientific community's response to a crisis and demonstrate the influence of the larger situation in determining the most persuasive value arguments in scientific writing.

LITERATURE REVIEW: CENTERING THE AUDIENCE IN SCIENTIFIC RHETORIC

In 1968, rhetorical theorist Lloyd Bitzer defined exigence, the reason compelling a rhetor to speak on a specific topic, as "imperfection marked by urgency" (6). By this definition, rhetoric is used when there is a pressing need for a rhetor to communicate to an audience about a situation that one or both parties are experiencing. In his response to Bitzer's paper, Richard Vatz added, "To the audience, events become meaningful only through their linguistic depiction. … Therefore, meaning is not discovered in situations, but created by rhetors" (157). As such, rhetoric constructs exigence; in order to communicate ideas effectively to an audience, a rhetor must convince the audience of the necessity of discussing the topic in the first place.

Bitzer and Vatz were not the first rhetorical theorists to understand the importance of the audience in creating rhetoric. Aristotle defined rhetoric as "the ability, in each particular case, to see the available means of persuasion" (Borchers and Hundley 5). In ancient Greece, the sons of wealthy Athenian men were taught rhetoric in preparation to become voting citizens and lawmakers for the *polis*, a role in which they would be expected to make speeches persuading their fellow citizens to support proposed laws or resolutions. When learning how to develop arguments, one of the tools they learned was the framework of stasis theory, which uses defined categories to focus a discussion on a specific, agreed-upon issue. Rhetors were taught to start at the lowest of the four stases—*fact*—and work upwards through the stases of *definition*, *quality*, and *policy*. Alternatively, they could argue within one stasis, according to their perception of the issue or their audience.

In 1988, rhetorical theorists Jeanne Fahnestock and Marie Secor further explored the uses of a five-stasis model in scientific writing. They found that, in a framework composed of *fact, definition, cause, value*, and *action*, scientific writing lies mainly in the lower stases of

fact and definition, leaving the value of the arguments implicit. Fahnestock and Secor write, "Every topic or issue must have 'won' an argument over value before it can be addressed at all. Such a preliminary value argument may not be addressed explicitly in the text of an actual argument, but it is a necessary part of the fit of argument to audience" (433). As such, when scientific writing presents its conclusions from the lower stases, it does so because the audience has already been made to understand the importance of discussing the topic in the first place.

Rhetorician Michael Carter expanded on these ideas in his study of the ways scientists argue for the importance of their research in scholarly articles. He found that, in the introductions of scientific papers, Bitzer's "imperfection" is reconstructed as the research problem or niche, and "urgency" is constructed through scientific authors' arguments for the value of their research ("Value Arguments" 324). The introductions of scientific research papers typically include multiple value arguments that serve to persuade the audience of the importance of the author's research. Unlike the ancient Greek stasis model of starting in the lower stases and working upwards, Carter argued that scientific rhetors can more persuasively demonstrate the value of their work to an audience of fellow scientists by introducing a paper in the value stasis before reporting their findings in the lower stases of fact and definition.

In an earlier paper on the construction of value arguments in scientific writing, Carter reported that value arguments are typically composed of two parts: the claim and the reason ("Value Arguments" 307). The claim argues for the importance of the author's work, and the reason explains why the work is important. He identified three types of value arguments. In the first type, *explicit* value arguments, the claim is signaled by the word "important" or a synonym, and the reason is signaled by the word "because" or a synonym (Carter, "Value Arguments" 308). Explicit value arguments usually take the form of arguing that a topic is "important" to study "because" it could help develop new technology, save lives, save money, or lead to some other favorable outcome. A *semi-explicit* value argument uses an explicit value claim, signaled by the word "important" or a synonym, but pairs it with an implicit reason, causing the reader to make their own connection between the reason and the claim it supports (Carter, "Value Arguments" 309). An *implicit* value argument has both an implicit claim and an implicit reason and typically uses vivid or value-laden words to suggest the value of the author's work (Carter, "Value Arguments"310). For example, one implicit value argument from my corpus is from a 2005 paper investigating the connections between Kawasaki disease and SARS: "In the developed world, Kawasaki disease is the *most common cause* of *acquired* heart disease in *children*" (Esper et al. 499, emphasis added). Here, the use of value-laden words such as "acquired" and "children" implies the claim that Kawasaki disease is, therefore, important to study for the reason that understanding more about the disease could help address the problem of heart disease in children. It is understood by the audience that healing sick children is an admirable goal for scientific inquiry and that studying the conditions that cause children to become sick is a useful method for achieving this goal;

thus, this sentence is an implicit value argument and not simply a statement of fact.

Value arguments can, and usually do, appear multiple times in a text and work together to serve some purpose for the readers. Carter identified seven functions of these value arguments (see Table 1). The first function, typically appearing near the beginning of the introduction to a paper, is to establish a value context for the research (Carter, "Value Arguments" 313). The second and third functions both appear after another value argument and serve to either amplify or narrow the preceding statement (Carter, "Value Argument" 315-317). The fourth and fifth functions address the importance of a research gap (Carter, "Value Argument" 318-319). The sixth function is to demonstrate the value of the research project for some broader application, while the seventh function is to demonstrate the value of the research findings presented in the paper (Carter, "Value Argument" 320-321).

Table 1: Seven Functions of Value Arguments According to Carter's Model

Function	Purpose	Location	Features
1	To establish a value context for the research	First or second sentence of the introduction	Typically begins the paper by framing the context of the research
2	To amplify the value of the preceding value argument	After another value statement	Adds to the reasons supporting the claim that the research has value
3	To narrow the focus of the research	After another value statement	Moves from a more general to a more specific value argument
4	To intensify the importance of a research gap	Before the discussion of a research gap	Makes the missing information seem more important
5	To justify the importance of a research gap	After the discussion of a research gap	Makes the gap itself seem more important
6	To demonstrate the value of the research project	Before a preview of the research presented in the paper	Tends to use qualifiers like "can" and "may"
7	To demonstrate the value of the research findings	After a summary of the principal findings of the paper	Tends to be more definite; suggests that the authors believe the value of their findings is not self-evident

CASE STUDY: VALUE ARGUMENTS IN SARS AND COVID-19 PUBLICATIONS

In order to understand how scientists construct meaning through writing during times of public crisis, I analyzed the introductions of thirty research papers and classified their value arguments according to Carter's three types and seven functions. My samples included fifteen papers on SARS-related research published between 2002-2005 and fifteen papers on COVID-19-related research that were published between January 2020 and the present. With most papers using multiple value arguments, I identified 33 total value arguments in the SARS literature and 38 total value arguments in the COVID-19 literature, meaning that there were 15 percent more value arguments in the COVID-19 literature than in the SARS literature. Table 2 presents all totals of value argument types and functions.

Table 2: Types and Functions of Value Arguments in Scientific Literature of the SARS and COVID-19 Pandemics

Type and Function	**SARS Literature**	**COVID-19 Literature**
Explicit	*0*	*0*
Semiexplicit	*9 (1 reverse semiexplicit)*	*9 (2 reverse semiexplicit)*
Implicit	*24*	*29*
Function 1 (establish a value context)	12	15
Function 2 (amplify the preceding argument)	0	1
Function 3 (narrow the focus)	3	11
Function 4 (intensify the gap)	2	1
Function 5 (justify the gap)	3	2
Function 6 (value of the project)	11	5
Function 7 (value of the findings)	2	3
	Total: 33	Total: 38

TYPES OF VALUE ARGUMENTS IN SARS AND COVID-19 LITERATURE

Across all 30 papers, I identified zero explicit value arguments. I identified nine semi-explicit value arguments in the SARS literature and nine in the COVID-19 literature for 27 percent and 24 percent of the total value arguments, respectively. The rest of the value arguments in each category were implicit, with 24 implicit value arguments in the SARS literature and 29 in the COVID-19 literature. Carter's analysis found that about a third of all value arguments used were explicit or semi-explicit ("The Construction of Value" 323). Here, the proportion is lower: the pandemic literature contains no value arguments at all, and only 25 percent of all value arguments are semi-explicit. Some examples of value argument classifications are given in Table 3.

Table 3: Examples of Explicit, Semi-explicit, and Implicit Value Arguments

Type	**Example**
Explicit: Explicit value claim, explicit reason "[Topic of paper] ***is important because*** [reason]."	"Identifying source populations of foraging animals is important because individuals from different populations may mix on foraging grounds." (Carter, "Value Arguments" 308)
Semiexplicit: Explicit value claim, implicit reason "[Topic of paper] ***is important for*** [connection or application]."	"To deal with a possible recurrence of the severe acute respiratory syndrome (SARS), the determination of targets in SARS related coronavirus (SARS-CoV) is important and pressing for the development of anti-SARS drugs." (Wu and Yan 901)
Implicit: Implicit value claim, implicit reason "[Topic of paper] ... [***value-laden words, statistics, or vivid descriptions***]."	"[COVID-19] has spread rapidly and globally and has caused a disastrous effect, resulting in more than 435 million confirmed infections and 5.9 million deaths as of March 1, 2022." (Zhou et al.)

FUNCTIONS OF VALUE ARGUMENTS IN SARS LITERATURE

The 33 value arguments of the SARS literature tended to rely on some of the seven functions more than others. Twelve value arguments used the first function, in which a value argument typically located as the first or second sentence of the paper establishes a broader context from which the authors' research derives its value (see Table 2). Additionally, 11 value arguments used the sixth function, in which a value argu-

ment that is often located just before a summary of the research is used to demonstrate the value of the authors' research project for its potential applications or some other persuasive reason. There were no second-function value arguments, but the other four functions had two to three value arguments each; the most-used value argument functions, therefore, were those that emphasized the connection between the research and its potential applications.

The SARS literature also exhibited patterns in the placement of these value arguments. Nearly all papers contained a first-function value argument in either the first or second sentence. Additionally, there were seven instances of a paper using both a first-function value argument and a sixth-function value argument, in which the first-function value argument establishes a larger context for the research performed, and the sixth-function value argument connects the specific research project to some larger value. For example, one paper began with a first-function implicit value argument calling attention to the large scale of the original SARS outbreak: "An outbreak of *atypical* pneumonia in Guangdong Province, People's Republic of China, that has *continued* since November 2002, is reported to have *affected 792 people and caused 31 deaths*" (Peiris et al. 1319, emphasis added). After a short discussion of the virus' resistance to treatment in Hong Kong hospitals, the introduction of the paper concluded with the sixth-function implicit value argument: "Subsequently, SARS has *spread worldwide* to involve patients in North America, Europe, and other Asian countries" (Peiris et al. 1319, emphasis added). Immediately after the sixth-function value argument, the authors transition from arguing for the relevance of their research to the SARS epidemic to introducing their work identifying the causal agent of the disease. By framing the discussion of the treatment of the SARS virus through the lens of the disease's worldwide impact, the authors effectively argue for the importance of their work through its relevance to treating the virus.

Interestingly, the SARS literature also included one example of a value argument that Carter did not address in either of his works. He defined a semi-explicit value argument as using an explicit claim for the importance of the subject, using the word "important" or a synonym, with an implicit reason for its value (Carter, "Value Arguments" 309). Carter did not address the possibility of a value claim using an implicit claim with an explicit reason. Such value claims, which I will call *reverse semi-explicit*, do not label the subject of the sentence as "important," but they use explicit signaling in the reason. For example:

> *Since* identifying the possible route of infection has *major implications* for understanding the pathogenesis and future treatment options for SARS, we investigated the immunolocalization of ACE2 protein in various human organs. (Hamming et al. 631, emphasis added)

Here, the authors do not explicitly write their claim that identifying the possible route of infection of SARS is important; instead, they frame the importance of this goal through the reason that this work could have "major impli-

cations" for understanding the disease. These reverse semi-explicit value arguments place the focus of the value argument on the specific relevance of the topic to the larger crisis without needing to explicitly state that the exigence is important.

FUNCTIONS OF VALUE ARGUMENTS IN COVID-19 LITERATURE

The COVID-19 literature continued these patterns in value argument functions, with five papers using a combination of first- and sixth-function value arguments. The COVID-19 literature also relied heavily on first-function value arguments; interestingly, 39 percent of the COVID-19 literature value arguments were first-function, compared to 36 percent in the SARS literature. The literature also exhibited much fewer uses of the second, fourth, fifth, and seventh functions. However, the COVID-19 literature had 11 third-function value arguments in the COVID-19 literature, compared to only three in the SARS literature.

These third-function value arguments were most often combined with a first-function value argument, with the first-function value argument establishing the larger issue at hand and the third-function value argument narrowing the scope of the paper to a specific, relevant research area. The COVID-19 corpus included nine uses of a first-function and third-function value argument together. For example, one paper opens with the first-function implicit value argument, "China has been the *epicenter* of *emerging and re-emerging viral infections* that continue to *stir a global concern*" (Ji et al. 433, emphasis added). The use of charged language such as "epicenter" and "stir a global concern," as well as the repetition of "emerging and re-emerging viral infections," establishes the importance of studying the numerous viruses spreading from China to the rest of the world. However, this introductory value argument is followed by the third-function implicit value argument, "The *most recent crisis* was the outbreak of an *ongoing* viral pneumonia with *unknown etiology* in the city of Wuhan, China" (Ji et al. 433, emphasis added). The second value argument focuses on the importance of finding the origin of a specific virus. Despite the COVID-19 literature's greater reliance on third-function value arguments to narrow the scope of the argument, some of the papers combine this approach with a discussion of the research project's importance to the larger value context; the COVID-19 corpus includes three instances of a first-function value argument appearing with at least one each of third- and sixth-function value arguments.

The COVID-19 literature also included two examples of reverse semi-explicit value arguments. For example:

> Delta variants of concern (VOCs) of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) such as B.1.617.2, AY.3, and AY.4 are the focus of intense international concern *because they are causing widespread coronavirus disease 2019 (COVID-19)* in the United States, Southeast Asia, Europe, and elsewhere. (Christensen et al. 320, emphasis added)

The mention of "intense international concern" suggests the claim that it is important

to study Delta variants of COVID-19, but the reason—"because they are causing widespread coronavirus disease"—explicitly connects the wide geographic impacts of COVID-19 to the importance of learning more about Delta variants.

CONTINUITY AND CHANGE OF VALUE ARGUMENT USAGE DURING PUBLIC HEALTH CRISES

I analyzed the introductions of 30 research papers and classified their value arguments according to Carter's three types and seven functions. As such, analysis of these 71 value arguments as compared to Carter's corpus serves as a way to understand continuity and change in the ways scientists argue for the value of their research through writing during public health crises. Overall, both groups tend to frame the value of their research within a larger context, as seen by the dependence on the first-function value arguments. Carter found that a quarter of all value arguments in his corpus used the first function ("The Construction of Value" 326). However, here, 38 percent of all value arguments total used the first function, including 36 percent of the SARS value arguments and 39 percent of the COVID-19 value arguments. This approach suggests that scientists writing during the SARS and COVID-19 outbreaks felt it more necessary than usual to support the value of their research with appeals to the need for learning more about these diseases while they affected the entire global population. It is possible that they felt that crafting their arguments to fit a wide-ranging, acknowledged issue in society would help their papers be published and cited, and this strategy helped them take advantage of a political climate where science was at the forefront of society.

However, authors writing during SARS and COVID-19 approached the first function differently. In the SARS literature, first-function value arguments were frequently paired with sixth-function value arguments, which narrowed the focus of the introduction to the value of the research project as a way to address the larger global issue of the SARS epidemic. Though first-function value arguments in the COVID-19 literature were often paired with sixth-function value arguments, they were often paired with third-function value arguments. This approach narrows the focus of the introduction from the larger value argument about the pandemic to a more specific value argument about the importance of studying the authors' specific research topic. Though the differences are subtle, the SARS papers tended to focus more on the value of the research project, such as the research question and the methodology employed to address it, while the COVID-19 papers tended to focus more on the importance of studying specific elements of the disease as they relate to symptoms, mortality, transmission, and other aspects of the pandemic's effects on humans that can be studied.

It makes sense that the first function, which orients the paper in the broadest level of context, would be widely used in papers about public health crises. However, the shift from arguing for the importance of project-level

details of the presented research to framing the research as addressing smaller aspects of the disease itself could suggest that scientists writing in the COVID-19 era learned from the SARS disease response twenty years earlier. The SARS epidemic was one of the first disease outbreaks of modern times, and scientists developed new models and methodologies for studying viruses through the early work on SARS which is reflected in this corpus. Perhaps the SARS papers reflect a time when scientists were learning how to design research on an epidemic, and the scientists writing during COVID-19 were better prepared to ask and answer questions about the nature of the disease.

Additionally, first-function value arguments in the SARS literature were almost three times as likely to appear in the first sentence as in the second sentence, but first-function value arguments in the COVID-19 literature were twice as likely to appear in the second sentence. This difference suggests that during the SARS outbreak, scientists did not feel it necessary to introduce their papers with orienting information about coronaviruses, caseloads, hubs for infection, or other details about the disease and its spread; they considered an implicit opening reference to the importance of studying SARS to be sufficient information for their readers to understand. During the COVID-19 outbreak, however, scientists thought it was more important to open with a concise background on the nature of the pandemic. For example, here is a first-sentence, first-function value argument from the SARS literature:

> Severe acute respiratory syndrome (SARS) is a newly recognized infectious disease with *significant health and economic impacts worldwide*. (Houng et al. 33, emphasis added)

Contrast it with a second-sentence first-function value argument from the opening of a COVID-19 paper:

> Coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), primarily emerged at the end of December 2019. *It has spread rapidly and globally and has caused a disastrous effect, resulting in more than 435 million confirmed infections and 5.9 million deaths as of March 1, 2022*. (Zhou et al., emphasis added)

Perhaps the scientists writing during the early days of the COVID-19 pandemic understood their research in the context of the time period, knowing that they were contributing to early, basic information about the virus that would be expanded upon in the coming months or years and that the progression of the pandemic itself could develop quickly and unexpectedly. As such, they introduced their papers by summarizing the state of the pandemic before transitioning to their first value arguments. During the SARS epidemic, there was uncertainty about how long the epidemic would last, where the disease would spread, and how scientists could address basic questions about the virus; however, it is possible that scientists in the early days of the COVID-19 pandemic understood the unpredictability of the disease and chose to situate their research in time as precisely as possible.

Despite these differences in approaches to first-function value arguments, implicit value arguments are more common in this corpus than in Carter's, and reverse semi-explicit value arguments are also included. The higher concentration of implicit value arguments and lack of explicit value arguments suggest that, during these global disease outbreaks, scientists found it less necessary to explicitly connect the importance of their research to its applications for the larger crises as a whole. Instead, they only found it necessary to identify the importance of their research areas, assuming that other scientists would understand the importance of addressing the spread of disease. While reverse semi-explicit value arguments only explicitly state the applications of the research topic to the larger issue and leave the reader to conclude that it is important, they still serve to argue for the importance of the research in addressing a larger issue, which makes the function of the reverse semi-explicit value arguments a microcosm of the first-to-third and first-to-sixth function progressions that are commonly used across both the SARS and COVID-19 literature.

CONCLUSIONS AND IMPLICATIONS

Compared to Carter's corpus, both the SARS and COVID-19 corpora use more implicit and first-function value arguments. These trends, along with the lack of explicit value arguments, suggest that, during these global disease outbreaks, scientists found it less necessary to explicitly connect the importance of their research to its applications for the larger crises as a whole. Instead, they only found it necessary to identify the importance of their research areas, assuming that other scientists would understand the importance of addressing the spread of disease. While reverse semi-explicit value arguments only explicitly state the applications of the research topic to the larger issue and leave the reader to conclude that it is important, they still serve to argue for the importance of the research in addressing a larger issue, which makes the function of the reverse semi-explicit value arguments a microcosm of the SARS and COVID-19 literature's reliance on situating research within the context of the disease outbreak.

During these periods of global crisis, scientists tended to rely on common knowledge of these crises to support the value of their research and establish the importance of their findings through the lens of the larger issue. However, the SARS papers tended to argue more for the importance of the specific research project being presented, while the COVID-19 papers tended to situate the research in relation to specific elements of the disease. Additionally, the SARS papers often began with a first-function value argument, situating the research within the larger context of the disease, while the COVID-19 papers more often began with a short statement orienting the paper in time before proceeding to the first value argument. These statements of fact support the larger implicit value argument about the real-world effects of the pandemic and effectively present the paper as dealing with the most up-to-date information, making the research seem more important. It is possible that scientists writing during the COVID-19 pandemic learned from the SARS epidemic response and that they had a better understanding of both science's role in addressing the spread of disease

and of their position presenting basic research on a virus about which, at the time, not much was known. Perhaps the wider spread of the COVID-19 pandemic, coupled with non-scientific audiences' increased scientific literacy and access to technology in the 2020s, prompted scientists to orient their work within a larger crisis that would be more widely recognized among scientists and the public alike, as compared to the SARS pandemic, which affected mainly healthcare workers and ended after less than a year of global transmission. As the COVID-19 literature also had significantly more value arguments in total, it seems likely that the greater impact of the COVID-19 pandemic and prior experience of the SARS epidemic influenced the shift in scientific writing between the SARS and COVID-19 crises.

However, several other factors could have contributed to these patterns in value arguments. For one, some prestigious academic journals have writing guidelines for submissions or have more competitive standards for publication, which could cause authors to write more defensively or explicitly than they would have in lower-impact journals. An extension of this work would, therefore, be to examine value arguments as a product of their journals, funding sources, and the tenured status of the authors. It is also likely that the full impact of the COVID-19 pandemic on scientific literature cannot be fully understood while the crisis is ongoing and that this investigation should be revisited in a few years so that both case studies can be viewed under the critical eye of historical perspectives.

Regardless, this corpus does show unique trends in value arguments in scientific literature, in which papers written during a time of widespread disease on the topic of the disease itself tend to rely more on the audience's own understanding of the crisis than papers written at other times or on other topics. Though the literatures differ in the exact functions of value arguments used to argue for the importance of the work, their overall use of value arguments to situate research in niche areas as addressing the larger crisis is indicative of continuity over a period of decades in the scientific community's response to crisis. In total, this analysis of scientific literature from these two pandemics suggests that the nature of the exigence has a profound impact on creating persuasive value arguments in scientific writing. These conclusions are based on scientific writers' communication aimed toward an audience of fellow scientists and performed within an insular rhetorical community. Further research is required to explore the ways that scientific rhetors communicate with the larger public during times of crisis and to fully reveal the complex relationship between scientific rhetors, their exigence, and their audiences.

ACKNOWLEDGMENTS

The author wishes to thank Dr. Gwendolynne Reid for her invaluable advice and support throughout the research and publication process and Dr. Sarah Singer for her insightful edits.

WORK CITED

Bitzer, Lloyd F. "The Rhetorical Situation." *Philosophy & Rhetoric*, vol. 1, no. 1, 1968, pp. 1–14. https://www.jstor.org/stable/40236733.

Borchers, Timothy, and Heather Hundley. *Rhetorical Theory: An Introduction*. 2nd ed., Waveland Press, 2018.

Carter, Michael. "The Construction of Value in Science Research Articles: A Quantitative Study of Topoi Used in Introductions." *Written Communication*, vol. 38, no. 2, 2021, pp. 311–46. https://doi.org/10.1177/0741088320983364.

---. "Value Arguments in Science Research Articles: Making the Case for the Importance of Research." *Written Communication*, vol. 33, no. 3, 2016, pp. 302–27. https://doi.org/10.1177/0741088316653394.

Cherry, James D. "The Chronology of the 2002–2003 SARS Mini Pandemic." *Paediatric Respiratory Reviews*, vol. 5, no. 4, 2004, pp. 262–69. https://doi.org/10.1016/j.prrv.2004.07.009.

Fahnestock, Jeanne, and Marie Secor. "The Stases in Scientific and Literary Argument." *Written Communication*, vol. 5, no. 4, 1988, pp. 427–33.

"History of COVID-19: Outbreaks and Vaccine Timeline." *Mayo Clinic*, https://www.mayoclinic.org/coronavirus-covid-19/history-disease-outbreaks-vaccine-timeline/covid-19. Accessed 20 Apr. 2023.

Myers, Greg. "Texts as Knowledge Claims: The Social Construction of Two Biology Articles." *Social Studies of Science*, vol. 15, no. 4, 1985, pp. 593–630. https://doi.org/10.1177/030631285015004002.

Overington, Michael A. "The Scientific Community as Audience: Toward a Rhetorical Analysis of Science." *Philosophy & Rhetoric*, vol. 10, no. 3, 1977, pp. 143–64. https://www.jstor.org/stable/40237028.

Rawat, Seema, and Sanjay Meena. "Publish or Perish: Where Are We Heading?" *Journal of Research in Medical Sciences: The Official Journal of Isfahan University of Medical Sciences*, vol. 19, no. 2, 2014, pp. 87–89. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3999612/.

Vatz, Richard E. "The Myth of the Rhetorical Situation." *Philosophy & Rhetoric*, vol. 6, no. 3, 1973, pp. 154–61. http://www.jstor.org/stable/40236848

APPENDIX A: SARS LITERATURE

Chang, Mau-Sun, et al. "Antibody Detection of SARS-CoV Spike and Nucleocapsid Protein." *Biochemical and Biophysical Research Communications*, vol. 314, no. 4, 2004, pp. 931–36. https://doi.org/10.1016/j.bbrc.2003.12.195.

Ding, Yanqing, et al. "Organ Distribution of Severe Acute Respiratory Syndrome (SARS) Associated Coronavirus (SARS-CoV) in SARS Patients: Implications for Pathogenesis and Virus Transmission Pathways." *The Journal of Pathology*, vol. 203, no. 2, 2004, pp. 622–30. https://doi.org/10.1002/path.1560.

Drosten, Christian, et al. "Identification of a Novel Coronavirus in Patients with Severe Acute Respiratory Syndrome." *New England Journal of Medicine*, vol. 348, no. 20, 2003, pp. 1967–76. https://doi.org/10.1056/NEJMoa030747.

Esper, Frank, et al. "Association between a Novel Human Coronavirus and Kawasaki Disease." *The Journal of Infectious Diseases*, vol. 191, no. 4, 2005, pp. 499–502. https://doi.org/10.1086/428291.

Fouchier, Ron A. M., et al. "A Previously Undescribed Coronavirus Associated with Respiratory Disease in Humans." *Proceedings of the National Academy of Sciences*, vol. 101, no. 16, 2004, pp. 6212–16. https://doi.org/10.1073/pnas.0400762101.

Guan, Y., et al. "Isolation and Characterization of Viruses Related to the SARS Coronavirus from Animals in Southern China." *Science*, vol. 302, no. 5643, 2003, pp. 276–78. https://doi.org/10.1126/science.1087139.

Hamming, I., et al. "Tissue Distribution of ACE2 Protein, the Functional Receptor for SARS Coronavirus. A First Step in Understanding SARS Pathogenesis." *The Journal of Pathology*, vol. 203, no. 2, 2004, pp. 631–37. https://doi.org/10.1002/path.1570.

He, Runtao, et al. "Potent and Selective Inhibition of SARS Coronavirus Replication by Aurintricarboxylic Acid." *Biochemical and Biophysical Research Communications*, vol. 320, no. 4, 2004, pp. 1199–203. https://doi.org/10.1016/j.bbrc.2004.06.076.

Houng, Huo-Shu H., et al. "Development and Evaluation of an Efficient 3′ -Noncoding Region Based SARS Coronavirus (SARS-CoV) RT-PCR Assay for Detection of SARS-CoV Infections." *Journal of Virological Methods*, vol. 120, no. 1, 2004, pp. 33–40. https://doi.org/10.1016/j.jviromet.2004.04.008.

Li, Lanjuan, et al. "SARS-Coronavirus Replicates in Mononuclear Cells of Peripheral Blood (PBMCs) from SARS Patients." *Journal of Clinical Virology*, vol. 28, no. 3, 2003, pp. 239–44. https://doi.org/10.1016/S1386-6532(03)00195-1.

May, R. M., et al. "Viral Evolution and the Emergence of SARS Coronavirus." *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences*, vol. 359, no. 1447, 2004, pp. 1059–65. https://doi.org/10.1098/rstb.2004.1478.

Peiris, J. S. M., et al. "Coronavirus as a Possible Cause of Severe Acute Respiratory Syndrome." *The Lancet*, vol. 361, no. 9366, 2003, pp. 1319–25. https://doi.org/10.1016/S0140-6736(03)13077–2.

van der Hoek, Lia, et al. "Identification of a New Human Coronavirus." *Nature Medicine*, vol. 10, no. 4, 2004, pp. 368–73. https://doi.org/10.1038/nm1024.

Wu, Guang, and Shaomin Yan. "Potential Targets for Anti-SARS Drugs in the Structural Proteins from SARS Related Coronavirus." *Peptides*, vol. 25, no. 6, 2004, pp. 901–08. https://doi.org/10.1016/j.peptides.2004.03.002.

Yan, Huimin, et al. "SARS Coronavirus Induces Apoptosis in Vero E6 Cells." *Journal of Medical Virology*, vol. 73, no. 3, 2004, pp. 323–31. https://doi.org/10.1002/jmv.20094.

APPENDIX B: COVID-19 LITERATURE

Boehme, Karl W., et al. "Pediatric SARS-CoV-2 Seroprevalence in Arkansas Over the First Year of the COVID-19 Pandemic." *Journal of the Pediatric Infectious Diseases Society*, vol. 11, no. 6, 2022, pp. 248–56. https://doi.org/10.1093/jpids/piac010.

Chan, Jasper Fuk-Woo, et al. "Genomic Characterization of the 2019 Novel Human-Pathogenic Coronavirus Isolated from a Patient with Atypical Pneumonia after Visiting Wuhan." *Emerging Microbes & Infections*, vol. 9, no. 1, 2020, pp. 221–36. https://doi.org/10.1080/22221751.2020.1719902.

Christensen, Paul A., et al. "Delta Variants of SARS-CoV-2 Cause Significantly Increased Vaccine Breakthrough COVID-19 Cases in Houston, Texas." *The American Journal of Pathology*, vol. 192, no. 2, 2022, pp. 320–31. https://doi.org/10.1016/j.ajpath.2021.10.019.

Grein, Jonathan, et al. "Compassionate Use of Remdesivir for Patients with Severe Covid-19." *New England Journal of Medicine*, vol. 382, no. 24, 2020, pp. 2327–36. https://doi.org/10.1056/NEJMoa2007016.

Hart, William S., et al. "Generation Time of the Alpha and Delta SARS-CoV-2 Variants: An Epidemiological Analysis." *The Lancet Infectious Diseases*, vol. 22, no. 5, 2022, pp. 603–10. https://doi.org/10.1016/S1473-3099(22)00001-9.

Huynh, Angela, et al. "Characteristics of Anti-SARS-CoV-2 Antibodies in Recovered COVID-19 Subjects." *Viruses*, vol. 13, no. 4, 2021, p. 697. https://doi.org/10.3390/v13040697.

Ji, Wei, et al. "Cross-Species Transmission of the Newly Identified Coronavirus 2019-NCoV." *Journal of Medical Virology*, vol. 92, no. 4, 2020, pp. 433–40. https://doi.org/10.1002/jmv.25682.

Kang, Min, et al. "Transmission Dynamics and Epidemiological Characteristics of SARS-CoV-2 Delta Variant Infections in Guangdong, China, May to June 2021." *Eurosurveillance*, vol. 27, no. 10, 2022, p. 2100815. https://doi.org/10.2807/1560-7917.ES.2022.27.10.2100815.

Nguyen, Nhu Ngoc, et al. "SARS-CoV-2 Reinfection and COVID-19 Severity." *Emerging Microbes & Infections*, vol. 11, no. 1, 2022, pp. 894–901. https://doi.org/10.1080/22221751.2022.2052358.

Okonkwo, Nneoma E., et al. "COVID-19 and the US Response: Accelerating Health Inequities." *BMJ Evidence-Based Medicine*, vol. 26, no. 4, 2021, pp. 176–79. https://doi.org/10.1136/bmjebm-2020-111426.

Vidanović, Dejan, et al. "First Whole-Genome Analysis of the Novel Coronavirus (SARS-CoV-2) Obtained from COVID-19 Patients from Five Districts in Western Serbia." *Epidemiology & Infection*, vol. 149, ed 2021, p. e246. https://doi.org/10.1017/S095026882100220X.

Vilcek, S. "SARS-CoV-2: Zoonotic Origin of Pandemic Coronavirus." *Acta Virologica*, vol. 64, no. 3, 2020, pp. 281–87. https://doi.org/10.4149/av_2020_302.

Wang, Xiaohui, et al. "Accurate Diagnosis of COVID-19 by a Novel Immunogenic Secreted SARS-CoV-2 Orf8 Protein." *MBio*, vol. 11, no. 5, 2020, pp. e02431-20. https://doi.org/10.1128/mBio.02431-20.

Zhao, Kaochang, et al. "Diagnostic Value of Using a Combination of Nucleic Acid and Specific Antibody Tests for SARS-CoV-2 in Coronavirus Disease 2019." *Epidemiology & Infection*, vol. 149, ed 2021, p. e62. https://doi.org/10.1017/S0950268821000406.

Zhou, Zhou, et al. "Role of COVID-19 Vaccines in SARS-CoV-2 Variants." *Frontiers in Immunology*, vol. 13, 2022, https://doi.org/10.3389/fimmu.2022.898192.