Liminality

The Work of Resilience in Technical Communication

Edited by Miriam F. Williams
and Lisa Melonçon

Foundations and Innovations in Technical
and Professional Communication

LIMINALITY

THE WORK OF RESILIENCE IN TECHNICAL COMMUNICATION

Foundations and Innovations in Technical and Professional Communication

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Contents

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THE WORK OF RESILIENCE IN TECHNICAL COMMUNICATION

Introduction. Examples of Components of Technical and Professional Communication's Identity

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On January 29, 2025, The Society for Technical Communication (STC) ceased all activities when they filed for bankruptcy. This is a moment that needs to be archived, to be noted because it closes an important chapter for both the professional and academic fields of technical and professional communication (TPC). The STC has been the professional organization of practitioners and academics since 1953 (e.g., Malone 2011, 2013), but as they noted in their email to members, "financial liabilities coupled with falling membership numbers" led to the need to dissolve the organization. As a long-time member—dating back to the mid-1990's when I started my technical communication consulting firm—STC provided vital opportunities to gather in community as professionals interested in technical and professional communication and to share information related to the work of TPC.

In the early days of STC, there was a closer relationship between the professional organization and academics working in higher education. Since the earliest degree programs were created in the same era (ca. 1950s), there was a greater synergy between working practitioners and those academics creating programs. This synergy was in some ways based on the common approach to what technical communication was during those early days of the professional field. The earliest work on academic programs was even sponsored by STC because there was a commitment to connect academic preparation to work being done in the professional world. The first recording of programmatic data can be found in *Academic Programs in Technical Communication* (Pearsall & Sullivan, 1976), and it detailed curricula of 18 programs in TPC. Three subsequent editions of this text were published (Geonetta et al., 1993; Kelley et al., 1985; Pearsall et al., 1981) and the follow-up to these four texts was Michael L. Keene's (1997) collection on "academic programs that work." Using programmatic concerns as a lens to chart the relationship between the STC and higher education also points to when that relationship started to break down.

In the late 1990's and early 2000s, STC experienced its highest membership numbers because of the rise of the Internet and related technologies, and this also marked a period of time when the relationship between the professional

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organization and higher education began to wane. Part of this was not only the rise in membership at STC but the related growth in academic programs where faculty's interest and attention had to be focused on the task of program building and increasing research outputs that always correspond with the maturation of an academic field. (Refer to Connors, 1982; Kynell, 2000; Adams 1993 for more historical information.) The economic crisis ca. 2007–2008 seemed to enhance the disconnect between STC and academics teaching and researching TPC. Some efforts were made to bridge the academic and industry divide with STC pre-conferences held at the Council for Programs in Technical and Scientific Communication during the 2013–15 conferences. The latter of which even generated an edited collection aptly titled, *Academy-Industry relationships and partnerships: Perspectives for technical communicators* (Bridgeford & St.Amant, 2015). All of this is not to say that academics did not remain connected to STC. Some maintained their membership to ensure access to the journal *Technical Communication* or to access the annual salary survey. Others (like myself) continued to attend and to present at the conference and stay connected through committees and professional networks. But I can attest to the fact that, for sthe last everal years before closing, there were only a handful of academics—and the same ones—that attended the annual STC Summit.

Like any historical documentation, it's important for the future of TPC in higher education to have this history documented to look back to it when we consider ways to move forward as an academic field. Because without a doubt both the academic and professional fields are in a moment of liminality. The most common definition of liminality is one of change that has something existing between two distinct stages, identities, or conditions. While originally used in anthropology in connection with people, academics have expanded this definition to include other cultural or social changes. In TPC, Joseph Jeyaraj (2004) argued that technical writers themselves are "liminal subjects" (p. 15) because liminality is a "state of flux that emerges at a particular stage in temporal process of community" (p. 15). Jeyaraj goes a step further by also noting that rhetoric is a "liminal discipline" because it works alongside other discourses "so that new ideas and fresh knowledge of these discursive practices may emerge" (p. 17). What I appreciate about Jeyaraj's use of liminality is that it opens up new avenues to reconsider the field's identity and its relationships, such as with professional practice.

For too long, TPC has held a too limited view of what a practitioner of TPC actually is and does. The field has relied too heavily on its historical connection to engineering and computer science (e.g., Connors, 1982; Kynell, 1999; Malone, 2015). Both fields are connected to the rise of the Internet and the plethora of practitioners that work to keep the myriad of applications and websites working. Historically, Paul Anderson (1984) attempted to create a model that addressed the typical work done by technical and professional communications across organization types. His work was one of the first I found to directly consider what TPC meant by practitioner. In another example, Mark Haselkorn et al. (2003)

described the range of their current research projects and suggested that technical communication was expanding far beyond traditional areas of writing, editing and production. One can also see this expansion in the increase in research in user experience (e.g., Brumberger & Lauer, 2016; Hunter, 2024; Gonzales & Walwema, 2022; Rose & Turner, 2023) or content management (e.g., Andersen & Batova, 2015; Bridgeford, 2020; Getto et al., 2019). Both of these research trends expand the work of TPC by broadening its definition to include other components, yet keeping the field closely aligned to its historical roots.

One can also see the expanded work of technical and professional communication in some of the workplaces where research has occurred. For example, TPC has solidified work in non-profits (e.g., Hopton &Walton, 2018; Melonçon, 2023), government agencies (Williams & James, 2008; Williams, 2010, 2022) and more traditional technical organizations such as software and coding organizations (e.g., Friess, 2019; Rea, 2021), and health organizations (e.g., Gerdes, 2023; Renguette, 2016). In 2014, Emily January (2014; formerly Petersen) explicitly called on TPC to redefine workplace when she studied mom bloggers. I found resonances of January's call for using households as a site of research similar to other scholars, such as Hannah Bellwoar (2012) and Prashant Rajan (2021) and complementary synergies with Laura Allen's (2022) examination of Black family reunions. Other scholarship that moves boundaries beyond traditional workplaces are small businesses such as an auto repair shop (Cushman, 2015) or worker cooperatives (Edenfield, 2017). All of these expansions to what it means to do "workplace" research are necessary to keep TPC vital and researching areas where the work of TPC occurs. The scholars who expanded where research occurred contributed to expanding what we consider technical and professional communication. It is true that not everything is technical communication, but the field was overdue for recognizing that specialized writing and communication occurs in a large swath of locations beyond more traditional workplaces and organizations.

TPC also has notable examples that explicitly consider practitioners and what practitioners could mean. For example, Matthew B. Cox (2019) considered practitioners in his workplace case study at a national discount retailer's headquarters to directly address LGBTQ practitioners, while Stacey Pigg (2020) also focused on practitioners and their mobile work strategies and practices. Taking a complementary approach to examining workplaces and practitioners need to be noted, Yvonne Cleary (2021) took a global approach. In her book, Cleary discussed the future of technical communication in broad terms, and when read alongside the work mentioned here, an expanding picture of the work and those who perform the work of technical and professional communication begins to emerge. Relatedly, Jeremy Rosselot-Merritt (2020) found from his interviews with practitioners that there was confusion and a sense of outdated ideas of what practitioners do. Moreover, Eva Brumberger and Claire Lauer (2020) collected data on job types and responsibilities to "provide a picture of how typical roles in the technical communication field are likely to operate" (4). They ended creating six personas that encapsulated the everyday work of different types of practitioners. All of these examples complement and support my insistence of the necessity to expand what TPC means by practitioner.

Expanding what TPC considers to be a practitioner opens new avenues to recognize tacit and everyday knowledge from more diverse locations and peoples. For my purposes in this chapter, practitioner simply needs to be more expansive than it ever has been. Why? Because the majority of students graduating from TPC programs in the US are not working in industries related to hardware or software; most are not working in engineering; many are not landing user experience jobs; most do not need some of the specialized skills (like DITA or programming languages) that they may have needed 10 or even five years ago. Though, of course, they gain a specialized subject matter expertise in these or other technical disciplines! Students graduating from TPC programs are working in expansive positions called everything from technical writer to social media manager to grant writer to copy editor, and even broader titles such as communications manager, project manager, web developer, content writer, promotional writer, distance learning director, and/or medical writer. All these titles are ones that alumi of TPC programs hold.

Thinking of expanding practitioners considers the word's association with practice, and as an "exercise of tendencies to activate greater capacities" (Boyle, 2018, p. 5). If as Casey Boyle claims, practice creates greater capacities then reconsidering what a practitioner is and can be creates greater capacities for TPC's understanding of the work that it does. My aim of expanding practitioner runs complementary to Temptaous Mckoy and her collaborators (2022), who made similar claims about wanting to engage more stakeholders in public feminist projects. Binding together multiple views of practitioner knowledge from different and diverse "organizations" means that TPC has the potential to expand existing knowledge structures with those that are more inclusive. TPC can maintain its connection to practice by expanding what TPC means by "practitioner."

The need to expand what TPC means by practitioner works alongside with the need to reconsider what TPC is and does. Although a number of classic works exist (e.g., Allen, 1990; Dobrin 1983; Faber, 2022; Henning & Bemer, 2016; Miller, 1989), TPC has not recently engaged in sustained conversations about defining, or not, the field. Joanna Schreiber and I (2022) argued that TPC needed to move beyond definitions because definitions exacerbate existing tensions—like those between industry and the academy—without offering ways to address those same tensions. Instead of a definition of TPC, we proposed a shift to thinking about what components make up the field's identity because "thinking in terms of an identity gives TPC a way in which scholars with diverse and varying research and teaching interests can still feel as though they share a common goal" (Melonçon & Schreiber, 2022, p. 6). Identities then return to the idea of liminality and what it means to change an identity or in this case, to expand it. Further, "identities are thus contingent: they are dependent on particular elements that could change, thereby changing the composition of the identity" (Slack & Wise, 2015, p. 152). Schreiber and I (2022) used assemblage theory to bring together the different identities, the different component parts that make up the full range of TPC and to more specifically answer the question, "How can TPC understand its identity to account for the past, present, and future demands of always in flux communication work?" (p. 7). Through Manuel DeLanda (2016), who expanded the work of Gilles Deleuze and Felix Guattari (1987), we came to understand that the "whole depend[s] on the interactions between its parts [to] ensur[e] that these are not taken to be either necessary or transcendent" (DeLanda, 2016, p. 12). The ontological emergence recognized "how at any given moment different facets of identity may need to be emphasized over others" (Melonçon & Schreiber, 2022, p. 8). The need to highlight or emphasize facets of TPC's identity aligns with the notion that the field is a liminal one, particularly at this moment. For example, current trends of graduating students landing jobs in UX does not change the definition of the field, rather, it expands TPC to include UX as one of its components. The same is true for recent conversations about social justice and its role in TPC (e.g., Jones 2016; Jones et al., 2025; Walton & Agboka, 2021). Thinking in terms of components that make up identity means there is an expansiveness and inclusiveness to what TPC has been, what it is, and what it may become.

The in-betweenness, the liminal space that both the academic and professional field currently finds itself only points to the previous instantiations of where the field had to pivot, expand, shift and change. If one had to use a single word descriptor of technical and professional communication, it would have to be resilient. The field and its identity and what have comprised that identity has always been responsive to change in industries and practices. The resilience of the field is a testament to its ability to be flexible and adaptable, which has always been one of TPC's hallmarks. The chapters in this book illustrate a range of topics and approaches that are all essential component parts of TPC's identity that includes both professional practice and the academic field. The chapters all point to the resilience of the field as they take old concepts and new concepts and place them firmly within the auspices of the work of technical communication.

Overview of the Chapters

The volume opens with two chapters on the newest facet, or a new interpretation of one of the oldest facets, of the field's identity: technological literacy through the lens of artificial intelligence (AI). Alisa Bonsignore reviews the limited data available on the environmental impacts of AI technologies and the substantial carbon footprint. It offers TPC its first field-specific look at the costs of this energy- and emissions-intensive technology. She calls for TPC to consider these costs on a case-by-case basis when balancing the merits and drawbacks of incorporating AI in technical communication. Hers is a much-needed pragmatic view to assist TPC teachers and practitioners to think through AI.

In the collaborative chapter written by Amber Hedqust, Mark Hannah, and Heidi Willers, they take on the topic of using AI within the process and practice of research. They report on the experiences and responsibilities of an AI Facilitator: a member of a collaborative team responsible for integrating AI in research workflows. Outlining the responsibilities of an AI Facilitator demonstrates the substantive role that a technical communicator can play in managing and shaping human-AI interactions. While their study offers insights into how to integrate AI into research, Hedquist and her collaborators also affirm the centrality of managerial oversight in human-AI collaboration, while highlighting how TPC researchers can expand their facilitative roles to support such collaborations

We have a trio of chapters that take existing components of TPC's identity, and they provide an update, of sorts, to them. Tim Giles completed an integrative literature review to work toward an answer to the question, should readability formulas be included in TC research, or in the TC practitioner's toolkit? Using literature in TPC and in accounting, Giles works through the current debates of readability formulas.

Building on his previous research, Yoel Strimling considers a theory to practice approach to improve technical documentation. Using a pilot study looks at documentation quality (DQ) by applying the Kano Model of customer satisfaction to it. The aim is to develop a more reliable way to collect DQ feedback and metrics, as well as provide evidence-based resources for teaching students how to write quality documentation. Strimling concludes with a foundation for developing robust feedback mechanisms, metrics, and teaching resources to apply the Kano Model's well-established methodology to DQ.

Prioritizing content is an important part of developing a content strategy. As a research method for websites, card sorting has most frequently been used to categorize content and create an information architecture. In this chapter, using a user experience/user-centered design methodology, Nicholas Carrington investigates how useful card sorting would be for prioritizing topics as part of developing a content strategy. The results suggest that web writers, content strategists, and technical communicators who have identified appropriate topics can use card sorting to help them prioritize their content

The next two chapters both contribute in meaningful ways to TPC's long standing emphasis on visual communication from two different perspectives. Joanna Wolfe, Juliann Reineke, and Karen Stump focus their attention on how best to encourage presenters to adopt new slide design models. Using presentation slides created by students in a senior capstone Chemistry course over three iterations of presentation design workshop, the research team compared different approaches that encouraged students to revise their slides following effective practices.

Nicole St. Germaine examines the Norwegian use of wayfinding design and to explore ways in which technical communicators can learn from this style of design to create more effective visuals. St. Germaine examines 451 examples of Norwegian wayfinding and compared them with equivalent signs in the US for reference. Then, St. Germaine examined how the Norwegian signs matched up with the principles of effective wayfinding, and she recommends that American and Western technical communicators and graphic designers could utilize many of the techniques utilized by Norwegian wayfinding designers to make their signs more recognizable and readable.

The next two chapters take different linguistic approaches to gain insights into two common genres of TPC's identity. In both cases, the authors use student work from a TPC classroom to gain insights into effective practices in writing specific TPC genres. Looking at the linguistic features of popularized science texts, Jordan Batchelor and Jordan Smith compare the lexicogrammatical features of student-written scientific reports with science press releases (SPRs). They compared a corpus of SPRs with a corpus of student-written scientific reports, and the features identified as key for both corpora were grouped according to their functional themes. They present six recommendations for teachers, students, and practitioners who want to mimic the style of SPRs as a form of science popularization.

Using the final report assignment in a TPC service course, Mike Duncan, Ashleigh Petts, Jillian Hill, and Andy Hill study how paragraphs function in technical report genres and reflect student notions of persuasion. They used a corpus of 1937 paragraphs from 74 student-authored recommendation reports coded at the sentence level by position (heading, sentence, list item, table, and image) and structure (the rhetorical function of the sentence within the paragraph). Their findings point to recommendation for instructors and practitioners alike

Breman Vance and Erica Stone offer a text mining analysis of job ads that focus on examining the expectations and perceptions of work in the field of technical writing. They created a corpus of 4,597 unique advertisements using the search terms *Technical Writing* and *Technical Writer* during their study's time frame, and they analyzed the corpus using distant reading and text as data methodologies. Their findings point to several implications for professional development, higher education, and job seekers, and it highlights several opportunities for reflecting on and studying the practices, priorities, and opportunities in technical writing.

In a case of last, but definitely not least, the volume ends with Ed Malone's chapter that does magisterial archival work to illustrate the vital history of Black technical communicators from the 1940s through the 1960s who worked in U.S. government and industry during the profession's formative decades. Employing the antenarrative method of *microstoria*, the study emphasizes the individual stories of practitioners who have been largely invisible in the field's recorded history. The project offers the first attempt to compile a registry of mid-20th-century Black technical communicators, presenting reconstructed historical and biographical details that shed light on their professional lives and experiences

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One of the practical results of STC's closing was the simultaneous closing of the organization's journal, *Technical Communication*, which has long been
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considered one of the key journals in the field (e.g., Boettger & Lam, 2013; Carradini, 2022; Friess & Boettger, 2021; Melonçon & St.Amant, 2019). That meant work that had gone through peer review in the journal, but not yet published, did not have an immediate home. In a conversation with *Technical Communication*'s last editor-in-chief, Miriam F. Williams, I offered to move those pieces into this collection. The WAC Clearinghouse accepted the existing peer reviews, and we moved the project into the first stages of publication. I was delighted that authors agreed with this solution because the chapters in this collection highlight the breadth of what is technical and professional communication in our current moment.

The liminality of this moment reminded me of Williams' (2021) editorial, "*To Pen Bridges*" where she envisioned *Technical Communication* as a bridge between practitioners and academics—an outlook shaped by her own career trajectory as both a practitioner and a scholar. Before entering academia, Williams worked in policy implementation, managing large-scale plain language and regulatory writing projects, and she credited *Technical Communication* with helping her navigate that work. That dual perspective fueled her call for more lesson drawing and genuine collaborations that treat practitioners and academics as co-researchers rather than separate audiences. She also emphasized that the journal must advance social justice and inclusivity by widening participation and adopting equitable review practices. This collection carries forward Williams' vision, bringing together chapters authored by practitioners, academics, and practitioner–academic teams, and demonstrating that the future of technical and professional communication depends on embracing liminality itself—the productive spaces between traditional boundaries where new knowledge emerges. The chapters are examples of different components of TPC's identity, and they serve as instantiations of the diversity of topics, locations, and approaches to what technical and professional communication is a quarter way through the 21st century.

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1. Is AI the Right Tool for the Job? Understanding the Environmental Implications of This Emerging Technology

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Abstract: Artificial intelligence (AI) has seen unprecedented rates of adoption and dominates the discourse within our industry. Most of the conversation focuses on the extremes of how it will affect practitioners' careers: AI is the salvation of our profession, or AI will put us all out of work. However, there is notably less attention given to the planetary impact of this powerful, yet energy- and emissions-intensive technology. Research shows that AI has a substantial carbon footprint. The accelerating adoption of AI for mundane content tasks puts us at risk of generating even more emissions at a time when we urgently need to reduce our impacts.

This chapter explores the limited data available regarding emissions impacts of AI technologies and addresses other potential costs to society. These costs must be considered on a case-by-case basis when balancing the merits and drawbacks of incorporating AI in technical communication.

Keywords: AI, LLM, carbon footprint, sustainable content, ethics

Artificial intelligence (AI) has become the hottest trend among communications professionals, dominating the discourse within our industry. Conferences, webinars, and newsletters are filled with discussions about how it will affect practitioners' careers and the information is polarized for clicks: AI is either the salvation and future of our profession, or AI will put everyone out of work. However, there is notably less attention given to the planetary impact associated with the use of this powerful, yet energy- and emissions-intensive technology.

I have established that our human-created digital content has an emissions impact (Bonsignore, 2023). That calculation is fundamentally an analysis of clicks—the number of webpage hits or file downloads—multiplied by the page weight or file size. But what is the difference when the content has been created by AI?

This article sought to explore the existing literature to generate similar metrics for AI-generated content. It is perhaps not surprising that the AI industry is moving fast, and the published research into the impacts isn't keeping pace. ChatGPT was released by OpenAI in November 2022, the first of the mainstream AI tools. Given the length of time that it takes to conduct research, gather

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data, undergo peer review, and be published, it's no surprise that the publicly available research correlating AI, content development, and emissions is limited.

AI tools have been developed by corporations that have been less than forthcoming with documentation. In an article for Wired, Paresh Dave (2024) noted that OpenAI, for example, has apparently scrapped a pledge for operational transparency. However, there is enough publicly available information that we can begin to draw informed inferences about the energy use and related emissions of AI as a whole, and begin to assess the impacts that its use can have on our planet. By looking at the bigger picture, we can begin to understand and balance the significant impact and tradeoffs associated with AI.

What Is AI?

Any discussion of AI needs to begin with a level-setting: what do we mean when we talk about AI?

Many terms fall under the umbrella of AI. It's important to clarify them upfront.

- Artificial intelligence (AI): The field of study in computer science that develops intelligent machines.
- Machine learning: The branch of AI focused on developing algorithms that make predictions. (e.g. spam filtering in your email)
- Large language model (LLM): An AI algorithm that uses massive data sets to understand and generate content. (e.g. ChatGPT)
- Natural language processing (NLP): The branch of AI that focuses on giving computers the ability to understand human language. (e.g. spell check)
- Generative AI: AI that analyzes data patterns to generate new content, including text, audio, imagery, and code. (e.g. "Write an explanation of a solar eclipse in iambic pentameter")

ChatGPT—the best-known AI tool—is a generative AI LLM that uses machine learning and NLP to interpret user queries and generate conversational, understandable responses. While it was the first tool of significance to go to market, is not the only player in this space, and is competing against Google, Microsoft, Amazon, and Meta for market share.

However, most people are referring to all aspects of these GPT-types of technologies colloquially as "AI" or "ChatGPT" regardless of the actual underlying system, not unlike the genericization of Kleenex, Xerox, or Band-Aid. Therefore, that is the terminology that will be used here.

We should also note that some AI tools have long been used in content, such as spell check and grammar checkers. However, these are relatively basic, low-energy tools that don't have the same emissions impact as the new wave of technology—ChatGPT and the like.

What Was AI Designed For?

AI was designed to analyze massive datasets and generate conclusions that would either be too time-consuming or outside the scope of one human's analytical grasp. For example, AI tools are increasingly used to forecast hurricane intensity and landfall; they can simulate and predict the long-term durability of a knee implant; or they can run time-intensive physics simulations to understand how buildings will perform in earthquakes. As noted by Lynn H. Kaack, et al. (2022), AI excels at information gathering, forecasting, and predictive simulations, delivering comprehensive results in accelerated timeframes.

How Does AI Work?

There are two primary aspects of AI:

- Training: the volumes of datasets that the tool uses to "learn" its skills; this can be anything from a specifically developed dataset to the collected works of Shakespeare
- Inference: making predictions using the trained models

While significant research is emerging regarding the impacts of AI training, there is less public understanding of the impacts of AI inferences. I'll examine them separately below for clarity, but researchers ultimately need to look at the full scope of the process to understand the impact in its entirety.

Literature Review

This paper began by investigating existing research into the environmental impacts of using AI tools as content tools. Given the novelty of these systems, the information does not exist. Therefore, it was necessary to take a step backward: if we can't measure the impacts of specific instances, we need to take a look at the development and use of AI tools as a whole.

AI and Energy

Generative AI tools have broken records for technology growth and adoption. Research by Andrew A. Chien, et al. (2023) noted that it uses extensive computational resources and can infer that there is a corresponding increase in energy use and carbon emissions.

Our use of digital technologies is ever-increasing, and every byte is energy. As I noted in previous literature, energy—at least for the foreseeable future—has a carbon footprint (Bonsignore, 2023). We power our electronic devices and data centers primarily by burning fossil fuels, such as petroleum, natural gas, or coal. These energy sources turn turbines that generate electricity, which is then distributed to our homes and businesses through the local or regional power grid. We use a lot of energy. Our digital footprints are ever-increasing, and every byte has a carbon cost.

According to Our World in Data (Ritchie, 2023), humanity has doubled its energy consumption in the past four decades, from roughly 87,000 terawatt hours in 1980 to approximately 174,000 terawatt hours in 2019. Increases in renewable energy generation are not meeting our increased demand. Our increased overall consumption limits the amount of headway that we're making on a true green energy transition. Our expanding use of information and communication technologies (ICT)—including AI—is driving a significant amount of that consumption.

AI and Energy: Past and Future

Even prior to the emergence of ChatGPT, AI technologies were known to be energy intensive. Between 2012 and 2018, Mariarosaria Taddeo and team (2021) reported that the computing power required for machine learning models increased by more than 300,000 times, doubling every 3.4 months.

Data centers were reportedly consuming more than 2% of the world's energy in 2020, and it was estimated that energy use would increase to "somewhere between 8% (best case) and 21% (expected)" by 2025 (Stein, 2020). Further, according to the International Energy Agency (IEA) (2023), these numbers would account for approximately 1% of global emissions.

Nicola Jones (2018) pointed out that data centers were responsible for 0.3% of the overall annual carbon emissions. However, when examined as part of the entire information and communications technology (ICT) ecosystem—adding digital devices and related networks used to create, store, transmit, and consume data—the impact of our data-hungry lifestyle accounts for roughly 2% of global emissions. That's comparable to the annual emissions from the aviation industry (Environmental and Energy Study Institute 2022).

Those working deep in the climate space are deeply aware of the added consumption that AI will bring. At a panel discussion during NYC Climate Week 2023—specific details restricted by Chatham House rules—the panelists discussed how AI is causing computational demand to skyrocket. Jonathan Koomey (2011) and NVIDIA (2021) agreed, and this means more computing hardware. This need for more hardware means more data centers (Shao et al., 2022), which Sebastian Moss (2021) notes will lead to increasing water and energy use to keep those data centers cool. The panelists believe AI to be roughly seven times as energy intensive as a standard data center because the nodes are constantly working at maximum capacity and requiring significant energy for operations and cooling. Consider that in traditional data centers—already known to have significant environmental impacts—most of the data is stored, not active. Whereas conventional data centers operate more like a car idling at a traffic light, AI requires the all-out effort of a Formula 1 racecar.

These high-intensity data centers use water for efficient cooling. However, many are in water-stressed areas such as Arizona and Utah, reducing the amount of fresh water available for residents. Mél Hogan (2015) estimated that one data center in Utah used 7 million gallons of water per day.

Jeffrey Daston (2024) reporting for Reuters noted that at a *Bloomberg* event at the World Economic Forum in Davos, Switzerland, Sam Altman—the on-again, off-again CEO of OpenAI—suggested that AI is so energy-intensive as to require the development of entirely new sources of electricity to accommodate the technology's needs. "With the ever-growing adoption of artificial intelligence (AI)-based systems, the carbon footprint of AI is no longer negligible," (Verdecchia et al., 2023, p. n.p.). While Emily M. Bender and her collaborators (2021) discussed the rapid expansion of model sizes, noting that this expansion brings with it a corresponding increase in environmental impacts.

The growth of AI and cloud-based services are driving record growth in the data center sector, which is being touted as a win for tech. However even those that are bullish about data center growth admit to their sustainability drawbacks. "Data centers are massive power users and require significant efforts to keep cool," said Matt Landek. "Given hyperscaler and colocation provider sustainability goals, the data center industry will need new innovations to improve cooling and energy efficiency for AI uses" (qtd. in Steele, 2023, n.p.).

As mentioned previously, AI is best at analyzing massive data sets for forecasting and predictive simulations. In those contexts, there is some amount of operational efficiency that reduces the time required for large-scale modeling of pharmaceutical drug development or Amazon deforestation simulations. There is an element of learning as it goes. It is less efficient when developing a conversational chatbot or a user journey because the experiences are human and therefore less predictable. Humans do not use consistent wording to request necessary information. Because generative AI is based on patterns, these variations in inputs require unique searches and can generate different results.

Measuring The Impact of AI

Measuring the impact of AI is complicated. There's legacy data on older technologies (insights as to the operational costs of smaller, less developed models), but the pace of growth for AI is rapidly accelerating, with newer tools being released regularly. And, as with any emerging technology, there is a lag between the launch of the new product, and the measurement of the impacts.

Research tends to approach measurement from the back door: If Company X is known to be developing AI models, and they have publicly reported that they have purchased a known number of servers or graphics processing units (GPUs) from Company Y, estimates can be made about the energy draw and related emissions associated with that hardware. Similarly, the acquisition of a new data center can result in a generalized inference based on square footage, rack space, and energy draw of the contained hardware. But the statistics will vary among OpenAI, Meta, and Google because no two systems are configured exactly the same way.

Alex De Vries (2023) estimated that Google's AI alone is on track to consume as much energy as the entire nation of Ireland. But the major tech companies like Google, Meta, and X (formerly Twitter), are hardly the only entrants into the AI race; these major organizations are competing against venture-funded startups that are incentivizing massive, rapid growth with even less transparency than publicly traded corporations.

Within the industry, there are calls to require energy and emissions costs explicitly, such as those by James O'Donnell and Casey Crownhart (2025). According to David Patterson et al (2021), this would stimulate competition among providers and help everyone understand the true costs,

Fortunately, these questions are also penetrating the mainstream consciousness. Chris Stokel-Walker (2023) argued that "the race to build high-performance, AI-powered search engines is likely to require a dramatic rise in computing power, and with it a massive increase in the amount of energy that tech companies require and the amount of carbon they emit" (n.p.). As noted earlier, there are two primary phases to AI: training and inference. There is uneven analysis of the impacts of each. While there is greater transparency on the impact of training, there is less attention paid to the impacts of individual queries.

Impacts of Training

The training phase is the aspect that's most studied (Verdecchia 2023). Processing human language is one of the most energy-intensive uses of AI. Estimates for the impact of training a single model to handle human language is equal to approximately five times the lifetime emissions of the average car in the US (Stein 2020).

One study by Taddeo, et al. (2021) estimated that a single training run of generative pre-trained transformer 3 (GPT-3) produced more than 200,000 kg of emissions, which is roughly equivalent to driving 49 passenger cars for a year. GPT-3 was the predecessor to GPT-4; the latter provides the backbone of ChatGPT. Each iteration adds additional capacity, more energy, and more emissions.

But of course, AI researchers don't just train a single model; they often train thousands of models before achieving publishable results (Taddeo, 2021). When we see numbers for a single training run, or daily energy use, we need to understand that this is just a small fraction of the total impact.

The Unknowns of the Inference

It's easy to think that training is the root of the problem because of the massive scope of the datasets used in the initial training. It's a big problem, to be sure, but it's not the whole story. For tools in widespread use—ChatGPT, Gemini, Claude—the inference phase has a significant impact. Inference is where you run data through a trained model in pursuit of a solution: the query that an individual runs. This is the part of the process that teaches AI systems to interpret and learn from their datasets. Kim Martineau (n.d.) notes in writing for IBM that "because up to 90% of an AI-model's life is spent in inference mode, the bulk of AI's carbon footprint is also here, serving AI models to the world" (n.p.). For example, while the training phase would involve exposure to every form of poetry and celestial phenomena, an inference would be the earlier example of asking it to explain a solar eclipse in iambic pentameter.

Alex de Vries (2023) investigated the balance of training vs. inference and saw signs that the impact of inference may be greater than previously assumed. This means that the overall impact of AI is significantly more than first thought. Because the same model is used to perform repeated inferences, the aggregated impact of inference over the lifetime of a model exceeds the impact of training (Patterson, 2022). The challenge comes with measuring that scope.

De Vries looked at a report from research firm SemiAnalysis authored by Dylan Patel and Afzal Ahamad (2023) who suggested that OpenAI required more than 3,600 NVIDIA HGX A100 servers and nearly 29,000 graphics processing units (GPUs) to support ChatGPT. Based on the known energy demand of these components, that suggested an energy demand of 564 MWh of energy use per day. Comparing that to estimates of nearly 1,300 MWh used for a single GPT-3 training run, it is clear that inference demand has a significant energy and emissions impact. This is reinforced by data from Google, which reported that 60% of AI energy consumption stemmed from inference in the period from 2019–2021 (Patterson, 2022). If we extrapolate this per-day use (564 MWh) over a year (365 days) we get 205,860 MWh of energy. Running this data through the U.S. EPA Greenhouse Gas Equivalencies calculator, a year's worth of inferences generate nearly 90,000 metric tons of emissions annually. (As a reminder, megawatt hours equal 1,000 kilowatt hours.) Analysis from Chien et al. (2023) showed that "for ChatGPT-like services, inference dominates emissions, in one year producing 25x the carbon emissions of training GPT-3" (p. 1).

Environmental Impacts

It's important to understand what this consumption means in terms of impacts to the planet. Anthropogenic climate change is expected to have significant impacts on the health and wellbeing of all humans, according to Imogen Tennison and her multinational research team (2021), which Nick Watts et al. (2019) noted will result in more intense heatwaves, higher risks of flooding and damaging storms, and a changing pattern of emerging infectious diseases. We are increasingly racing towards the point of no return. In November 2023, the planet first crossed the threshold of 2.0°C above pre-industrial temperatures (Copernicus, 2023, n.p.). For reference, an increase of no more than 1.5°C was the goal set forth by the Paris Agreement in 2015 (United Nations Framework Convention on Climate Change, 2023). However, even at 1.5°C, we are facing significant planetary impacts.

For context, the difference between a 1.5°C and 2.0°C increase often results in impacts that are twice as severe, as seen in Table 1.1, based on data from the World Resources Institute (2018). Small temperature differences can have profoundly different effects. This is why there are urgent calls to reduce emissions as much as possible to mitigate the worst of the outcomes.

Table 1.1. Forecasted Differences in Planetary Impacts between 1.5°C and 2.0°C Temperature Increases

Impacts of 1.5°C and 2.0°C Temperature Increases			
	1.5°C	2.0°C	Difference
Global population exposed to severe heat at least once every five years	14%	37%	2.6x worse
Number of ice-free years in the Arctic	At least 1 every 100 years	At least 1 every 10 years	10x worse
Amount of Earth's land area that will shift to a new biome	7%	13%	1.86x worse
Decline in marine fisheries	1.5 million metric tons	3.0 million metric tons	2x worse

Source: World Resources Institute.

According to the International Panel on Climate Change (IPCC) (2022), human-induced warming of the climate system is already widespread, as noted by Gabriele C. Hegerl and Francis W. Zwiers (2007). However, the impacts are already being unevenly felt, with more dramatic consequences experienced by women, people with disabilities, those experiencing poverty, and Black, Indigenous, and people of color (Abeygunawardena et al., 2003; United Nations WomenWatch, 2009; U.S. Environmental Protection Agency Press Office, 2022; van Daalen et al., 2020; Yabe & Ukkusuri, 2020).

Although these more vulnerable or marginalized populations have been the first to experience the most severe consequences of climate change, we will all experience the long-term impacts. "Near-term actions that limit global warming to close to 1.5°C would substantially reduce projected losses and damages related to climate change in human systems and ecosystems," (IPCC, 2022, n.p.). There is a lag time between emissions and their effects. The changes that we're seeing today are a result of emissions from roughly a decade ago. Even if the entire planet were to change their habits tomorrow, it will be another decade before the tide turns and we start to see improvements. This is why we need to take swift and decisive action today. With that in mind, we all have an ethical obligation—and an enlightened self-interest—to mitigate our climate impacts as quickly and comprehensively as we can (Bonsignore, 2022).

Additional Ethical Considerations

While environmental concerns are the primary focus of this article, there are many other ethical considerations that need to be weighed when assessing the value of AI in any project. These ethical considerations fall into a few basic categories: bias, legality, privacy, and accuracy. I will address each one briefly.

Discrimination and Bias

Any model is only as good as the data used in its training and the perspectives of the individuals who review it. Training data bias can emerge when systems are designed with poor data sets, reinforcing structural racism (Zalnieriute & Cutts, 2022). It's easy to blame this on the dataset alone, but as with many social problems, this is exacerbated by homogeneous groups responsible for reviewing the data for social context, oblivious to the implications and harm, notes Gina Lazaro (2023). With AI, we don't know who was in the room formulating and framing the discussions. It's been broadly reported that OpenAI—the parent company behind ChatGPT—hired an outsourcing firm in Kenya to filter the worst violent, harmful, and toxic content for less than U.S.$2 per hour. While this is economically feasible, Billy Perrigo (2023) discussed that it is also ethically questionable to pay subsistence wages for nine-hour daily shifts reviewing sexual abuse of children and adults, hate speech, and extreme violence. Yet despite the work of these Kenyan workers, the problems with content that promotes discrimination, self-harm, and harm to others persists. Zachary B. Wolf (2023) honed in on the heart of the issue: "AI can be racist, sexist and creepy. What should we do about it?" (n.p.) Unsurprisingly, the article does not solve the problem.

The ethics frameworks used to guide AI development lack geo-cultural diversity and are "primarily framed in the Western context, by researchers mostly situated in Western institutions/organizations, to mitigate social injustices prevalent in the West, using data from the West, and implicitly imparting Western value systems, as noted by Vinodkumar Prabhakaran and team (2022). Additionally, Josephine Seah and Mark Findlay (2021) pointed out that much of the ethics work tends to be male-authored, which is representative of the industry, but not the world as a whole.

Furthermore, even if we're using "good" data, it can have unintended consequences. Data used in one context may not transfer accurately to another. Interpretation bias is always a possibility; Victor Galaz et al. (2021) pointed out that the user may infer something that the designer didn't intend, or the system might not support.

Copyright Issues

There is increasing public awareness that the data used to train ChatGPT (and others) was copyrighted or proprietary. Multiple generative AI systems were trained on the Books3 dataset that includes upwards of 200,000 copyrighted books (Reisner, 2023). If a content organization is using AI for its content, it may be unwittingly putting the employer in legal jeopardy, generating results that violate copyright law.

Privacy Implications

The question of privacy violations looms large (Stein 2020). The information contained within the training set may not be used in the same context as intended. For example, OpenAI stores individual data such personally identifiable information (PII), data which is potentially protected in accordance with the General Data Protection Regulation (GDPR). Sunder Ali Khowaja et al. (2023) reminded us that this decoupling is in violation of GDPR because individuals did not explicitly consent to this particular use.

How accurate is it?

There is widespread reporting of queries that returned incorrect information, known in the industry as "hallucinations." Tom Carter (2023) reported that Google Gemini—a GPT competitor—was hallucinating answers to even simple questions. In additional work on errors,
Myeongjun Erik Jang and Thomas Lukasiewicz (2023) analyzed the errors and inconsistencies that have appeared in ChatGPT when questions are phrased differently. They wrote that "although LLMs are a revolutionary technique that brought an unprecedented era to NLP, such issues should be resolved before ChatGPT is used in real applications, particularly considering the huge economic and environmental costs for training and inference of LLMs" (p. 9). Further investigations on errors, Klaudia Jaźwińska and Aisvarya Chandrasekar (2025) compared the eight most prominent AI tools. They discovered that they're all bad at accurately citing their sources and found chatbot responses wrong. Moreover, upgrading to premium models did not improve results with answers remaining incorrect.

There are ethical concerns associated with using an AI system that delivers factually inaccurate but widely reported misinformation, or one that fabricates information. These tools can put organizations in legal jeopardy. Considering the breadth of known ethical challenges and harms caused by AI—even those above and beyond the planetary impacts—it seems unwise to rely on artificial intelligence as a trusted and viable tool in content development.

Social-Professional Pressures to Adopt AI

In light of the prevalence of AI discourse within the technical communication community, there is increasing pressure to learn about AI, use it in our work, and be perceived as cutting-edge technology experts by peers and management. This is not unlike the "mutually reinforcing social norms" that drive teens to use social media, noted Toke Haunstrup Christensen and Els Rommes (2019) even when presented with knowledge of the environmental impacts of their digital choices. Unfortunately, by the time peer-reviewed research is published that directly connects AI, content, and emissions, AI tools will have already become an embedded part of our workflows. It is crucial that we raise awareness of the tradeoffs between new technologies and their harms.

Conclusion: Balancing Benefits Vs. Harms

Looking at the rapid adoption of AI in content development, it is critical to build awareness of the environmental and ethical impacts of these resources before they become standardized tools in the content toolbox. While we may not have direct emissions metrics due to limited publicly available information, we have more than enough signs that AI is an overpowered tool for a job that could be performed by humans.

Given that we already understand the significant and accelerating climate impact of AI, it seems irresponsible to use it for anything but the most data-intensive simulations that require rapid and comprehensive analysis beyond the scope of what humans can reasonably handle. Using AI for hurricane landfall and intensity forecasting, material fatigue and long-term durability testing of medical devices, or modeling the global impacts of polar ice melt have very different values than chatbots and content generation.

If we are already implementing sustainable content strategies to measure and mitigate the impact of our digital content on the planet, we should also be including the impact of the use of AI in content. Is AI so invaluable to our chatbots, product descriptions, and user journeys to support UX teams that we can't use other, lower-emissions methods for developing content?

All of our work has climate impacts, but we need to decide if the benefits of AI outweigh the harms. I'm inclined to let humans develop content for humans and leave the high-impact, energy- and emissions-intensive queries to areas where humans simply aren't equipped to do the work. These costs need to be considered on a case-by-case basis to balance the benefits and drawbacks of this rapidly growing technology in technical communication.

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2. Navigating Human-AI Collaboration: The Emerging Role of Technical Communicators as AI Facilitators

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Abstract: This study reports on the experiences and responsibilities of an AI Facilitator: a member of a collaborative team responsible for integrating AI in research workflows. Outlining the responsibilities of an AI Facilitator demonstrates the substantive role that a technical communicator (TCer) can play in managing and shaping human-AI interactions. A TCer assumed the role of AI Facilitator during a qualitative coding process with a three-person team. The dialogue between the facilitator and the AI model, consisting of 422 interactions, was analyzed to understand the AI Facilitator's role. Thominet et al.'s framework for conversational roles with AI (manager, teacher, colleague, and advocate) was utilized to explore how the roles informed the AI Facilitator's responsibilities. By employing quasi-coding, dialogue with collaborators, and reflective memos, the research team identified distinct features of each role. Across the interactions, TCers initiated their work as managers but frequently evolved to assume additional responsibilities, such as enculturating the AI, creating space for conversation, and leveraging AI's capacity for pattern recognition. This study affirms the centrality of managerial oversight in human-AI collaboration, while highlighting how TCers can expand their facilitative roles to support such collaborations.

Keywords: Collaboration, Artificial Intelligence (AI)

This study focuses on how technical communicators (TCers) can leverage their expertise in facilitation to support human-AI collaboration. In contexts such as community-engaged research and organizational communications, researchers and scholars in technical and professional communication and also rhetoric have facilitated dialogue (e.g., Moore & Elliott, 2016), access to resources (e.g., Gottschalk-Druschke, 2022; Hartline, 2023), interpersonal relationships (e.g., Hannah & Lam, 2023; Redish, 2010) and communication with users (e.g., Ceraso, 2013; Cleary & Flammia, 2012). In each of these contexts, the TCer operates as an

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intermediary responsible for negotiating tensions (Ceraso, 2013) and assembling people to achieve common goals (Redish, 2010). As the TC discipline begins to assess AI's potential role in teaming contexts (Carradini, 2024), it is important to understand how their expertise as intermediaries adds value to collaborative work with AI, but more importantly, how the application of such expertise creates work conditions that call into question TCers' disciplinary and ethical responsibilities in AI integration.

Thus far, human-AI collaborations have been described in contexts of work, writing, and research; however, the human's role in these interactions has narrowly focused on overseeing the accuracy of the AI. For instance, interdisciplinary scholars have investigated the ways that AI can support collaborative research by assisting coding (Omizo, 2024; Thominet et al., 2024), data analysis (DeJeu, 2024), and writing (Babl & Babl, 2023). While accuracy is important when collaborating with AI, it is insufficient as a basis for evaluating and theorizing the relational dynamics of researchers' work with AI in research contexts. This study assesses how TCers not only manage AI towards accuracy but also how they guide its integration in ways that support the rhetorical, relational, and ethical demands of collaboration.

In this chapter, we refer to the expanded intermediary role as "AI Facilitator": a member of a collaborative team responsible for the rhetorical, relational, and ethical integration of AI into team processes. Our case study builds upon Luke Thominet et al.'s (2024) work on conversational roles with AI as a framework for human-AI research collaboration. Specifically, we report on how a TCer simultaneously enacted Thominet et al.'s conversational roles of manager, teacher, colleague, and advocate when supporting AI integration in a collaborative research context. By providing examples of how the TCer enacted these roles, we develop an initial conceptualization of an AI Facilitator, its responsibilities, and the connection between AI facilitation and disciplinary goals.

Literature Review

In this section, we describe how AI is integrated in TC work and explore the roles that TCers enact to support AI collaboration. Specifically, we document the discipline's tendency to highlight TCers' work managing AI systems that prioritizes accuracy and output quality. While noting the significance of this work as foundational in this emerging line of research, we also highlight a growing disciplinary interest in developing ethical critiques of AI that move beyond accuracy concerns and confronts the ethical and relational dimensions of TCers' interaction(s) with AI.

Working with AI: Assessing Accuracy and Ethics

At present, AI models cannot operate independently (Johnson-Eilola et al., 2024; Mallette, 2024). Rather, AI is seen as a non-competitive collaborator

(Johnson-Eilola et al., 2024) and early work has outlined where human oversight is necessary in support of TC work tasks. Generally, this phenomenon is described as 'human-in-the-loop' collaborations, wherein humans insert themselves into AI systems to "assess and modify AI-generated content toward nuance and quality" (Verhulsdonck et al., 2024, p. 62). In the workplace, TCers operate as the human in the loop to actively support the training and implementation of AI as a workplace tool. Their work in these instances often is described in managerial terms, i.e., as ensuring an AI model's accuracy. Underlying this concern with accuracy is TC practitioners and researchers' general lack of trust in AI models to "communicate effectively with users (or evolve) on [their] own" (Hocutt et al., 2022, p. 128), which thus necessitates continuous human involvement and collaboration throughout the AI's lifecycle. As an example, TC practitioners in user experience (UX) and content management are increasingly asked to develop AI models, such as chatbots, that can provide context-rich information to users (Hocutt et al., 2022; Porter, 2017). In this role of "botmaker" (Porter, 2017, p. 186), TCers are responsible for training and managing the AI models to produce accurate information and thereby achieve a positive user experience. While important in documenting an early role for TCers in the AI landscape, the tendency in work like this to focus on accuracy limits TCers' ability to imagine more expansive roles that work beyond the pragmatic and managerial.

Anticipating the need to think beyond accuracy, some scholars have urged the field to remain critical of the ethical implications that accompany AI integration (Bender et al., 2021; Johnson-Eilola et al., 2024; Lauer et al., 2018; Sano-Franchini, 2025). For instance, valuing accuracy might obscure important questions about what is being optimized, for whom, and at what cost (Sano-Franchini, 2025). Often, researchers highlighted AI's capacity for bias (Bender et al., 2021) and misinformation (Sano-Franchini & Carpenter, 2023). These concerns often stem from AI being a "black box": a metaphor for systems that take an input and return an output without exposing the algorithmic logic or decision-making processes that facilitate them (Lauer et al., 2018, p. 405). Without understanding this underlying logic and its influence on their managerial work, TCers risk facilitating systems that reinforce harmful patterns or biases. To mitigate these risks, employers are encouraged to establish clear AI policies and incorporate active human involvement throughout an organization's decision-making processes (refer to Kong & Ding, 2024, p. 33).

Concerns with accuracy and ethical assessment further intersect with questions of authorship and voice in the writing process. There is a sustained debate about how to determine when an AI model is assisting writing versus overtaking the writer's unique voice (Cardon et al., 2023). This debate centers on issues such as reduced critical thinking and authenticity (Cardon et al., 2023, p. 247). These concerns have prompted teachers and educational institutions to develop strategies for how to guide students through responsible AI use. Responding to this need, Ehren Helmut Pflugfelder and Joshua Reeves (2024) offered a framework that teaches students how to approach AI-assisted writing with a "critical, authorial, rhetorical, and educational" mindset (p. 419). Their work stresses the importance of engaging with AI critically, with attention to its incapacity for rhetorical nuance. Students are therefore encouraged to maintain rhetorical awareness and authorial control while working with AI. While useful for suggesting that thoughtful use is ethical use, this approach tends to equate criticality with ethical responsibility. Such frameworks might conflate ethical responsibility with preserving authorship and accuracy, leaving little space to discuss broader ethical implications such as access, power, and bias in AI-assisted writing.

Researching with AI: Assisting Analysis

AI has been evaluated as a research assistant capable of handling tasks such as data analysis and data visualization. In qualitative coding contexts, for instance, AI has demonstrated proficiency in locating "concrete, descriptive themes" but struggles to locate more "subtle, interpretative" themes (Morgan, 2023, p. 1) and make decisions based on shared norms or tacit knowledge (Hedquist, 2024, p. 267). Similarly, AI models can produce results that are 'hallucinations' or otherwise baffling, e.g., unrelated to the specified context (Omizo, 2024). Due to these inconsistencies—whether they be a hallucination or missing knowledge—TCers consistently have to verify accuracy and interrogate how outputs are shaped, the assumptions they reflect, and their implications. Particularly in qualitative data analysis, there is a risk of reinforcing reductive narratives or overlooking participant experiences.

Recently, scholars such as Thominet et al. (2024) have deepened our understanding about the multi-faceted roles TCers can adopt when working with AI assistants in research. Recognizing that AI can be a powerful collaborator in qualitative research practices due to its ability to potentially "broaden access to automated textual analysis" (p. 397). Thominet et al. (2024) found that researchers can affect an AI's behavior through adopting a particular kind of conversational frame. Specifically, they describe four conversational frameworks for working with AI: as manager, teacher, colleague, and advocate. Significant for our purposes in this chapter, this framing expands the relational dimension of human-AI collaboration. That is, rather than exclusively managing AI, TCers engage with AI through adaptive and co-constructive interaction that extends their work beyond concerns with accuracy.

Building on this foundation, we designed our case study to shift the focus away from accuracy and management issues towards the broader concerns called for in the discipline's scholarship. We see these concerns as implicated in the teacher, advocate, and colleague roles described by Thominet et al. (2024) and wanted to develop understanding about how those roles are activated and evolve in AI research collaborations. Using a qualitative coding experience as our example, we posit facilitation as a form of TC expertise that can ethically support the relational and rhetorical work of collaboration. By outlining the TCers' responsibilities as an AI Facilitator before, during, and after our qualitative coding work, we illustrate how TCers can broadly contribute to meaning-making, coordination, and ethical responsiveness in human-AI interaction. In doing so, we offer a set of skills and vocabulary that can help TCers make a case (Hannah & Arreguin, 2017; Willers, 2025) for their role in ethically and effectively leveraging AI in collaborative research.

Methodology

This case study examines how a three-member research team operationalized an 'AI Facilitator' while collaborating with a custom AI model during a qualitative research project. In the original study, the team collaborated with a university student coalition dedicated to improving accessibility and disability etiquette on campus. To support the coalition's advocacy goals, the researchers interviewed students about their experiences and analyzed the interview transcripts (Hedquist et al., 2024). The team's goal in this work was to develop themes that could inform the coalition's future advocacy campaigns on their campus. During the analysis process, the team configured a custom AI bot (known as a 'GPT') to help analyze the interviews. Specifically, the AI supported the research team's codebook development and transcript coding. To sustain the team's interaction with the AI bot during this work, one researcher was designated as the AI Facilitator and was responsible for managing how the AI was integrated into the research workflow.

Over the course of several months, the research team coded the interview transcripts and met regularly via Zoom to review progress, refine the codebook, and discuss emerging patterns. Each team member, including the AI, independently coded transcripts and participated in coding discussions. The AI Facilitator was responsible for guiding the AI's participation in these activities, which involved asking the AI to complete tasks, posing questions to the AI, and translating the AI's input back to the team. In previous work (Hedquist et al., 2024), we focused on the broader process of integrating AI into qualitative coding. In the present case study, we focus instead on the interactions between the AI and the Facilitator, namely how the AI Facilitator prompted, responded to, and adapted to the AI throughout the collaboration.

Because the AI Facilitator role was emergent and evolved throughout the collaboration process, we developed a mixed methods approach, including transcript analysis, team dialogue, and reflective memos. By examining the data collected across the full arc of the collaboration, we identified patterns and practices that helped define the responsibilities and impact associated with the AI Facilitator role in collaborative research.

Textual Analysis: Reviewing the Dialogue

One of our objects of analysis was the dialogue between the AI Facilitator and the AI. Using the ChatGPT software, we were able to download the full dialogue that the AI Facilitator had with the AI, which included conversations about the codebook, line-by-line coding, and discussions about revising codes. The dialogue included 422 messages.

To analyze the dialogue, we quasi-coded the messages using Thominet et al.'s (2024) framework for conversation roles with AI, which they refer to as 'GAI.' We used Thominet et al.'s (2022) definitions to guide our analysis:

- **Manager:** "the researcher carefully observes and verifies GAI's work to ensure consistency" (p. 404).
- **Teacher:** "the researcher seeks to teach GAI about theories, research methods, or qualities of the data to improve its outputs" (p. 406).
- **Colleague:** "the researcher seeks to understand data better by openly discussing it with GAI. Rather than expecting GAI to replace the researcher's work, colleagues expect meaning and knowledge to be produced through the chat conversation" (p. 405).
- **Advocate:** "the researcher works with GAI to improve the user experience of texts similar to those being studied. In this way, advocates expect GAI to provide useful insights into how specific users might understand and use the texts in a dataset" (p. 407).

We reviewed the transcript to find examples of each role, marking when and how the Facilitator enacted different roles across the phases of the collaboration.

Dialogue with Collaborators: Reflecting as a Team

To better understand the evolving nature of the AI Facilitator role, the research team spent a portion of each coding session reflecting on and discussing how facilitation practices were evolving. Early in the collaboration, team members described the Facilitator as a "scribal" figure—someone who relayed information from human researchers to the AI without shaping the interaction. However, as the project progressed, the team began to recognize that the Facilitator's role involved far more than transcription.

Notes were taken during these reflective discussions to document emerging ideas and shifts in how the team understood the Facilitator's contributions and responsibilities. Reflection prompted important revelations; for instance, during the coding process, one of the collaborators noted that the facilitator is, in many ways, the voice of the AI. Thus, timing when and how that voice appears in the collaboration took on special significance. This reflection—among others—was documented in reflective notes that we analyzed later, alongside reflective memos that were written specifically by the AI Facilitator.

Reflective Memos: Reflecting as Facilitator

In addition to team meetings, the AI Facilitator engaged in structured reflection by maintaining reflective memos throughout the coding process. During and after coding sessions with the GPT, the Facilitator documented her observations, challenges, and evolving strategies for integrating the AI. Unlike the team reflections, these memos provided a first-person account of the Facilitator's experience and offered insight into the moment-to-moment decision-making involved in facilitating human-AI interaction. These memos served as data sources for identifying tensions, adjustments, and patterns that helped shape the definition of the Facilitator role.

Results

This section presents our analysis of how the Facilitator role was enacted across the qualitative coding process. Drawing on Thominet et al.'s (2024) framework of conversational roles—manager, teacher, colleague, and advocate—we describe the Facilitator's interactions with the AI to explore the range of responsibilities involved in these roles when facilitating human-AI collaboration.

We restate each role definition at the beginning of its respective subsection to guide the reader and contextualize our findings. After defining each role, we then offer examples that illustrate how the role was enacted throughout the coding process. This approach helps us trace how the Facilitator's responsibilities evolved over time and how role adoption varied across phases of the collaboration.

Facilitating as Manager: Assessing Accuracy and Comprehension

Thominet et al. (2024) describe the managerial role as one in which the researcher "carefully observes and verifies GAI's work to ensure consistency" (p. 404). In our study, the AI Facilitator enacted this role when assessing alignment with the uploaded data, closely monitoring the AI's memory, and overseeing the accuracy of the outputs.

One responsibility of the AI facilitator in this role was checking the AI's access to and comprehension of the data in the interview transcripts. While coding statement seven of the second transcript, the AI suggested multiple codes when the human coders did not have any. After asking the AI to cite evidence from the statement, we realized it was coding the wrong statement. The Facilitator responded, stating "I don't think you are looking at the right statement. The text you pulled for statement seven (lines 37–43), is from line 126." The AI continued to code the wrong statement until the Facilitator prompted the AI by stating, "this line starts with '100%.' Try again." This strategy was effective, and the AI was able to locate statement seven successfully. While this led to the identification of the correct line, the Facilitator learned that they would need to tell the AI which statement was being analyzed and provide the first word of the statement.

A second responsibility involved managing the AI's memory and tracking its use of previous conversations during the coding process. Often, the Facilitator asked the AI to complete a task or make a decision based on information stated earlier in the conversation as a means to gauge the AI's capacity for recalling information. After the first transcript, the Facilitator gave the AI instructions on how to create a table about agreement between coders (what to include in the rows, columns, and so forth). During subsequent requests, the Facilitator asked "Can you do what you did last time? Where you create the table? Do you remember the elements of the table?" The AI responded in the affirmative and created the table accordingly. Had the AI not remembered, the Facilitator would have been alerted to a lapse in memory that could affect other elements of the collaboration, such as coding decisions or enculturated norms. As a result, the Facilitator's role was essential for overseeing the accuracy and consistent memory of the AI, which were foci that continued throughout the collaboration.

The final managerial responsibility involved scrutinizing the AI's outputs to assess its accuracy. For example, as just noted, the AI was asked to create tables that summarized agreement levels among collaborators. Here, the Facilitator manually verified the calculations by counting the agreements and disagreements between collaborators from the transcript. As the AI's results were correct, this confirmation process increased the research team's confidence in the AI's performance and calculations. This practice of validating outputs was especially important given the risk of AI models hallucinating or producing inaccurate results (Omizo, 2024)—a phenomena we noticed in the AI's inconsistencies with pulling the correct statements. Those inconsistencies were significant because they signaled a need for more verification and oversight, which ultimately encouraged us to check that the AI cited the source material in each of its discussion points. The Facilitator's role here included anticipating and guarding against such errors, emphasizing that managing AI requires active oversight.

Together, these responsibilities align with the managerial oversight described in early research. However, the responsibilities also involved evaluating if outputs were usable and contextually appropriate for the team's goals. In these ways, managerial facilitation in this case study became a matter not only of attending to data access, memory, and rhetorical implications of potential inaccuracies but also protecting the quality and credibility of the data analysis process.

Facilitating as Teacher: Structuring and Iterating the Learning Process

According to Thominet et al. (2024), the teacher role emerges when the researcher "seeks to teach GAI about theories, research methods, or qualities of the data to improve its outputs" (p. 406). In our collaboration, the AI Facilitator took on this role by shaping the AI's knowledge base, providing iterative feedback, and filling gaps in knowledge.

When configuring the AI, the AI Facilitator was responsible for training the AI on discipline-specific literature. First, the Facilitator collaborated with the research team to curate texts in five content areas, including widely cited coding manuals, such as *The Coding Manual for Qualitative Researchers,* and foundational literature in technical communication relevant to our research such as the *Routledge Handbook of Disability Studies*, which were uploaded as TXT files. Before configuration, the AI's knowledge base was limited to the Internet with a knowledge cutoff date of January 2022. Therefore, the Facilitator played an important role in anticipating potential knowledge that the AI might need in order to code from a similar perspective to that of the human team. By accounting for this disciplinary knowledge at the beginning, the Facilitator pre-emptively filled knowledge gaps resulting from the technology's content limitations.

A second teaching responsibility involved adding local or tacit knowledge when appropriate to support the AI's coding. While these teaching moments arose out of managerial checks for accuracy, they revealed opportunities to assess and address gaps in the AI's knowledge. For example, we noticed an important knowledge gap when we coded an interviewee's discussion of tabling on campus. At Southwestern University, tabling is a significant community activity where student groups and organizations set up tables in a major campus hub to meet and recruit new student members. As such, we coded this as 'community' and the AI did not. Once we explained the context in more detail, the AI was persuaded. If these instances are not interrogated, then the research team might assume that the AI does not think the phenomenon is significant or relevant. However, if the AI is informed about tacit or local knowledge, the research team can better understand and integrate its perspectives. In this sense, AI Facilitators engage in building shared language (Hannah & Saidy, 2014), which requires attention to knowledge gaps and enculturation opportunities (Hannah et al., 2024). Attending to dimensions of enculturation can help the AI substantially contribute to the collaboration as a disciplinary peer while simultaneously being mindful of important moments to pause, reflect, and iterate.

In addition to providing local knowledge, the AI Facilitator often had to enculturate the AI into the group to help the AI operate within the norms and expectations of the team. Throughout the coding process, the Facilitator encouraged the AI to refine its outputs, adjusting response length, tone, or framing based on the group's expectations. For instance, the Facilitator noticed that the AI continued to list recommendations for next steps rather than discussing specific codes and tensions as the team had developed as a practice. Recognizing this tendency, the Facilitator prompted the AI to discontinue including recommendations for next steps in its responses, which led to more productive and nuanced discussions within the team. In no longer listing next steps, the AI better aligned with the team's expectations. This attention to instructing the AI about collaborative norms continued when the Facilitator enacted the colleague role.

Facilitating as Colleague: Creating Space for Contribution

Thominet et al. (2024) describe the colleague role as one where "the researcher seeks to understand data better by openly discussing it with GAI. Rather than expecting GAI to replace the researcher's work, colleagues expect meaning and knowledge to be produced through the chat conversation" (p. 405). The AI Facilitator adopted this role by engaging the AI in moments of interpretation, pausing the conversation to facilitate AI input, and spending time dissecting the AI's contributions.

Establishing the AI as a peer contributor began during the configuration stage by assigning it the role of a qualitative researcher and continued throughout the coding process as the Facilitator worked to reduce the AI's deference and encourage substantial collaboration. While configuring the AI's backend instructions, the Facilitator added the instructions that the AI's purpose is "analyzing text as a qualitative researcher in the field of Technical and Professional Communication." Then, before coding, the AI was told that it was "a collaborator" and all team members would be coding interviews. Despite these efforts, the AI was deferential early on, in the sense that it rarely pushed back on the decisions of the human coders; similarly, the AI rarely explained its answers and was quick to agree with the human team members. Recognizing these deferential tendencies, the Facilitator experimented with different prompting strategies. Prompts such as "why didn't you code anything for statement 6?" were largely ineffective; the AI was quick to re-code the statement, rather than to explain its decision-making. However, prompts such as "Why did you originally code for education?" led to more detailed answers from the AI which in this case study included, "I originally coded for 'Education' in Statement 5 because I might have interpreted the participant's discussion of their diagnosis and understanding of their differences as part of an educational journey or process." This justification helped us understand the textual basis for the AI's coding decision. In turn, we could more aptly consider its contributions as a colleague through discussing the merits of the AI's rationale alongside competing rationales from other team members. This example reveals the importance of trying different prompting strategies to overcome deference and integrate AI effectively. Achieving these substantive responses was made possible through the Facilitator's prompting adaptations.

Throughout the process, the AI Facilitator was responsible for helping the team maintain a pace suitable to fully integrating the AI. Often, the coding process involved dialogue wherein researchers built upon the ideas and contributions of their colleagues. Lacking the capacity for in-time contributions to the team dialogue, the AI's comments and suggestions did not fit seamlessly into the team's dialogue style. Specifically, the AI Facilitator had to continually pause the conversation to inform the AI about shifts and/or updates in the conversation. In these moments of pause, the Facilitator would inform the AI and ask for its contribution and reactions. In one instance, the human coders were talking about a difficulty with the concept of 'role,' which the Facilitator summarized in a message to the AI as, "Do you think this line in isolation should be coded as role? We are hesitant because Amber thinks she was reading into the context too much when she coded with role." In response, the AI explained that the "brevity and ambiguity" of the statement would not warrant coding the statement for 'role.' While the pause disrupted the steady flow of human dialogue and dampened the excitement that emerged through new coding insights or working through difficulties, it was a formative moment for drawing in the AI as an entity or object that the researchers work with rather than isolating it as a tool that did work for the researchers. By securing and maintaining a slower pace, the Facilitator was able to incorporate the AI as a substantive contributor to the research team's dynamic conversations.

As emphasized in Thominet et al.'s (2024) definition, colleagues expect the AI to contribute to meaning-making, which the Facilitator prioritized when the AI coded differently from the human researchers. Rather than dismissing these differences as errors, which might happen if the AI was viewed as a tool or passive assistant, the Facilitator treated them as opportunities for more reflection. In one instance, the team was coding a statement about language use. No one coded for 'community' except Amber, and she was struggling to articulate how she saw the code operating in context. Since the AI also coded for 'community,' the Facilitator asked for its justification. In response, the AI stated that "community is emphasized because the participant is discussing how the debates and perspectives on language use are shaped and shared within the community." This explanation reminded the team of their original definition, particularly its emphasis on the social. As a result, all coders agreed to apply the 'community' codes in this instance, and in subsequent statements, thereby shifting their interpretive lens to look for similar discussions around language and community. This instance highlighted the important role of the Facilitator in calling attention to the AI's contributions and exploring its justification. Without this intervention, the AI's divergent coding may have been undervalued. The Facilitator's attentiveness reinforced the team's commitment to integrating the AI as a colleague and meaningfully incorporating its contributions in the coding process. While treating the AI as a colleague helped the team's interpretive process, the Facilitator also assumed an advocate role, which helped surface patterns that could support the project's overall goals of investigating disability etiquette and supporting the coalition.

Facilitating as Advocate: Harnessing AI's Pattern Recognition

In the advocate role, Thominet et al. (2024) explain that the researcher "works with GAI to improve the user experience of texts similar to those being studied. In this way, advocates expect GAI to provide useful insights into how specific users might understand and use the texts in a dataset" (p. 407). In an example of this type of facilitation, Thominet et al. describe how a study team member used AI to "identify some patterns relevant to the populations she sought to assist" (p. 409). Our team was utilizing AI in a similar manner as we wanted to incorporate AI into our efforts to define disability etiquette, develop themes, and provide the insights to the coalition to support their campaigns about disability etiquette.

Before engaging the AI in conversations about key themes or patterns in the interviews, the Facilitator was responsible for informing the AI about the study and its objectives as it relates to the coalition's goals. Specifically, the Facilitator explained the project's history, scope, and ideal deliverables prior to the coding process. The Facilitator outlined these dimensions of the collaboration early on, through statements such as "We are all coding interviews with [Southwest University] students from the [coalition]. The interviewees are all students with disabilities who are reflecting on their thoughts and experiences related to disability etiquette." By framing the data as coming from a specific community, the Facilitator helped the AI contextualize the material beyond the coding process. This groundwork enabled the AI to engage more meaningfully in later prompts, particularly those asking it to identify patterns that could inform how the coalition understood and shared reflections on disability etiquette on campus. Overall, the Facilitator supported the AI's knowledge acquisition as an initial step toward leveraging the AI's pattern recognition and dialogic interactions as the team worked to parse through complex concepts.

The student coalition asked the research team to help define disability etiquette, a concept they found to be important and difficult to define; therefore, the task of pulling key themes from the transcript and developing actionable insights was difficult. In these moments of difficulty, the Facilitator asked the AI to help the team think through conceptual tensions. In one such example, the team was struggling to parse through definitional differences between the codes 'normativity' and 'ethics,' which would have important implications for how we defined disability etiquette and proposed solutions for the coalition. The Facilitator asked the AI, "We see normativity and ethics as being very similar. Here, it seems like the speaker is suggesting that asking about language preferences is ethical, and therefore should be the norm. How do we decide what is leading in this case?" In response, the AI justified how 'ethics' was the leading code (the code with the most emphasis) because the interviewee seemed to equate language preferences as "fundamentally an ethical issue." This response helped the team clarify the conceptual distinction between the two codes and better articulate the ethical dimensions of disability etiquette. Importantly, it allowed the team to frame the issue in a way that aligned with the coalition's goals. By integrating the AI in these important, conceptually difficult discussions geared toward future deliverables, the Facilitator helped the team develop analytically clear and useful outputs.

After tracing how the AI Facilitator enacted each role, we recognize that each role involves significant responsibilities throughout the collaboration. To make them accessible for readers, Table 2.1 outlines the responsibilities associated with each role, as well as an applied example to contextualize how each responsibility might be enacted.

The enactment of these roles reveals how an AI Facilitator can balance rhetorically complex decision-making and support the practical demands of collaborative human-AI teams. The following section builds on these insights by examining how the Facilitator pivots between roles to sustain interaction.

Table 2.1. Roles, Responsibilities, and Applied Examples of AI Facilitation

AI Facilitator Role	Key Responsibilities	Applied Example
Manager	Oversees that the AI's knowledge base and source materials are comprehensive and accessible.	Conduct pre-project assessments of AI systems to confirm that all necessary data sources are uploaded and legible.
	Continually monitors the AI's memory capacity.	Check that the AI can recall conversations from early in a collaboration.
	Verifies AI outputs for accuracy and ties outputs to data sources.	Use AI for generating data summaries or reports and verify accuracy to assess the reliability of outputs.
Teacher	Guides AI learning by selecting relevant training materials.	Meet with multiple stakeholders to gather perspectives on what should be included in the AI's training.
	Provides iterative feedback to improve AI performance.	Establish feedback loops with AI systems, such as explaining which of its outputs were helpful for collaboration and why.
	Fills knowledge gaps, such as those related to disciplinary knowledge or norms.	Create a workflow wherein the AI is continually asked to recall prior conversations and concepts.
Colleague	Treats AI as a knowledge contributor, not just a tool.	Make space for including the AI during conversations, rather than using an AI model as a means for starting or book-ending a conversation.
	Controls the pace of the conversation to ensure the AI is included.	Ask colleagues to pause their conversation to allow time for the AI to be updated.
	Spends time asking for the AI to justify its decisions to contribute to meaning-making.	Ask AI to justify its coding decisions to explore how its meaning-making processes differ from other team members.
Advocate	Leverages AI's pattern recognition to uncover insights.	Utilize AI for advanced data analysis tasks like identifying trends in customer feedback or predicting user behavior in product development.
	Aligns AI contributions with broader organizational goals.	Use AI to support advocacy efforts by identifying underrepresented issues or communities based on analysis of large datasets.

Discussion

This section illustrates how AI Facilitation often centers on managerial concerns and then pivots to one of the other conversational roles (teacher, colleague, or advocate). To illuminate these pivots, we organize the following discussion around how and why the TCer transitions between roles. Tracing these pivots clarifies the responsibilities and rhetorical skills that an AI Facilitator demonstrates in collaborative work. In addition to clarifying the role, these pivots speak to the complex relational work involved in sustaining human-AI collaboration.

Manager to Teacher: Filling Knowledge Gaps

One of the earliest pivots the Facilitator made was from manager to teacher in instances where the AI needed to be enculturated into the team through a better understanding of group norms and shared language. Enculturation is the "process of learning our own culture" (St.Amant, 2016, p. 7) and in collaborative teams, this involves developing shared norms and understandings of language and processes. As collaborators who have worked together several times, we had a rhythm to our work process that we had cultivated over time. Therefore, it was a bit jarring in instances where the AI, for instance, used a lot of pleasantries. In response to one piece of feedback, the AI stated, "Thank you for emphasizing the importance of critical engagement and assertiveness in our collaboration. I appreciate your guidance and will ensure to provide thoughtful, independent analysis moving forward." This statement was not inaccurate; however, the Facilitator recognized an opportunity to help the AI enculturate into the team. To do so, the Facilitator stated, "please do away with the pleasantries." In doing so, the AI focused its responses more on the task at hand, which aligned with the group's working expectations. This foundational instruction helped set expectations for the AI's role in the group; however, the Facilitator intervened at a more granular level when it was evident that the AI needed more information about the coding process itself.

Beyond group norms, the Facilitator shifted focus at times from verifying outputs to explaining how the AI could be more aligned with the team's coding process and expectations. In multiple instances, the AI stated its recommended codes without justifying their relevance or situating the codes in the text. In one moment, the Facilitator seized the opportunity to clarify expectations, explaining "What in the text made you code normativity? Again, we need this information. Think out loud. This makes you a good collaborator." Similar to the enculturation example above, the Facilitator focused less on accuracy and more on the AI's alignment with the group's workflow and expectations. These teaching moments helped the AI begin to participate more meaningfully in the work. Therefore, the Facilitator continued to look for gaps in conceptual knowledge as opportunities to support the AI's involvement.

Filling in the AI's local knowledge gaps not only supported more accurate analysis but also helped the Facilitator improve the AI's enculturation into the team's shared understanding and knowledge. Since the interviewees were all students, there were several instances where campus-specific-phenomena were discussed. In one example, a student mentioned being an online student and all human coders coded the instance as 'community.' When the AI did not include this code, the Facilitator determined that the omission could be due to a lack of tacit knowledge about the campus community. Thus, the Facilitator stated, "We realize that you were unaware that the institution where these students go to school has a 100% online option. These students operate in a different community, so we coded as a community. Do you agree?" The AI responded that the knowledge clarified the context, and it agreed that 'community' should be a code. In this example, as with the prior examples in the teacher section, enculturation is made possible in instances where the Facilitator moves beyond accuracy to fill knowledge gaps. Teaching played a foundational role in the AI's performance and the Facilitator jumped into this role intermittently, when necessary. Unlike the teacher role, pivoting from manager to colleague required more attention and consistency.

Manager to Colleague: Creating Space for Pause

The pivot from manager to colleague began when the Facilitator slowed the pace of collaboration to create space for the AI's contributions. Pausing thus required the Facilitator to resist the urge to move quickly and efficiently, instead taking the time to ask follow-up questions and provide the AI time to respond. In one instance, the Facilitator asked "Why do you suddenly agree with putting in agency? Please elaborate. Here is where longer answers are appreciated to better understand your thinking." The team learned that the AI was focusing on dissemination and emotions within the participant's experiences, which helped the team understand its decision-making process. Taking the time to dive into the AI's contributions signals how the AI was valued as a meaning-making member of the collaboration.

Part of this pivot to colleague involved taking the time to restructure expectations to best situate the AI for meaningful and substantial collaboration. At times, this involved positively reinforcing the AI's behaviors that were supporting the collaboration. In one exchange, the AI indicated which codes were 'emphasized' in a statement and which were secondary (or, as the AI termed them, 'relevant'). The Facilitator responded with the following, "We would also like to note that in statement 3 your discussion of relevance versus emphasis is really important and was really helpful…please keep doing this." Here, the Facilitator recognized the AI's contributions and gave it the space and vocabulary to continue being an effective collaborator. Though time intensive, taking the time to confirm the AI's positive communication styles helped the team treat the AI as a colleague and benefit from its contributions and meaning-making.

In many instances, creating space afforded the AI opportunities to contribute while helping the team leverage the AI's insights. In particular, the Facilitator valued incorporating the AI in moments of conceptual disagreement. For instance, the human coders continued to struggle creating distinctions between the definitions for 'knowledge' and 'awareness.' In light of this difficulty, the Facilitator communicated to the AI that "Amber coded as knowledge and Mark coded as awareness. Heidi thinks it might be an overreading. We would like your input." In response, the AI argued for neither—instead, arguing that ethics was the primary code. We were impressed by the AI's unique contribution here that we ultimately adopted. The contribution spurred new dialogue that helped us think through the interviewee's experiences and situate it within the broader context and help the coalition define and frame disability etiquette on its campus.

Manager to Advocate: Embracing Anticipatory Thinking

The move from manager to advocate began when the Facilitator pivoted from equipping the AI with a disciplinary knowledge base to preparing the AI to align its decision-making with the coalition's project-specific goals. Specifically, in pivoting toward the advocate role, the priority shifted to helping the AI see the coalition's stakeholders as end users. For instance, the Facilitator explained an important change in our codebook that anticipated the project's deliverables. We informed the AI that we would remove 'etiquette' as a code, explaining that "it does not make sense to have 'etiquette' be a code. We want to think of each code in our codebook as representative of a different component of disability etiquette." This decision was geared toward our plan to present the coalition with a framework or set of themes for understanding disability etiquette on campus. Providing this rationale helped the AI align its future decisions with the coalition's purpose of raising awareness about disability etiquette on its campus. Ultimately, this anticipatory thinking encouraged the team to see the AI not as a tool but as a partner in shaping and uncovering findings that could support the community-engaged research goals with the coalition.

The pivot toward anticipatory thinking was particularly important when the Facilitator prompted the AI to help the team think through key concepts that would inform how disability etiquette was communicated to the coalition. We were mindful of the coalition's goals throughout the project, and we were particularly attuned to the fact that closely related concepts—such as 'normativity' and 'ethics'—would be difficult to distinguish. Additionally, after interviewing the coalition's members, we knew that the themes associated with 'normativity' and 'ethics' would be key components in how disability etiquette was framed and defined. As we worked through the transcripts, disagreements emerged. During a disagreement about one statement—where the interviewee reflected on capitalizing the 'D' in disabled—only Mark coded for 'ethics.' To explore this difference, and inform the AI that there was disagreement, the Facilitator informed the AI and asked, "For statement 35, none of us saw ethics but Mark did. What do you think about this?" In response, the AI disagreed with Mark and situated 'normativity' and 'community' as the more relevant codes. The AI explained why it did not code for 'ethics' and made the argument that the perspective on language was grounded in social dynamics and should be considered a normativity concern. By offering an alternative and justifying its coding, the AI helped the team clarify the conceptual boundary between 'ethics' and 'normativity,' which would later shape how disability etiquette was framed and defined when communicating results to the coalition.

Limitations

This study presents findings from an exploratory case study in an effort to articulate the emergent concept of the AI Facilitator role and has three main limitations. First, our collaborative group has worked together previously, which may have influenced the success of facilitation. For example, we did not run into significant issues with human-to-human norming or challenges related to collaborative workflows. Future studies might investigate how an AI Facilitator can be operationalized in a new team, which would require balancing both AI integration and facilitating new interpersonal relationships and expectations.

Secondly, our team shared an interest in exploring AI integration in research practice. While this alignment supported a productive and exploratory environment, it also created conditions that may not reflect the realities of other collaborative settings. We recognize that our shared interests may not reflect the range of perspectives or hesitations about AI in broader contexts. In these instances, AI Facilitators may need to spend more time engaging collaborators, listening to concerns, and adapting processes in a way that reflects every collaborator's values. An outcome of this process may be that AI is not included in the collaboration, which would be an appropriate outcome given the pressing concerns and ethical implications of AI work.

Lastly, though this paper focused on defining an emergent concept, we acknowledge that AI integration raises important ethical questions, including algorithmic biases. While we briefly discussed these concerns when appropriate, future work can further examine how ethical considerations can and should inform facilitation practices with AI and future technologies.

Conclusion

This study demonstrates how AI facilitation can involve moving beyond accuracy and attending to the relational and rhetorical dimensions of human-AI collaboration. By pivoting from a managerial role to the roles of teacher, colleague, and advocate, AI Facilitators enable the AI to participate more meaningfully in the co-construction of knowledge. These pivots reflect the adaptive, rhetorical work required to sustain collaborative engagement, highlighting a growing opportunity for TCers to apply and expand their expertise in AI-enabled spaces.

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3. The Error of Using Readability Formulas for Research and Practice: An Integrative Review of the Technical Communication and Accounting Literatures

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Abstract: Because some U.S. government agencies have required documents to be written at a specific reading grade level, and Microsoft Word can be set to evaluate readability, readability formulas seem ensconced in the workplace. Given the formulas' limited variables, however, the Technical Communication (TC) literature has long evidenced resistance to readability formulas, especially to direct revision. Should readability formulas be included in TC research, or in the TC practitioner's toolkit? To address this conundrum, an integrative literature review analyzes readability formula discussion in the TC and Accounting literatures.

Keywords: Flesch Reading Ease, Flesch-Kincaid Reading Grade Level, McCall-Crabbs scores, Readability, Audience-appropriate texts

Readability formulas have been part of the technical communication (TC) landscape for almost 65 years (Docter, 1961), and in numerous articles, technical communicators have objected to applying the formulas to their work (Bruce et al., 1981; Carliner et al., 2023; Clark, 1975; Connaster, 1999; Davis, 1967; Docter,1961; Giles, 1990; Hargis, 2000; Plung, 1981; Redish, 1981, 2000; Schriver, 2000; Stevens et al., 1992). As recently as 2023, in contemplating TC's past, Janice Redish championed developments in "user-centered focus, user-centered design, [and] usability testing" (as cited in Carliner et al., 2023) and dismissed readability formulas because they ignore "the person who's going to actually use the text." In support, Karen Schriver (2023) commented,

> The most overrated development for technical communication is the inclusion of readability statistics in Microsoft's MS Word. Adding readability output to MS Word led many people to believe that running the Flesch or Kincaid formula would tell them if their document was understandable or not. . . many writers and even non-writers look to readability output as a kind of one-button

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> solution to understandability. But as research on usability has clearly shown, the output was really overrated in terms of what it told us about text quality. And here we are many years later still haunted by the same formula in Microsoft's Office 365. (as cited in Carliner et al., 2023)

The word "readability" in the phrase "readability formula" may be part of the problem. Generally, the idea of "readability" has a positive connotation for technical communicators. Christina M., a U.S. technical editor, noted, "Technical editors improve readability, by making sure the content has a consistent voice, tone, style, and format" (as cited in Henkin, 2023). Layout and document design are important facets of readability. As Nikki Arnell (2023) observed "viewers must be able to easily view the consistent chunks of information, or it will compromise readability." Denmark et al. (2022) advised, "write in plain English. Ninety percent of U.S. states have specific readability guidelines…. Content should not exceed a 3rd- to 8th-grade reading level, depending on the state," (p. 4) and "Measure readability (Flesch-Kincaid is generally accepted as the standard)" "Readability" emerges, then, as a TC motif and as it is reported in the review of the TC literature.

Because readability formulas seem widely accepted for use in TC, they might be useful for studying readability as part of TC theory. On using them, Moreno and Casasola (2016) posited that

> although some concerns have been raised about readability formulas, this study uses an adapted version of the Flesch readability formula for comparability because it is the measure most widely applied by the accounting literature in general and studies of readability evolution in particular. (p. 205)

Thoms et al., (2020) acknowledged Redish (2000), who has repeatedly denied the dependability of formulas (Carliner et al., 2023; Redish, 1981); otherwise, Thoms et al. do not further delve into the TC readability literature, which suggests that, despite the formulas' drawbacks, using them as research tools can render meaningful insights that can contribute to the TC literature.

Research Problem

Though readability formulas seem ingrained in TC, they do not offer a useful evaluation. The Flesch Reading Ease and the Flesch-Kincaid formulas, for example, measure only the number of words per sentence and the number of syllables per word, rendering either a score on a scale of zero to one hundred, or a reading grade level, respectively. The Flesch Reading Ease's grounding in readability is from grade school children who were tested nearly 100 years ago, and the Flesch-Kincaid's is drawn from 1980s Navy personnel. Both formulas are available as a Microsoft Word tool setting.

That readability formulas are so widely used is problematic, especially when they become a part of the TC research methodology. Thoms et al. (2020) and Moreno and Casasola, (2016) study TC questions on readability drawn from Accounting, which has been studying and making use of readability formulas, usually with empirical studies, for as long as it has been a concern in TC. Is there something worthwhile that might emerge from examining this research that might benefit TC? This article explores that research to try to learn from it.

Background on Readability Formulas

Education scholars first developed readability formulas in the 19th century to determine appropriate reading materials for children. Russian scholar N. A. Rubakin evaluated readability to correlate with a 1500-familiar words vocabulary list (Klare, 1963). By 1898, F. W. Kaeding correlated the word count of a text with its readability. In the US, E. L. Thorndike catalogued words most frequently found in English texts, providing teachers insight into measuring difficulty, especially for new texts.

By the 1920s, the Vogel and Washburne Formula could evaluate 100-word samples, accounting for the numbers of different words, prepositions, words not on the Thorndike list, and simple sentences. These factors were then cast into a regression equation:

$$^{X}1 = .085X2 + .101X3 + .604X4 - .411X5 + 17.43$$

This formula is credited as a precursor to Rudolph Flesch's (1948) formula:

Reading Ease = 206.835 - 846wl - 1.015sl

wl = word length (number of syllables per word)

sl = number of words per sentence in 100-word samples

Originally, the Flesch Reading Ease formula was applied to 100-word samples, which allowed it to be applied to longer works, such as books (Flesch, 1948, p. 225). The Flesch Reading Ease yields a score on a 0 to 100 scale: the higher the score, the more readable the text (p. 230).

Other formulas popularized after World War II still in use today include the Dale-Chall Formula (Dale & Chall, 1948a, 1948b), which was revised in 1995. The Dale-Chall formula drew upon 769 words common to Thorndike's list, another list from the International Kindergarten Union, and an 8000-word list familiar to 4th, 6th, and 8th grade students, expressed in this formula:

$$Xc_{50} = .1579X_1 + .0496X_2 + 3.6365$$

Xc_{50} = reading score of a pupil who could answer one-half of the test questions correctly

X_1 = Dale score (relative number of words outside Dale list of 3000 words)

X_2 = average sentence length

3.6365 = constant (the point against which deviation and correlation are measured) (1948a, p. 18).

In 1981, J. Peter Kincaid published his revision of the Flesch Reading Ease. A version of it is available as part of Microsoft Word 365 (Microsoft, 2024) and renders a reading grade level using the same two variables from the Flesch Reading Ease:

Grade Level = 0.39 (Avg. No. Words/Sentence) + 11.8 (Avg. No. Syllables/Word) - 15.59 (Kincaid et al, 1981, p. 38).

The Flesch Reading Ease and the Flesch-Kincaid Reading Grade Level are widely available for a technical communicator's use. Not only can Microsoft Word easily be set to run the Flesch Reading Ease and the Flesch-Kincaid Reading Grade Level formulas, various web sites offer free readability assessments that only require the user to cut-and-paste text onto the site to receive the Dale-Chall, Flesch Reading Ease and Flesch-Kincaid Grade Level readability measures, among others (Readability formulas, n.d.).

Readability Formulas in the Technical Communication and Accounting Literatures

Studying readability questions in accounting is relevant to TC because the *2020–2021 STC Salary Database*'s "Ten Largest Job Gains For Technical Writers In 2020" ranked "Management of Companies and Enterprises" third among top-10 employers (2022, p. 26). A company's annual report for stockholders, then, might be written by a TC professional and could be part of the public relations specialist's purview as well (p. 25).

Some U.S. government agencies require documents to be evaluated with readability formulas. The U.S. Food and Drug Administration (2001) has recommended that patient-support materials be written at the eighth-grade level, which the Flesch-Kincaid Reading Grade Level formula, originally created for the U.S. Navy, supplies (Kincaid et al., 1981).

Research Questions

With this background in mind, we can pose these questions:

- Research Question One: Should readability formulas be part of a TC research methodology, when so many valid objections have been raised to their use, or has the ease of the application of readability formulas

ignored what otherwise does not belong in our professional toolbox, much less in research methodologies generating new knowledge in TC?
- Research Question Two: Because readability formulas have been a part of the Accounting literature longer than, and to a greater degree, than in TC, has TC missed something of value?

Research Methodology: The Integrative Literature Review

To explore readability and its meaning to TC, an integrative literature review can be useful, especially "when the knowledge base of a mature topic is larger and more diversified," which is certainly the case after 65 years in both TC and Accounting, because it can "capture the dynamics and development of new knowledge on the topic by reviewing and critiquing the literature and then synthesizing knowledge in its current state through . . . [its] reconceptualization" (Torraco, 2016, p. 409). Examining the references for Moreno and Casasola (2016) and Thoms et al. (2020) revealed that their inquiries are grounded in readability scholarship from the field of Accounting. Moreno and Casasola (2016), for example, cited 23 Accounting journals.

To access additional literature for TC and Accounting, the MLA, ProQuest (Accounting, Tax, and Banking Collection), and Business Source Complete databases were queried with the keywords "Readability Formula," "Flesch" and Flesch Reading Ease." These searches rendered 21 articles on readability as a TC issue and 24 in Accounting for review, as listed in Table 3.1:

Table 3.1. TC and Accounting Readability Researchers Reviewed

Technical Communication	Accounting
Arnell, 2023	Adelberg, 1979
Bruce, Rubin, & Starr, 1981	Clatworthy & Jones, 2001
Carliner, Redish & Schriver, 2023	Courtis, 1986, 1995, 1998, 2004
Cherry, 1982	Hongkang, et al., 2022
Clark, 1975	Hrasky et al., 2009
Connaster, 1999	Jones, 1988, 1997
Davis, 1967	Jones & Shoemaker, 1994
Denmark, Lippincott, & Morel, 2022	Lewis et al., 1986
Giles, 1990	Li, 2008
Hargis, 2000	Miller, 2010

Technical Communication	Accounting
Henkin, 2023	Pashalian & Crissy, 1952
Klare, 2000	Schroeder & Gibson, 1990
Longo, 2004	Smith et al., 2006
Moreno & Casasola, 2016	Smith & Taffler, 1992
Plung, 1981	Soper & Dolphin, 1964
Redish, 1981, 2000	Still, 1972
Schenck, 1977	Stone & Lodhia, 2019
Schriver, 2000	Stone & Parker 2013
Spinuzzi & Zachry, 2000	Sydserff & Weetman, 1999
Thoms, Degenhart & Wohlgemuth, 2020	Tan et al., 2014

Additionally, the search included names of these scholars who appeared multiple times with forward and backward searches of their names as listed in Table 3.2:

Table 3.2. TC and Accounting Forward and Backward Name Searches

Accounting	TC
Clatworthy, M.	Redish, J.
Courtis, J.K.	Schriver, K.
Jones, M.J.	
Shoemaker, P. A.	
Smith, M.	
Stone, G.	

Using the same search terms, five TC-focused journals were also searched because they have long been the major TC journals, which is important since this topic spans 65 years

- *IEEE Transactions on Professional Communication*
- *Journal of Business and Technical Communication*
- *Journal of Technical Writing and Communication*
- *Technical Communication*
- *Technical Communication Quarterly*.

Similarly, Ryan K. Boettger and Erin Friess (2020) surveyed these journals in their longitudinal content analysis, and so did Lisa Melonçon and Kirk St.Amant (2019) to study technical communication research methods in articles. After queries in both disciplines, relevant articles were analyzed according to their content and conclusions.

Findings

The literature review from the TC and the accounting literature answered the research questions:

- Research Question One: Should readability formulas be part of a TC research methodology, when so many valid objections have been raised to their use, or has the ease of the application of readability formulas ignored what otherwise does not belong in our professional toolbox, much less in research methodologies generating new knowledge in TC?
- Research Question Two: Because readability formulas have been a part of the Accounting literature longer than, and to a greater degree, than in TC, has TC missed something of value?

This study's first research question focuses on TC theory and research, and the second question relates to literature published in 21 Accounting journals. The results are organized with a discussion of TC literature and then of the Accounting literature.

Readability Formulas in the Technical Communication Literature

The TC literature demonstrates that technical communicators have resisted readability formulas, without any studies posing questions regarding readability set up in an experimental design. In fact, up until Moreno and Casasola (2016) and Thoms et al. (2020), TC scholars had not used readability formulas as part of their research methodology, perhaps because the resistance to their use has been so adamant. Instead, theoretical concerns with audience and comprehension emerged as dominant themes in the TC articles addressing readability formulas. As early as 1961, Stewart Docter asserted, ". . . technical writing is not, at least with the present formulas, a proper medium for the Flesch methods" (p. 91) because "our readers are human and do become bored and fatigued" (p. 96). After excoriating writing to please a formula, because to do so would be "to invite disaster," Andrew K. Clark (1975) reminded the technical communicator "how important the *reader* is perceived to be in the communication process" (p. 69).

In the 1980s, technical communicators more actively resisted readability formulas, and the formulas do not appear in TC research methodologies. In 1981, *IEEE Transactions on Professional Communication* published, "Forum: Readability Formulas: Used or Abused?" It consisted of six articles (pp. 43–54) that the editor claimed to be "both pro and con, on the use of readability formulas" (p. 43), though most responders opposed the use of readability formulas. In this forum (1981), Redish noted that readability formulas cannot determine a text's relevance for an audience, citing Robert M. Gordon's (1980) study measuring Plato's *Parmenides* as appropriate for 4th- to 8th-grade students, according to the Dale-Chall and Fry formulas (pp. 47–48). Daniel L. Plung (1981) faulted readability formulas for not considering audience: "All books on writing, expository and technical, agree that writing must be adapted to its intended audience. Yet readability formulas ignore this rule" (p. 53). Furthermore, he objected to being required to write for "people with extremely limited vocabularies and reading abilities" (p. 53).

As Plung suggested, comprehension continued to concern technical communicators. Bertram Bruce and his collaborators (1981) explained how writing to accommodate a readability formula could create miscomprehension if conjunctions indicating cause and effect, for example, are omitted to shorten a sentence, an edit to which readability formulas such as the Flesch Reading Ease and the Flesch-Kincaid Reading Grade Level respond favorably when the number of words per sentence is a variable: shorter sentences render a higher Flesch Reading Ease score (90 to 100 is evaluated as "very easy"), or a lower reading grade level for the Flesch-Kincaid.

Lawrence T. Frase (1981) argued readability formulas as an ethical lapse because, for a work to be readable, it should be comprehensible. However, the formulas' variables are only peripherally related to comprehension, such as the correlation with the 1926 McCall-Crabbs Standard Test Lessons in reading from the original Flesch formulas.

Quantifying comprehension: The McCall-Crabbs correlation

On comprehension, Eleanor Schenck (1977) first questioned this serious methodological flaw with the Flesch Reading Ease, which cited a positive correlation of its scores with the McCall-Crabbs Standard Test Lessons in Reading as proof of comprehension. The correlations were drawn from question-comprehension scores based on passages that test takers (who were children) had read in 1926. These scores were correlated with the Flesch Reading Ease as well as other formulas developed at that time (Jacobson et al., 1978).

On comprehension, Flesch (1948) admitted that

> For many obvious reasons, the grade level of children answering test questions is not the best criterion for general readability. Data about the ease and interests with which adults will read selected passages would be far better. But such data were not available at the time the first formula was developed, and they are still unavailable today. So McCall-Crabbs' Standard test lessons are still the best and most extensive criterion that can be found; therefore they were used again for the revision. (pp. 222–223)

Though Flesch completed his PhD at Columbia University's Readability Laboratory of the American Association of Adult Education in 1944, he did not choose to test his formula for comprehension on adults (Longo, 2004, p. 168), which is odd since after World War II, many veterans were attending college on the GI Bill. Schenck (1977) does not directly ask but infers the question of the extent data from 1926 would be relevant to readers in 1948, when the Flesch and the Dale-Chall formulas were published, or in 1977, when Schenck published her article. Jacobson et al. (1978), who researched reading processes, concluded, after working with revising the McCall-Crabbs Standard Test Lessons, that "the McCall-Crabbs norms are out of date" and required revision (p. 229).

Introducing the Flesch-Kincaid Reading Grade Level Formula

J. Peter Kincaid's Formula Reading Grade Level (1981) accounted for comprehension to some degree, but such an undertaking never occurred for the Flesch Reading Ease. The same March 1981 issue of *IEEE Transactions on Professional Communications*, with the previously cited readability forum, heralded the publication of what has come to be known as the Flesch-Kincaid Reading Grade Level formula: "a recalculation of the Flesch Reading Ease Formula developed by testing Navy enlisted personnel on their understanding of passages from Navy training manuals" (Kincaid et al., 1981, p. 38). For this formula, the variables remained the number of words per sentence and of syllables per word, with vocabulary lists included to quantify comprehension further, including the 1948 Dale-Chall List, plus three different lists particular to the military and one specifically from U.S. Navy training materials: "About 1,900 words common in Navy documents were identified by a computer frequency analysis of 240,000 words taken from two basic Navy training texts used in recruit training" and "a merged list of 4300 root words made up of three military word lists," (Kincaid et al., p. 39). Kincaid used these variables, rather than updating the 1926 McCall-Crabbs grounding for reading scores to account for comprehension. Instead, he modeled his formula on the Dale-Chall Formula, which accounts for deviation from vocabulary lists. Those deviations are not supplied on the truncated version of the Flesch-Kincaid Reading Grade Level included with Microsoft Word, which uses the same variables but renders a reading grade level.

The Research Deficit

Though readability formulas lack research focused on adults, which Flesch readily admitted, the formulas lack research support for use in TC. To begin to address this void, Richard M. Davis (1967) experimented with headings, description, and visual aids in a study with more than 2300 subjects and concluded by lamenting that,

> considering the rooms full of reports generated in the production of an automobile, the tons of paperwork developed in the building of a power plant, or the shelves full of manuals and other supporting documents necessary to maintain a single airplane, it is a little surprising . . . that there just does not seem to be much controlled experimentation aimed at determining how such things should best be written to fill their functions. (p. 38)

Today, such research emanates most frequently from universities, whose TC programs were only beginning as recently as the 1960s and 1970s. Tracing the development of academic programs in TC, Kenneth T. Rainey and Rebecca S. Kelly (1992) credited Rensselaer Polytechnic University for the first TC PhD program, beginning in 1965, with the first two dissertations completed in 1979. At Carnegie-Mellon University, the second oldest university offering a PhD in TC, no dissertations were completed there before the 1980s. Considering these dissertations, when Davis (1967) published his research related to TC and readability, only one dissertation per year related to TC had been written in 1965, 1969, and 1973, respectively, gradually increasing to 32 in 1988 and 31 in 1989. And though Rensselaer Polytechnic University is cited as the first technical communication PhD program, Rainey and Kelly (1992) credit the first PhD dissertation as Harold Burton Simpson's "A Descriptive Analysis of Scientific Writing," completed at the University of Michigan in 1965, with other early works completed at Columbia University (1969) and the University of Houston (1973), so very little TC research to support the study of readability was being conducted at universities.

Bell Labs and Writer's Workbench

Without support of TC research in universities, Bell Labs created Writer's Workbench, an evaluative software whose various iterations released in the 1970s and 1980s included the Flesch Reading Ease, the Flesch-Kincaid Reading Grade Level formula, and other formulas, as well as additional information for evaluation of writing, such as the number of words, length of sentences, percentage of verbs, and the percentage of active or passive voice, with vestiges of these programs still apparent in Microsoft Word 365's Editor. To introduce their research, Bell Labs researchers published articles in *IEEE Transactions on Professional Communications*. Two articles that can serve as examples are one by computer scientist Lorinda Cherry (1982) and another by four Bell Labs employees (Macdonald et al., 1982).

On writing, Cherry asserted, "For many people, writing is painful and editing one's own prose is difficult, tedious, and error-prone" (p. 100). Macdonald et al. (1982) assured their readers of the general agreement over what constitutes good writing, which they defined as grammatical correctness, correct spelling, and conciseness. From sources described as "disparate," they assimilated advice on writing from Walter Strunk and E. B. White, "who wrote notes for a college course" [*sic.*] ; George. R. Klare, "who wrote about the readability of a text"; and E. B. Coleman, "who empirically studied comprehension," which led them to assert these experts valued active voice, "short concrete words," and a verbal (rather than a nominal) style. In these two articles, Cherry (1982) and Macdonald et al. (1982) described various computer programs that constitute Bell's Writer's Workbench, which carried out tasks now taken for granted, ranging from tracking spelling errors and punctuation errors, or assessing word choice, or measuring a passage's abstractness. Subsequent Bell Labs publications seemed similar to "complimentary copy," articles in trade magazines that claim to compare different products but are really advertisements, in this case for Writer's Work Bench (e.g., Coke & Koether, 1983; Frase, 1983). For technical communicators, the discussion about readability formulas decreased, with the title of one article declaring "Last Rites for Readability Formulas in Technical Communication" (Connaster, 1999).

Technical Communicators Respond

In 2000, another forum on readability formulas, this time in the *ACM Journal of Computer Documentation*, included a reprint of the first chapter from George R. Klare's *The Measurement of Readability* (1963), another response from George R. Klare (2000), and from IBM software engineer Gretchen Hargis (2000), readability researcher J. Redish (2000), TC researcher K. Schriver (2000), web designer K. Zibbel (2000), and TC researchers Clay Spinuzzi and Mark Zachry (2000). A resonant theme for the articles from TC scholars supported implementing usability studies to determine readability, and to support revision; audience and comprehension again emerged as the technical communicator's primary concerns. In the final article, Spinuzzi and Zachry (2000) allude to "genre ecology," encouraging technical communicators to work with readers to create meaning but not specifically addressing readability.

The Accounting Literature

The second research question for this study focuses on the Accounting literature, which dealt with Accounting concepts such as "obfuscation," typically an attempt to measure how less-readable text might obscure loss or other forms of dishonesty.

In Accounting, readability formulas began to be used only a few years after R. Flesch (1948) started promoting their application to adult reading materials, specifically professional documents (what we call business and technical communication today). In a 1950 issue of the *Journal of Applied Psychology*, Siroon Pashalian and William J. E. Crissy first recommended applying the Flesch Reading Ease to annual reports, using research from Pashalian's 1949 New York University master's thesis in psychology, "An Investigation of the Application of the New Flesch Readability Formulas to Corporate Annual Reports." Two years later, in *The Journal of Accountancy*, Pashalian and Crissy (1952) published an article that is in places verbatim to the *Journal of Applied Psychology* article. Because the 1952 article focused on applying readability to Accounting issues, specifically the readability of annual reports, it is the more relevant one referenced in this study. In this article, they recommended using the Flesch Reading Ease and the Flesch Human Interest score. Citing feedback from readers indicating "considerable apathy to company reports," they recommended applying the Flesch Reading Ease to improve how easily company reports can be read and comprehended (Pashalian &

Crissy, 1952, p. 244). Recognizing the difficulty of writing these reports, to provide "sufficient technical data and information for the financial expert," they sought to accommodate a stockholder reading about a company's yearly progress, its technological and scientific advancements, or both (p. 215).

Applying the Flesch Reading Ease and the Human Interest Rating formulas to the annual reports for companies cited by *Business Week*'s Corporate Billion-Dollar Club listing for June 11, 1949, Pashalian and Crissy (1952) learned that these reports' scores ranged from 6 to 58 on the Flesch Reading Ease, which rates them as "very difficult" to "fairly difficult" on Flesch's scale (p. 215–216). Flesch equated the "very difficult" category with "scientific" journals and "fairly difficult" with what he referred to as "Quality," which rated as less difficult than "Academic" but more difficult than "Digests," such as *Reader's Digest* (Flesch, 1948, p. 230).

Accounting Responds

An Accounting scholar immediately supported Pashalian and Crissy (1952). John A. Beckett (1952), a former MIT Accounting Professor and practicing San Francisco accountant, wrote to the editor of *The Journal of Accountancy*, supporting the Flesch Reading Ease as "a step in the right direction" but recommending "further experimentation . . . if the method is to prove helpful to financial reporting . . . [I]t is hoped that the profession will use the best results—with imagination and judgment—toward the improvement of the art" (p. 547). Though Beckett called for testing, Accounting was not quick to explore readability formulas but did so before TC began to consider using them.

Fred J. Soper and Robert Dolphin (1964) appear to be credited with the next academic study of readability formulas. Replicating Pashalian and Crissy (1952), Soper and Dolphin (1964) evaluated annual reports according to the Flesch Reading Ease, citing Pashalian and Crissy (1952) and Pashalian's master's thesis (1949), from which her two articles with Crissy, a Queens College professor, were drawn. On the Flesch Reading Ease, they concluded it offers "a useful rating of reading ease for corporate annual reports" (p. 362), noting "the reading ease of corporate annual reports has not improved from 1948 to 1961, [and] reading ease is a vital factor in aiding comprehension of the corporate annual reports. . ." (p. 362). As a result, the Flesch Reading Ease emerged rendering the same fascination with evaluating readability formulas that sustains it to this day.

Ubiquity of the Flesch Reading Ease

The Accounting literature provides proof of the dominance of the Flesch Reading Ease, as many studies used readability formulas as a central tenet of their methodology in the 73 years after Pashalian and Crissy (1951). Generally, the 24 studies identified in this literature review sought to discover a relationship between readability and an Accounting theoretical concept such as "obfuscation," which typically means to seek to determine deception, and if deception could be determined by a readability score.

In these studies, the Flesch Reading Ease and the Flesch-Kincaid Reading Grade Level were used more often than any other tool to evaluate readability. Its use eventually pointed to its ubiquity, which Accounting researchers Mark Clatworthy and Michael J. Jones (2001) supported, justifying it as a tool when they sought to determine if the middle of the annual reports were less readable for less-profitable companies, as John K. Courtis (1998) claimed. At this point in the Accounting literature, objections to the Flesch Reading Ease included its limited measure of readability, given the variables and its age, which included its comprehension correlations dating to the 1926 McCall-Crabbs scores, but instead, Clatworthy and Jones (2001) characterized it as resilient, and cited Courtis (1998) to affirm its "computational ease, understandability, and comparability" (p. 313). Clatworthy and Jones (2001) concluded by reminding readers that they aimed to address Courtis' claims, not to test the Flesch Reading Ease as a method for evaluating comprehension.

Courtis (1998), for example, had sought to connect a corporation's reported loss to a lower readability score. He sampled 120 companies on the Hong Kong Stock Exchange, with attention, in terms of profitability, to the top and bottom 30 companies. He asked if loss would be buried in the middle of an annual report, rather than signaled in the introduction, or included in the conclusion. To study overall readability, he applied the Flesch Reading Ease because it "has been the dominant choice of researchers, essentially because of its computational ease, general understandability, and comparability with other similar studies" (p. 2). He admitted as problematic that " validation studies . . . seem to be quite dated" (p. 2), which must mean the McCall-Crabbs scores since he references George R. Klare (1964). Here, Courtis (1998) does recommend that "Until an accounting researcher successfully correlates a readability formula score with a conventional reading comprehension test, there is a risk that these measures could be misleading" (p. 2). Courtis concluded by noting that they can provide a general idea of what they claim to measure, which is fine so long as too much judgement is not predicated upon them.

Discussion

Accounting has long used readability formulas for assessment. If Accounting had not used readability formulas to assess documents, perhaps the formulas would not be in Microsoft Word 365. Instead, the business world, and Accounting in particular, heed a rudimentary assessment of writing, especially for the annual report, as a convenient way to ignore and elide the time and expense required to correlate the score meaningfully with comprehension and through the study of usability.

Business and technical communicators then have four options for dealing with readability studies and readability tests:

- Push for user-experience studies to evaluate readability of documents;
- Endorse "big data" studies to refine readability tests and triangulate methods;

- Revise the Flesch Reading Ease and the Flesch-Kincaid Reading Grade Level Readability formulas;
- Wait for readability tests to fall into disuse.

Push for Usability Testing

Carliner et al. (2023) advocated for usability studies since they are more meaningful. What has kept usability testing from being more widely used is the time and expense that it calls for. However, to what extent have the post-COVID-19 technical advances of communication technologies, such as Zoom calls, been fully exploited? In other words, how might such technology decrease the amount of time it takes to set up and carry out usability studies? Such studies have not yet begun to emerge from TC theory.

Endorse "Big Data" Studies

Some Accounting researchers (e.g., Hongkang et al., 2021; Miller, 2010; Smith et al., 2006) have advocated correlating readability formulas with other variables. For example, to test the "obfuscation" hypothesis, Smith et al. (2006) examined the chair's statement for 513 Malaysian companies, correlating the Flesch Reading Ease with the Bullfighter Composite Index, which measures readability by the amount of "corporate jargon," because jargon is "likely to include potentially obfuscating terms and phrases" (p. 50). They correlated both scores with seven variables: "profitability," "liquidity," "total liabilities and assets," size in terms of total assets, "number of administrative boards, "PN [Pacific National] status," and "industry group [consumer, industrial, or trading]" (p. 56). Despite such extensive data analysis, no significant support for the obfuscation hypothesis emerged.

Brian P. Miller (2010) correlated the Gunning Fog Index, the number of words in a document, and eighteen other variables to measure the readability of 10-K reports, which are required annually by the SEC and are intended to be more detailed than annual reports. Miller concluded that longer, more complicated 10-K reports were less likely to be read than the typically shorter annual reports, which negatively affected the ability of 10-K reports to generate sales.

Hongkang Xu and their collaborators (2021) sought a correlation between a local government's political corruption and the readability of documents produced by those corporations that correspond geographically to those areas. They suspected that management of these companies would be more likely to write less readable reports. Examining 12,742 annual reports for 2369 different firms, from 2006–2014, they concluded that less readable reports were produced by such managers. Xu et al. (2021) see their work as contributing both to the obfuscation theme in accounting and political corruption and to measuring its effect.

Revise the Flesch Reading Ease and the Flesch-Kincaid

If the Flesch Reading Ease is to continue to be used, its correlation with comprehension should be addressed, and its 1926 comprehension scores should be updated. Though the U.S. Navy version of the Reading Grade Level accounts for technical vocabulary and its deviation from vocabulary lists, the version of the Flesch-Kincaid Reading Grade Level available with Microsoft Word 365 does not feature any correlation with any vocabulary lists, or any other correlation with comprehension other than assigning a reading grade level.

On these issues, Gerard Stone and Leah D. Parker (2013) critiqued the Flesch Reading Ease, arguing the word length variable to be the least meaningful but without advocating for its removal because doing so would leave the Flesch Reading Ease's score ". . . unusable. Moreover, reducing the number of variables to predict readability arguably further limits the measure's utility," especially because the formula is weighted about 89% in favor of word length, leaving sentence length at only 11% (p. 43). Tweaking word- and sentence-length weightings would create problems with how prose measured in the past might correlate with these scores. Rather than accept these formulas for their influence on research, Gerard Stone and Sumit Lodhia (2019) instead favor being more audience-focused and valuing document design. From the Accounting literature, they valued what had been written about visual aids--especially tables, charts, headings, and subheadings--and recommend a model for what could become a formula to evaluate document layout and design. However, even if the Flesch Reading Ease, and the Flesch-Kincaid were revised, unless meaningful variables were identified, the Flesch Reading Ease, and the Flesch-Kincaid, would still be manipulating syllable and word counts.

Wait for Readability Tests to Fall Into Disuse

Readability formulas may indeed eventually fall into disuse: for example, word processers like Google Docs and Open Office do not provide readability formula evaluation. Many U.S. government agencies continue to require organizations that seek funding to write and revise, according to reading grade levels; for example, the FDA recommends that patient labeling be written at an eighth-grade level (U.S. Food and Drug Administration, 2001, p. 16). On the other hand, a document recommending the use of readability formulas on the Centers for Medicare & Medicaid Services web site (see Figure 3.1) was removed (U.S. Department of Health and Human Services Centers for Medicare & Medicaid Services, 2021) and replaced in 2023 (see Figure 3.2).

TOOLKIT for Making Written Material Clear and Effective
Table of contents 10

SECTION 4
Special topics for writing and design

TOOLKIT PART 7

Using readability formulas: A cautionary note

Figure 3.1. From the Medicare & Medicaid ToolKit (U.S. Department of Health and Human Services Centers for Medicare & Medicaid Services, 2021)

Although Figure 3.1 advocates readability formulas, with reservations, Figure 3.2 does not mention them. The Fry "method" recommended in Figure 3.1 calculates a score based upon the same variables as the Flesch Reading Ease: the number of syllables per word and the number of words per sentence (Fry, 1968), and the SMOG index variables are another contortion of the number of syllables and sentence length, and includes the opportunity for the researcher to "Estimate the square root of the number of polysyllabic words counted" (Mclaughlin, 1969, p. 639) Rather than sentence length, the placement of sentences in the document are accounted for. Either reflects more of a fascination, as Bernadette Longo (2004) has asserted, with mechanism and technique than with readability.

Guidelines for effective writing

Keep content meaningful & user-focused

Give users clear value.
Ask yourself: Is this content saying something meaningful or adding new information?

Get right to the point.
People have limited attention and patience and are quickly frustrated when expectations aren't met. As communicators, it's our job to help them get what they need quickly.

Delete fluff.
Too much unnecessary text leads to skipping. Users don't care about what your organization and programs are doing; they care about WHAT AFFECTS THEM. Eliminate promotional, redundant, outdated, and trivial copy.

Show, don't tell.
Language like "this page makes it easy for you to find helpful contacts" is unnecessary. If the page really makes it easy, it should be obvious.

Limit introductory text or instructions.
If we write clearly and concisely, the purpose and meaning should be obvious.

Limit sentence & page length

Keep sentences as short as you can — the shorter, the better.
Try to keep sentences to 20 words or less. Express one point per sentence. Put the most important information at the beginning. Remember audiences are scanning, not reading.

Paragraphs should be 2 or 3 sentences max.
Put the most important information first.

Tips for web pages.
Write content in independently meaningful chunks that make sense when taken out of context. Each content chunk should address just one issue. Readers overlook the second point when there are multiple items in a single chunk.

If your webpage requires scrolling, make sure there are headers and/or menus to help users find what they're looking for. Consider breaking up long text across multiple pages.

Figure 3.2. From the current Medicare & Medicaid Services Guidelines for effective writing (U.S. Department of Health and Human Services Centers for Medicare & Medicaid Services, 2023)

Plain Language?

Although it would be reasonable to expect the digital and print manifestations of the plain language guidelines put out by the U.S. General Services Administration to support usability studies and to criticize readability formulas, such a stance has been weak, at best, with, for example, the 2011 Plain Language Guidelines only devoting about ten pages to testing, and in fact obliquely supporting Rudolph Flesch (1979) by citing one of his later books on style. An interesting contrast may be found in the U.S. Security and Exchange Commission (SEC) produced *A Plain English Handbook: How to create clear SEC disclosure documents* (1998). This handbook, which is still available for purchase on Amazon, is likely to be read by an accountant and includes a one-page chapter devoted to "Using Readability Formulas and Style Checkers." There, on readability formulas, the U.S. SEC (1998) notes, "Take their suggestions as just that—suggestions. The final test of whether any piece of writing meets its goal of communicating information comes when humans read it" (1998, p. 57). Interestingly enough, the U.S. SEC's guide for writing does not mention Rudolph Flesch's work. The SEC supports, in another brief chapter, the use of "focus group testing" (1998, p. 59), which is helpful but needs to be updated to represent how much more is now known about, and through, usability testing.

Conclusion

The Flesch Reading Ease and the Flesch-Kincaid Reading Grade Level formulas, like all readability formulas, are flawed: they depend upon too few variables, and as we have seen, adding variables generally has not proven fruitful.

Problems with comprehension correlation plague the Flesch Reading Ease and the Flesch-Kincaid. The Flesch Reading Ease's correlations are not only almost 100 years old but were based on data drawn from elementary school children. Surely reading abilities have changed since then, and better testing for usability, rather than readability, could be done with a cross-section of adults.

Tweaking the Flesch Reading Ease and Flesch-Kincaid's formulas' variables might seem more useful for the technical communicator. However, changes would require extensive testing, not only of the equation but also of comprehension. Fortunately, TC programs can be stimulated with corporate funding and, it is important to remember, despite the influence of artificial intelligence on writing, people will continue to read what technical communicators write and design. Testing and refining readability formulas could be done with "big data" approaches to support using the Flesch Reading Ease and the Flesch-Kincaid, but so far, correlating multiple variables in Accounting has not proven fruitful.

Technical communicators should acknowledge that the U.S. government's support for readability formulas is beginning to wane, as at least one agency is starting to remove grade-level readability requirements. (see Figures 3.1 and 3.2.) Additionally, readability formulas are not part of Google Doc or Open Office, which writers use for collaborative writing.

Considering the challenges of testing and revising the scores and the waning of government, and software, interest in these formulas, it seems more prudent to wait. While TC waits, technical communicators and researchers should understand the limitations of readability formulas and protest their use to determine usability. Additionally, they should not be accepted as tools for research methods in TC studies, not when human subjects can provide more accurate data on the use of documents, both print and digital. As reading and writing abilities wax and wane as part of the effects of educational experiences disrupted by epidemic, weather catastrophes, digital media, or AI, we must be more than ever observant, and flexible, in our approaches to evaluating audiences.

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4. Beyond Relevance: Improving Documentation Quality with the Kano Model

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Abstract: This pilot study refines my previously proposed (Strimling, 2019) reader-derived definition of documentation quality (DQ) by applying the Kano Model of customer satisfaction to it. The aim is to develop a more reliable way to collect DQ feedback and metrics, as well as provide evidence-based resources for teaching students how to write quality documentation. Technical documentation readers were asked to rate the same DQ dimensions used in my previous study (and originally based on Wang and Strong's (1996) comprehensive information quality category/dimension framework) using a Kano Model questionnaire. The results indicate that the Accurate, Easy to Understand, and Accessible DQ dimensions continue to strongly align with their respective information quality categories: Intrinsic, Representational, and Accessibility. However, unlike in my previous study, the Complete DQ dimension emerged as a better representative of the Contextual information quality category than the Relevant DQ dimension. These findings strengthen my proposed reader-oriented DQ framework, with the Kano Model providing insights into how documentation features influence user satisfaction. This approach offers technical communication professionals and educators a foundation for developing robust feedback mechanisms, metrics, and teaching resources, and represents an initial attempt to apply the Kano Model's well-established methodology to DQ.

Keywords: Documentation quality, documentation quality metrics, documentation quality feedback, teaching documentation quality, Kano Model of customer satisfaction

Collecting meaningful and actionable feedback from readers about the technical documentation they use is an important tool that technical communicators can use to improve the quality of their content. This feedback can also be used to create consistent and reliable documentation quality (DQ) metrics that technical communicators can present to their managers to both prove the value of good documentation as well as determine where more effort needs to be invested. But collecting feedback about DQ and creating metrics that measure it are not easy tasks:

- It can be very difficult to get any kind of feedback at all from readers about

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the documentation they use. There is often a disconnect between information producers and information consumers; this might be due to a lack of time, resources, or interest—or even a company policy of not asking customers about DQ (possibly because they are afraid of what readers will say and be unable to fix the problems they raise).

- Knowing what metrics we should be looking at to determine DQ can be very complicated. What should we be measuring? What is a useful metric and what is not? There are any number of DQ and usability criteria that we can collect—how do we know what is important? And how many metrics do we need to get a complete picture?

How to measure DQ is a major concern for technical communicators and their managers. In 2018, the Center for Information-Development Management (Stevens et al.) did a study to determine which critical metrics (for example, DQ, customer satisfaction, on-time delivery, and translation costs) their members were tracking and what they did with the information they collected. Most of them reported that they only tracked metrics that were easy to collect (what they called "metrics of convenience rather than metrics of significance"), and very few of them had any formal user feedback mechanism for collecting information from readers about the quality of their documentation.

According to their study, 76% of documentation managers were held accountable for DQ, but only 44% were measuring it in some way, and there was no guarantee that the metrics that they were collecting reflected how readers felt about DQ. Quite the contrary, in fact—while the quality metrics that were most measured were technical accuracy, clarity, and completeness, most respondents (86%) said that they relied mainly on editorial or peer reviews (not user reviews; this was only 34%) as the most common method of determining DQ. This begs the question—how can you possibly create meaningful metrics for these critical aspects of DQ without asking the actual documentation users?

Dawn Stevens et al. (2018) also found that 60% of their respondents were starting to turn to Web analytics (for example, views per page or time spent on a page) to collect additional insights about the quality of their documentation. User experience (UX) expert Jared Spool has spoken extensively about possible issues with using these types of analytics to measure quality. For example, Spool (2015; 2018) says that analytics like time on page or bounce rate, while easy to collect and track, do not really tell us much at all because there can be any number of different reasons for their values, and we can often infer contradictory deductions from them. It is possible to measure any number of criteria and track them over time to see increases or decreases—but without knowing if they are useful metrics or not, it is a waste of time to measure them. The only way to know if a metric is useful is to determine if it improves our users' experience—in other words, it is only our users who can tell us if we are measuring and tracking the right things. For DQ, this means that we must listen to the "voice of our readers" to find out what they want from the documentation we send them. But to do this, we must first understand what our readers mean when they talk about DQ so we can align ourselves with their expectations. Only after we know how readers define DQ can we measure and track that to ensure that we are meeting their needs.

In this chapter, I will evaluate the preliminary framework for a focused, clearly defined, and reader-derived definition of DQ that I proposed in previous research (Strimling, 2019). That research was based on empirically tested and distinct information quality categories and dimensions presented in Richard Wang and Diane Strong (1996). In my 2019 study, I found that readers define high-quality documentation as being "accurate, relevant, easy to understand, and accessible," and proposed that this definition of DQ could be used to both collect meaningful and actionable feedback as well as provide clear and reliable metrics for measuring DQ.

I will attempt to make this definition of DQ from the readers' point of view more robust and strengthen its theoretical underpinnings by presenting the results of a pilot study I ran with the Kano Model of customer satisfaction. With a stronger definition of DQ, I think that a more reliable and comprehensive approach to DQ feedback and metrics can be formed. I have attempted to follow the recommendations presented by Rebekka Andersen and JoAnn Hackos (2018) to ensure that academic research findings are clearly applicable and relevant to technical communication practitioners. The need to understand how readers define DQ, and how we can use this definition to measure and improve reader satisfaction, are real-world issues that have clear practical implications.

Evaluating the Proposed DQ Definition

In 1996, Wang and Strong proposed a "comprehensive, hierarchical framework of data quality attributes" that were important to data consumers. Their underlying assumption was that, to improve data quality, they needed to understand what data quality meant to data consumers; data quality cannot be approached intuitively or theoretically because these do not truly capture the voice of the data consumer.

Their framework was made up of 15 quality dimensions, grouped into four quality categories: Intrinsic, Contextual, Representational, and Accessibility (ICRA), as listed in Table 4.1

Wang and Strong (1996) claimed that their proposed data quality framework of categories and dimensions could be used as a basis for further studies that measure perceived data quality in specific work contexts. They stated that the framework was methodologically sound, complete from the data consumers' perspective, and was useful for measuring, analyzing, and improving data quality. They cited "strong and convincing" anecdotal evidence that the framework had been used effectively in both industry and government and had helped data managers better understand their customers' needs by "identifying potential data deficiencies, operationalizing the measurement of these data deficiencies, and improving data quality along these measures" (p. 9).

Table 4.1. Data Quality Categories and Dimensions

Category	Dimensions
Intrinsic Quality: Data must have quality in its own right.	**Accuracy**: The data is correct, reliable, and certified free of error. **Believability**: The data is true, real, and credible. **Objectivity**: The data is unbiased (unprejudiced) and impartial. **Reputation**: The data is trusted or highly regarded in terms of its source or content.
Contextual Quality: Data must be considered within the context of the task at hand.	**The Appropriate Amount**: The quantity or volume of the available data is appropriate. **Completeness**: The data is of sufficient breadth, depth, and scope for the task at hand. **Relevance**: The data is applicable and helpful for the task at hand. **Timeliness**: The age of the data is appropriate for the task at hand. **Value**: The data is beneficial and provides advantages from its use.
Representational Quality: Data must be well represented.	**Conciseness**: The data is compactly represented without being overwhelming (that is, it is brief in presentation, yet complete and to the point). **Consistency**: The data is always presented in the same format and is compatible with previous data. **Ease of Understanding**: The data is clear, without ambiguity, and easily comprehended. **Interpretability**: The data is in an appropriate language and units, and the definitions are clear.
Accessibility Quality: Data must be easy to retrieve.	**Accessibility**: The data is available or easily and quickly retrievable. **Security**: Access to the data can be restricted, and hence, kept secure.

Source: Wang and Strong (1996)

While the originally stated object in Wang and Strong (1996) was *data quality*, it is now more commonly referred to as *information quality* (Arazy et al., 2017; Huang et al., 1999; Kahn et al., 2002; Lee et al., 2002; Pipino et al., 2002; Strong et al., 1997a, 1997b; Wang, 1998; Watts et al., 2009).

Wang and Strong's framework has been used as the basis for a number of practical information quality assessment and management methodologies, most significantly total data quality management (TDQM) (Huang et al., 1999; Wang, 1998), "assessment and improvement (AIM) quality" (AIMQ) (Lee et al., 2002), and data quality assessment (DQA) (Pipino et al., 2002). Subsequent research on these methodologies has found that they work very well in identifying and solving information quality issues, and that the underlying framework (i.e., Wang & Strong's quality dimensions) is robust and applicable to real-life information quality situations. For example, Martin Eppler (2006) evaluated seven different information quality frameworks in the literature, and he determined that Wang and Strong's framework "is the only framework in the series of seven that strikes a balance between theoretical consistency and practical applicability" (p. 54).

Similarly, Carlo Batini et al. (2009) did a "systematic and comparative" review of 13 of the most well-known and established information quality methodologies (including TDQM, AIMQ, and DQA). They grouped them into four types (audit, complete, operational, and economic), based on how well they supported information quality assessment and improvement, as well as how they addressed technical and economic issues. They found that "audit methodologies [such as AIMQ and DQA] are more accurate than both complete and operational methodologies in the assessment phase… they are more detailed as to how to select appropriate assessment techniques… they identify all types of issues, irrespective of the improvement techniques that can or should be applied… the AIMQ methodology is the only information quality methodology focusing on benchmarking, that is, an objective and domain-independent technique for quality evaluation" (p. 28 and p. 38). As for operational methodologies, they found that

> one of the main contributions is the identification of a set of relevant dimensions to improve, and the description of a few straightforward methods to assess them. For example, TDQM is a general-purpose methodology and suggests a complete set of relevant dimensions and improvement methods that can be applied in different contexts … TDQM is comprehensive also from an implementation perspective, as it provides guidelines as to how to apply the methodology. (p. 28 and p. 35)

The main strength of Wang and Strong's (1996) information quality framework is that it covers all aspects of information quality—both objective (that is, "meets requirements") and subjective ("meets expectations"), as defined by Eppler (2006). Information quality must be measured along multiple dimensions—some objective (that is, that can be measured using objective methods) and some subjective (that is, that can only be measured based on how the user feels about it); any methodology that ignores one or the other will not provide a complete picture. It is certainly possible for information to have high objective quality and low subjective quality (Ge & Helfert, 2007). Stephanie Watts et al. (2009) emphasized that information quality must always be assessed "in use" because "information that is valuable and informative for one person may not be valuable and informative to the next, even when the information is objectively accurate and consistent" (p. 209). Extending the work done by Mouzhi Ge and Markus Helfert (2007), Phillip Woodall et al. (2014) stated that information quality issues can be grouped into four different quadrants based on a two-by-two conceptual model: issues that are either from the information's or user's perspective, and issues that are either context-independent or context-dependent.

Wang and Strong's (1996) framework is uniquely suited for information quality assessment because it includes both quantifiable and objective "context-independent" dimensions (for example, how accurate or consistent the information is) as well as quantifiable and objective "context-dependent" dimensions (for example, how complete or relevant the information is), and then measures them both using user-dependent subjective assessments (Huang et al., 1999).

My Proposed DQ Definition

Based on the research that showed the efficacy of Wang and Strong's (1996) framework of information quality categories and dimensions, in my 2019 study, I decided to apply it to the field of DQ. Because the framework in Wang and Strong (1996) is really a framework for measuring information quality, and documentation is information (that is, information that is transformed into knowledge by readers in a particular context for a particular reason), I believed that there was a strong basis for attempting to use this framework to accurately measure how readers define DQ.

Based on 81 responses from a broad, worldwide range of technical documentation readers from different fields (who were contacted via customer service personnel from various companies), I determined the single most important information quality dimension per ICRA category. I then created a reader-oriented DQ definition based on them. According to readers, high-quality documentation must be:

- Accurate (Intrinsic quality category)
- Relevant (Contextual quality category)
- Easy to Understand (Representational quality category)
- Accessible (Accessibility quality category)

Although this result might seem self-evident, I stated in my 2019 study that it provided a strong empirical underpinning for my claim that DQ could be defined using a narrow yet comprehensive set of clear and unambiguous information quality dimensions.

I then used this definition of DQ from the readers' point of view to propose a model for collecting meaningful and actionable feedback that could improve DQ and increase reader satisfaction. I claimed that my definition of DQ could also be used to provide reliable methods and metrics for measuring DQ, establish editing best practices, create a common DQ terminology, and help writers understand what is important to readers when feedback is unavailable (Strimling, 2018; 2021).

The framework proposed in my 2019 study seems to offer a good starting point for technical communicators who want to evaluate its practical applications, especially feedback and metrics (e.g., Johnson, 2021; Klein, 2024; Masycheff, 2023; Mui & Shwer, 2022; Yong, 2024). But to confirm its validity, it is important to ensure that its underlying reader-derived definition of DQ is robust and truly representative of what readers want from high-quality documentation.

To do this, I ran a pilot study applying the Kano Model of customer satisfaction to the ICRA information quality categories and dimensions presented by Wang and Strong (1996). The Kano Model is used in many industries for decision analysis during the product/service development and design phases to "hear the voice of the customer" and determine which proposed features and customer requirements will have the greatest effect on customer satisfaction. The Kano Model has been successfully implemented and empirically tested in numerous studies of customer satisfaction across various product/service settings (for example, television sets and decorative table clocks (Kano et al., 1984); kindergartens, tourist destinations, mobile phones, and sports equipment (Mikulić, 2007); mobile banking, websites, and home appliances (Löfgren & Witell, 2008); pizzerias and video rental stores (Tontini et al., 2013); bicycles (Lin et al., 2017).

The Kano Model is also used in the field of UX to design strategies that help developers "hear the voice of the user" and focus only on the features that will have the most impact and present the biggest design opportunities (Spool, 2013; 2015; 2018). It is an indispensable tool for understanding user preferences (both stated and implied) precisely because it enables us to identify how they prioritize the possible features; organizations such as IBM, GitLab, the Nielson Norman Group, and the Baymard Institute use the Kano Model for UX improvements projects and feature prioritization (DeSanto, 2025; Gibbons, 2021; Holst, 2012; Olsen-Landis, 2017).

Kuan-Tsae Huang et al. (1999) make a strong case for considering information to be a "product" that has "features" that can increase or decrease customer satisfaction just like any other product. Bad information can have negative business impacts in the same way that other bad products do, and like other products a company makes, must be managed in the same way—by having a thorough knowledge of the consumers' needs and quality criteria. If this is not how a company regards its information, it will be impossible to deliver high-quality information consistently and reliably. If information is indeed a "product," then the Kano Model should certainly apply to it as well.

Based on this, I felt that the Kano Model would be well suited for measuring reader preferences (that is, "the voice of the reader") for the various DQ dimensions (which can be seen as "features" of the documentation, that is, the "information product"), and help build a stronger DQ definition.

Using The Kano Model Of Customer Satisfaction to Strengthen the DQ Definition

What Is the Kano Model of Customer Satisfaction?

In 1984, Noriaki Kano et al. proposed a model that stated that customer satisfaction/dissatisfaction with a product/service's quality attributes (that is, the features it has) depends on their "state of physical fulfillment." Like Wang and Strong's (1996) framework, the Kano Model looks at both the objective aspect of quality (how much or how little the feature is fulfilled in the product/service) as well as the subjective aspect of quality (how customers feel about the feature) and then correlates the two.

The definition of the term "fulfillment" originally used by Kano et al. (1984) is somewhat vague. Charles Berger et al. (1993), in their significant and comprehensive review dedicated to the instruction, experience, ideas, and theories that have evolved from using Kano's methods, define the term fulfillment as a measure of functionality (i.e., how well or how badly the feature fulfills the task it is supposed to do). If the feature has its full functionality, then it can be implemented well; if it does not, then its implementation is not as good. Similarly, Josip Mikulić and Darko Prebežac (2011), in their extensive review of the most commonly used approaches to the classification of quality attributes according to the Kano Model, conclude that the correct way to look at fulfillment is to define it as "the provision (or non-provision) of the *benefits to be expected through the provision of the attribute* rather than the provision of the *attribute itself*" (p. 48, emphasis in original). In other words, we are asking customers to rate their satisfaction/dissatisfaction with the presence/absence of the feature's optimal implementation level and the performance of its benefits when provided.

Berger et al. (1993) also revised and improved the validity and reliability of the Kano Model in practice by making a number of modifications to it (e.g., rewording the allowed possible answers to the questions, recalibrating the evaluation table, adding a perceived importance rating (based on Hauser, 1991), assigning numerical values to responses, suggesting the use of continuous rather than discrete measurements, and so on). These improvements have been operationalized into a comprehensive and easy-to-use Kano Model Excel tool by Daniel Zacarias (2015) that enables UX and product management researchers to collect and analyze data about how proposed features will affect customer satisfaction.

Subsequent research on the Kano Model in the decades since its introduction (Löfgren & Witell, 2008; Madzík, 2018; Mikulić, 2007; Mikulić & Prebežac, 2011; Witell et al., 2013) has focused on attempts to improve its ease of use and the accuracy of its methodology, as well as comparing it to other customer satisfaction models. While a number of improvements have been suggested and the advantages of other models have been proposed, in general, researchers have found that the Kano Model (especially using continuous rather than discrete measurements and importance ratings, as per Berger et al. (1993) and implemented by Zacarias's(2015) tool) is a very valid and reliable method for determining which features will have the greatest impact on customer satisfaction.

Determining Feature Types

The Kano Model is based on two axes: customer satisfaction and functionality, as shown in Figures 4.1 and 4.2

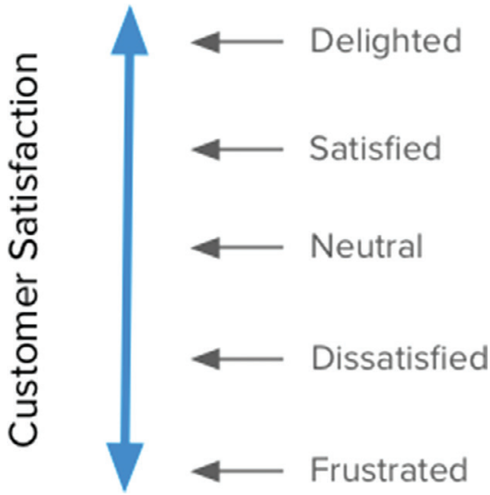

Figure 4.1. Kano Model customer satisfaction axis (from Zacarias, 2015)

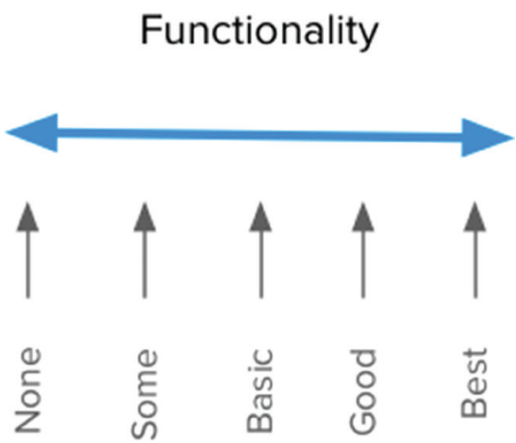

Figure 4.2. Kano Model functionality axis (from Zacarias, 2015)

The axes combine to form the following feature types, as shown in Figure 4.3.

- **Must-Be (M)**: These are features that are expected and taken for granted. They must be implemented properly; if they are not, customers will consider the product to be incomplete or bad. Their presence does not increase satisfaction or delight, but their absence decreases it. No matter how well they are implemented, customers will never be more than neutral about them; but if they are done badly, customers will quickly become frustrated.
- **One-Dimensional (O)**: These are features that have a one-to-one correlation between the level of functionality and customer satisfaction—the

better they are implemented, the greater the satisfaction; their presence delights customers and their absence frustrates them.

- **Attractive (A)**: These are features that the customer does not expect to be present, but when they are, they cause excitement and delight (even if they are not implemented as well as they could be). Their absence has very little effect on customer satisfaction, because customers were not expecting them in the first place (and therefore cannot be frustrated by their absence).
- **Indifferent (I)**: These features have no effect on customer satisfaction, regardless of how well they are implemented.

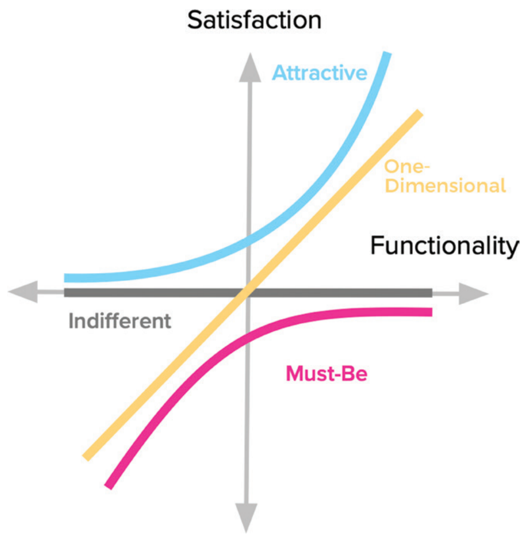

Figure 4.3. Kano Model feature types (based on Zacarias, 2015)

The following description of the Kano Model methodology is based on the modifications and improvements made by Berger et al. (1993) and operationalized by Zacarias (2015).

To determine a feature's type, customers are asked two types of questions about it:

- **Functional**: Determines how the customer feels when the feature is present (that is, well implemented) in the product
- **Dysfunctional**: Determines how the customer feels when the feature is absent (that is, not well implemented) from the product

The Functional/Dysfunctional questions have five allowed possible answers:

- **I Like It**: I would like it; enjoy it; it would be helpful to me.
- **I Expect It**: Must be that way; it is a basic need.
- **I Don't Care**: Neutral; wouldn't concern me; don't care.

- **I Can Live with It**: Dislike it but can live with it; inconvenience.
- **I Dislike It**: Extreme dislike; can't accept it; major issue.

Each answer is assigned a numerical value, which is plotted on a Functional/Dysfunctional two-dimensional grid, as shown in Figure 4.4. The value combinations create quadrants that are associated with the four feature types (Must-Be, One-Dimensional, Attractive, and Indifferent), as well as two other types:

- **Questionable (Q):** These are features whose type is unclear because the answers collected do not make sense. This could be because the question was not worded properly, or the respondents misunderstood what was being asked; for example, they like it when the feature is both present and absent.
- **Reverse (R):** These are features that respondents do not want in the product, and that need to be avoided; for example, they like it when the feature is not implemented and dislike it when it is.

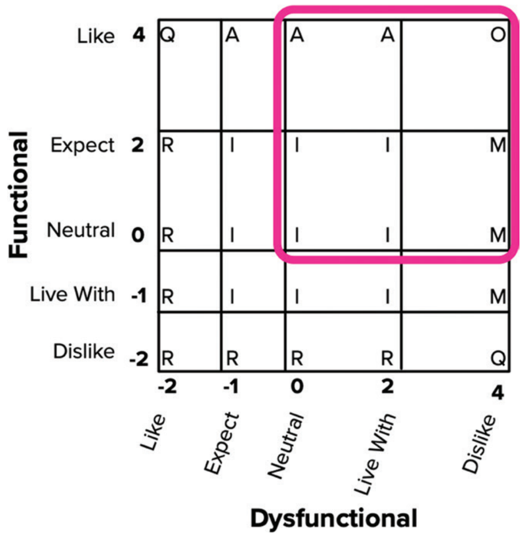

Figure 4.4. Kano Model rating two-dimensional scoring grid (from Zacarias, 2015)

Based on Figure 4.4, the rule of thumb for determining a feature's type can be summarized as follows:

- If the Functional value is *high* and the Dysfunctional value is *low*, then the feature type is *Attractive* (that is, it has a high potential to delight users if implemented well, but little effect otherwise; the greater the difference, the stronger the potential).
- If the Functional value is *low* and the Dysfunctional value is *high*, then the feature type is *Must-Be* (that is, it has a high potential to frustrate users if implemented badly, but little effect otherwise; the greater the difference, the stronger the potential).

- If both the Functional and Dysfunctional values are *high*, then the feature type is *One-Dimensional* (that is, its potential to delight or frustrate users correlates strongly to its level of implementation; the higher the values, the stronger the potential).
- If both the Functional and Dysfunctional values are *low*, then the feature type is *Indifferent* (that is, users are not delighted or frustrated by its level of implementation).

In addition to the Functional/Dysfunctional questions, a question is also asked about how important it is to the customer that the feature be implemented, rated on a unipolar Likert scale. This enables a finer level of differentiation among features.

These three values (Functional, Dysfunctional, and Importance) are combined to determine the proposed feature's type and its potential effect on customer satisfaction.

Prioritizing Feature Types

The heart of the Kano Model is the differentiation between feature types, which enables product/service planners and designers to know which features to prioritize to increase customer satisfaction. Due to time and resource constraints, not all features can be implemented, so it is critical to know which will have the greatest impact on customer satisfaction so those can be focused on.

Logically, those features that are classified as "Must-Be" should be the ones that get the highest priority. But, as Berger et al. (1993) said, the Kano Model shows us that not all customer requirements are equal—"improving performance on a Must-Be customer requirement that is already at a satisfactory level is not productive when compared to improving performance on a One-Dimensional or Attractive customer requirement" (p. 7). Improving Must-Be features does not increase customer satisfaction—they only have a negative effect if they are implemented badly, but no positive effect if they are implemented well. The question designers and project managers must ask is "after I address the Must-Be features to a satisfactory level, which feature type do I focus on next—One-Dimensional or Attractive?" Berger et al. (1993) suggested that a general guideline might be to first ensure that all Must-Be features are fulfilled, then be competitive with market leaders on the One-Dimensional features, and then add a few Attractive features to differentiate the product/service from others that are available. This too is logical—both Must-Be and One-Dimensional features have high Dysfunctional values (see the summarized "rule of thumb" above), which means that both have a high potential for frustrating customers. The difference, of course, is that One-Dimensional features also have a high potential for *delighting* them; Attractive features do as well but have a low potential for frustrating customers.

These feature types do not exist in a vacuum. Gerson Tontini et al. (2013) found that badly implemented Must-Be features negatively affect customer satisfaction with well-implemented One-Dimensional and Attractive features and, to a lesser extent, badly implemented One-Dimensional features negatively affect customer satisfaction with well-implemented Attractive features. In other words, if Must-Be features are not implemented well, it does not matter how well the other features are implemented—the delight customers feel cannot compensate for the frustration they feel.

The addition of the Importance measure can be used to further prioritize and order features within a single type. For example, if many users say that a particular One-Dimensional feature is more important to them than another One-Dimensional feature, a case could be made to include one and not the other. Designers and project managers need to weigh all of these possibilities carefully, and the Kano Model provides them with a tool to help them do that.

Methods

Like in my 2019 study, this pilot study focused on finding the representative information quality dimension for each of the four ICRA information quality categories presented by Wang and Strong (1996) (as they related to documentation).

Pretest Questionnaires

Because the Kano Model questionnaire can be confusing and hard to use if not presented correctly, it is very important to test it before sending it to customers (Berger et al., 1993; Löfgren & Witell, 2008; Madzík, 2018; Zacarias, 2015). A pretest was therefore run with a limited audience of technical documentation readers (n = 12). Because of the intentionally small sample size and the exploratory nature of the survey, no quantitative data was collected about the Dysfunctional, Functional, and Importance values, and no demographic data was collected about the participants. However, a good deal of qualitative data was collected about the survey experience and how to reduce the cognitive load associated with the process, which was implemented in the pilot study. For example, it was determined that:

- The information quality dimensions must be divided into their respective ICRA quality categories; participants commented that 15 dimensions were too many to rate at one time using the Kano Model methodology.
- The allowed Kano Model answers must be defined on each page of the survey; participants commented that they could not remember what each option meant.

Pilot Study Questionnaires

In the pilot study itself, a number of technical communication department managers from various companies (in different industries, for example, software development, robotics, oil and gas) were contacted via LinkedIn, and they were asked to talk to their respective customer service personnel about sending the revised Kano Model questionnaire to their technical documentation readers.

As in the pretest, no demographic data was collected about the participants. While standard Kano Model practice does include the collection of demographic data (for example, company and personal characteristics, familiarity with the product, use of competitors' products; see Berger et al., 1993), I chose to omit this step in the pilot study because I wanted to capture a wide spectrum of reader experiences with documentation across industries, rather than focus on demographic diversity. My primary goal was to determine if the Kano Model's approach to measuring customer satisfaction could be useful in improving DQ across a broad range of contexts, without introducing the additional complexity of segmenting respondents based on demographic factors.

Because I was trying to see if the Kano Model could help make the model I proposed in my 2019 study more robust, I felt that introducing demographic data would have added variables beyond this scope and potentially complicate the analysis. The limitation of this approach is that it required assuming a generic reader, as I was unable to focus on specific types of documentation readers (for example, readers with varying levels of experience, age groups, or other demographic distinctions). Nevertheless, because this was a pilot study, I believed that gathering insights from a broad range of readers across different industries would still provide valuable preliminary data.

Readers were asked to answer the Kano Model's Functional/Dysfunctional questions for each of Wang and Strong's (1996) 15 quality dimensions, as well as rate their Importance on a five-point Likert scale (1 = not important at all to 5 = extremely important). The questionnaire can be seen at https://www.surveymonkey.com/r/JSK9ZL9; note that the quality dimensions here are adjectives that describe the information in the documentation, and readers are being asked to consider the presence/absence of their best implementation level.

Data Analysis

A total of 47 readers responded to the pilot questionnaire (but only 43 of them rated all of the information quality dimensions). The Dysfunctional, Functional, and Importance values were entered into the Kano Model Excel tool provided by Zacarias (2015), which assigned a preliminary Kano Model feature type for each entry. As per Berger et al. (1993) and Peter Madzík (2018), information quality dimensions that received a Questionable rating from respondents (19 response entries out of 705) were removed from the analysis and were indicated by missing values.

The Kano Model Excel tool then calculated the mean weight per information quality dimension for all respondents and plotted them on the Functional/Dysfunctional two-dimensional grid, as shown in Figure 4.5.

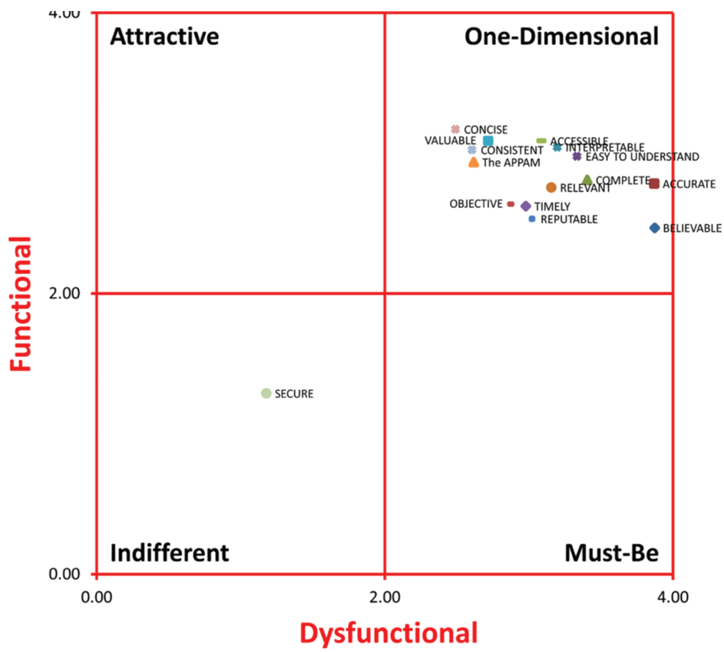

Figure 4.5. Functional/Dysfunctional two-dimensional scoring grid results (all feature types)

Each information quality dimension was assigned a Kano Model feature type based on their location on the grid. This was done to determine the relative priorities of each information quality dimension, as per the prioritization guidelines described previously. As can be seen in Figure 4.5, all but one of the information quality dimensions were located in the One-Dimensional quadrant; only Secure is in the Indifferent quadrant.

To enable better Kano Model data visualization within the One-Dimensional quadrant, I used "stack rankings" (modified from Moorman, 2012), which stacks the mean weights and standard deviations for the Dysfunctional, Functional, and Importance values of each information quality dimension. This enabled me to "zoom in" and determine which information quality dimensions had the highest potential for customer satisfaction. Based on the summarized "rule of thumb" described previously for determining a feature's type and the rationale for their priorities, the process was as follows (as suggested by Zacarias, 2018):

1. First, I looked for information quality dimensions whose Dysfunctional values were significantly higher than their Functional values (that is, their potential for frustration was greater than their potential for delight, almost like a Must-Be feature).

   To fine-tune the results, these dimensions were then sorted by Importance.

2. After this, I looked for information quality dimensions that had Dysfunctional and Functional values similar to but significantly higher than other dimensions (that is, a potential for frustration similar to their potential for delight, which would make them a purely One-Dimensional feature).

   To fine-tune the results, these dimensions were then sorted by Importance.

3. Lastly, I looked for information quality dimensions whose Dysfunctional values were significantly lower than their Functional values (that is, their potential for frustration was lower than their potential for delight, almost like an Attractive feature).

   To fine-tune the results, these dimensions were then sorted by Importance.

This process enabled me to identify the dimension that had the strongest combination of Dysfunctional, Functional, and Importance values per ICRA category, which I considered as representing the entire category.

It is important to note here that the Dysfunctional, Functional, and Importance values cannot be statistically compared to each other—the Dysfunctional and Functional values are rated on a -2 to 4 scale, and the Importance values are rated on a 1 to 5 scale. However, the Dysfunctional and Functional values can be compared to each other within and across information quality dimensions, and the Importance values can be compared to each other across information quality dimensions.

To determine if the differences in mean weights between the Dysfunctional and Functional values within and across the dimensions in each category (as well as the Importance values across them) were significant (set as $p < 0.05$), a one-way ANOVA test was run.

Results

Functional/Dysfunctional Two-Dimensional Grid Scoring

As mentioned previously, all but one of the information quality dimensions are located in the One-Dimensional quadrant; only Secure is in the Indifferent quadrant. One-Dimensional features have a one-to-one correlation between the level of functionality and customer satisfaction. In other words, most of the information quality dimensions are things that readers expect and that have a direct, proportional impact on reader satisfaction. For a discussion of this result, see the *Must-Be/Attractive Features vs. One-Dimensional Features* section.

Intrinsic Quality Category Results

Figure 4.6 shows the stack ranking results of the Dysfunctional, Functional, and Importance values for the Intrinsic information quality dimensions. The full range of descriptive statistics is presented in Table 4.2, and the list of statistically significant differences is presented in Table 4.3.

Looking at these results, a number of interesting points appear:

- Readers have a statistically stronger *negative* reaction (that is, are the most frustrated, to use the Kano Model terminology) when the information in a document is not *Accurate* than a positive reaction (that is, delighted) when it is.
- They have a statistically stronger *negative* reaction when the information in a document is not *Believable* than a positive reaction when it is.
- They have the strongest *negative* reactions when the information in the documentation is not *Accurate* or *Believable*; these differences are statistically significant compared to both the *Objective* and *Reputable* dimensions.
- They have the strongest *positive* reaction when the information is *Accurate*; however, none of the differences are statistically significant.
- They think that the most important Intrinsic information quality dimension is *Accurate*; this difference is statistically significant only compared to the *Objective* and *Reputable* dimensions, but not to the *Believable* dimension.

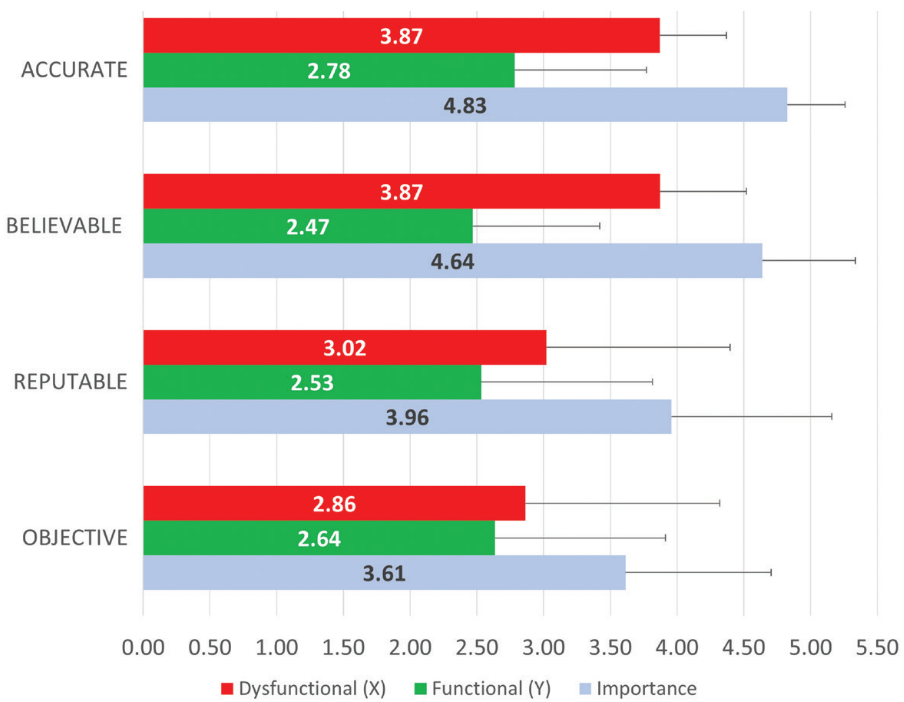

Figure 4.6. Intrinsic documentation quality dimension stack rankings

Table 4.2. Descriptive Statistics for Intrinsic Documentation Quality Dimensions

Quality Dimension	n	Dys Mean	Dys SD	Func Mean	Func SD	Imp Mean	Imp SD
Accurate	46	3.87	0.50	2.78	0.99	4.83	0.43
Believable	47	3.87	0.65	2.47	0.95	4.64	0.70
Objective	44	2.86	1.46	2.64	1.28	3.61	1.09
Reputable	47	3.02	1.38	2.53	1.28	3.96	1.20

Table 4.3. Statistically Significant Comparisons for Intrinsic Documentation Quality Dimensions

Quality Dimensions	*p* value
D_ACCURATE vs F_ACCURATE	< 0.0000
D_BELIEVABLE vs F_BELIEVABLE	< 0.0000
I_ACCURATE vs I_OBJECTIVE	< 0.0000
I_BELIEVABLE vs I_OBJECTIVE	< 0.0000
I_ACCURATE vs I_REPUTABLE	< 0.0000
D_ACCURATE vs D_OBJECTIVE	0.0001
D_BELIEVABLE vs D_OBJECTIVE	0.0001
D_BELIEVABLE vs D_REPUTABLE	0.0010
D_ACCURATE vs D_REPUTABLE	0.0011
I_BELIEVABLE vs I_REPUTABLE	0.0021

(D_ = Dysfunctional, F_ = Functional, I_ = Importance)

The combination of these results suggests that either *Accurate* or *Believable* might be the Intrinsic information quality dimension that readers want us to focus on to ensure high-quality documentation; in my 2019 study, the representative Intrinsic information quality dimension was *Accurate.* For a discussion of this result, refer to the *Documentation Accuracy vs. Documentation Believability* section.

Contextual Quality Category Results

Figure 4.7 shows the stack ranking results for the Dysfunctional, Functional, and Importance values for the Contextual information quality dimensions. The full range of descriptive statistics is presented in Table 4.4 and the list of statistically significant differences is presented in Table 4.5.

Looking at these results, a number of interesting points appear:

- Readers have a statistically stronger *negative* reaction (that is, are the most frustrated) when the information in a document is not *Complete* than a positive reaction (that is, delighted) when it is.
- They have the strongest *negative* reaction when the information in the documentation is not *Complete;* this difference is statistically significant only compared to the *Appropriate Amount* dimension.
- They have the strongest *positive* reaction when the information is *Valuable*; however, none of the differences are statistically significant.
- They think that the most important Contextual information quality dimension is *Complete*; this difference is statistically significant only compared to the *Appropriate Amount* and *Valuable* dimensions.

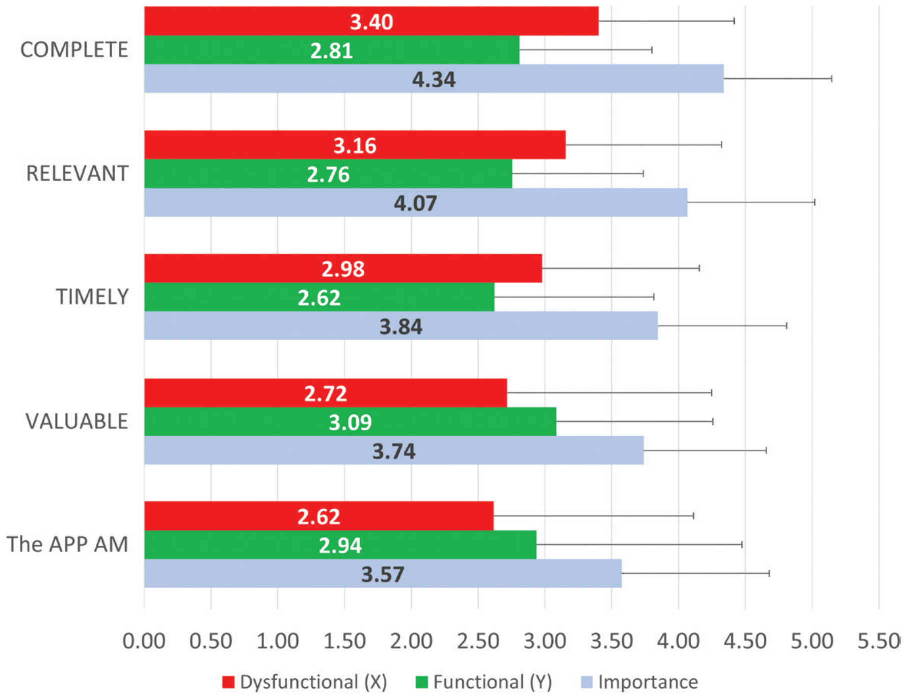

Figure 4.7. Contextual documentation quality dimension stack rankings

Table 4.4. Descriptive Statistics for Contextual Documentation Quality Dimensions

Quality Dimension	n	Dys Mean	Dys SD	Func Mean	Func SD	Imp Mean	Imp SD
Complete	47	3.40	1.01	2.81	0.99	4.34	0.81

Quality Dimension	n	Dys Mean	Dys SD	Func Mean	Func SD	Imp Mean	Imp SD
Relevant	45	3.16	1.17	2.76	0.98	4.07	0.95
The Appropriate Amount	47	2.62	1.50	2.94	1.54	3.57	1.11
Timely	45	2.98	1.18	2.62	1.19	3.84	0.97
Valuable	46	2.72	1.53	3.09	1.17	3.74	0.92

Table 4.5. Statistically Significant Comparisons for Contextual Documentation Quality Dimensions

Quality Dimensions	*p* value
D_COMPLETE vs F_COMPLETE	0.0050
I_COMPLETE vs I_APPAM	0.0012
D_COMPLETE vs D_APPAM	0.0287
I_COMPLETE vs I_VALUABLE	0.0222

(D_ = Dysfunctional, F_ = Functional, I_ = Importance)

The combination of these results suggests that *Complete* might be the Contextual information quality dimension that readers want us to focus on to ensure high-quality documentation. This is different from the Contextual quality category result I reported in my 2019 study; there, the representative information quality dimension was *Relevant*. For a discussion of this result, refer to the Documentation Completeness vs. Documentation Relevance section.

Representational Quality Category Results

Figure 4.8 shows the stack ranking results for the Dysfunctional, Functional, and Importance values for the Representational information quality dimensions. The full range of descriptive statistics is presented in Table 4.6, and the list of statistically significant differences is presented in Table 4.7.

Looking at these results, a number of interesting points appear:

- Readers have a statistically stronger *positive* reaction (that is, are the most delighted) when the information in a document is *Concise* than a negative reaction (that is, frustrated) when it is not.
- They have the strongest *negative* reaction when the information in the documentation is not *Easy to Understand*; this difference is statistically

significant only compared to the *Concise* and *Consistent* dimensions.

- They have the strongest *positive* reaction when the information is *Concise*; however, none of the differences are statistically significant.
- They think that the most important Representational information quality dimension is *Easy to Understand*; however, none of the differences are statistically significant.

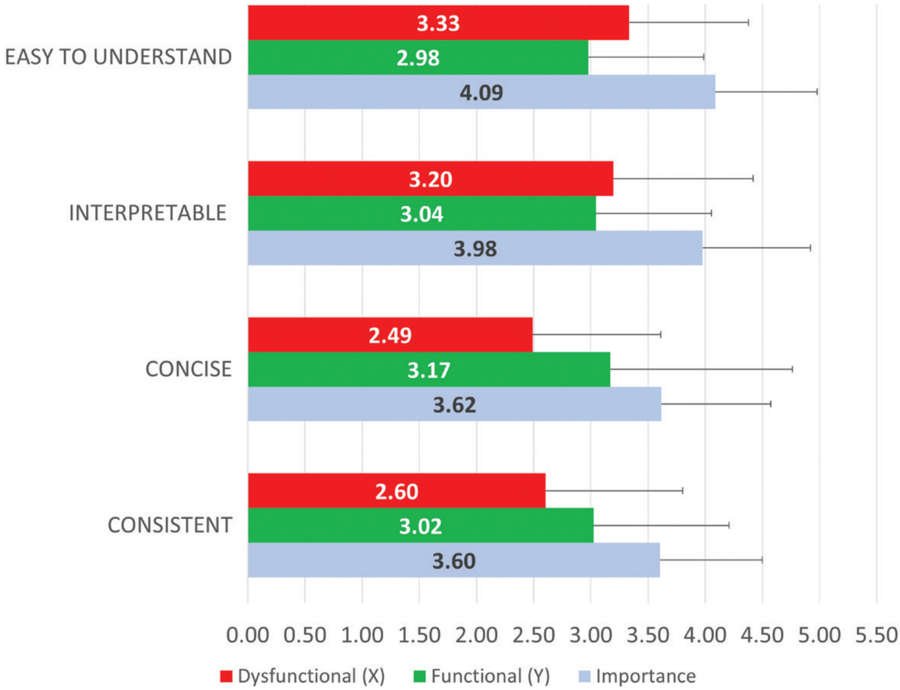

Figure 4.8. Representational documentation quality dimension stack rankings

Table 4.6. Descriptive Statistics for Representational Documentation Quality Dimensions

Quality Dimension	n	Dys Mean	Dys SD	Func Mean	Func SD	Imp Mean	Imp SD
CONCISE	47	2.49	1.12	3.17	1.59	3.62	0.96
CONSISTENT	43	2.60	1.20	3.02	1.18	3.60	0.89
EASY TO UNDERSTAND	45	3.33	1.04	2.98	1.01	4.09	0.89
INTERPRETABLE	46	3.20	1.22	3.04	1.01	3.98	0.94

Table 4.7. Statistically significant comparisons for Representational Documentation Quality Dimensions

Quality Dimensions	***p* value**
D_EASYTOUNDERSTAND vs D_CONCISE	0.0030
D_EASYTOUNDERSTAND vs D_CONSISTENT	0.0174
D_INTERPRETABLE vs D_CONCISE	0.0179
F_CONCISE vs D_CONCISE	0.0185

(D_ = Dysfunctional, F_ = Functional)

The combination of these results suggests that *Easy to Understand* might be the Representational information quality dimension that readers want us to focus on to ensure high-quality documentation, which is similar to the representative Representational information quality dimension I reported in my 2019 study.

It is interesting to note here that the *Concise* dimension is the only dimension (in any quality category) whose Functional value is significantly higher than its Dysfunctional value. This implies that documentation readers are very delighted with documentation that is concise but are not overly frustrated if it is not. Quite the contrary—readers are more frustrated when a document is not easy to understand than when it is not concise. For a discussion of this result, refer to the *Documentation Conciseness vs, Documentation Understandability* section.

Accessibility Quality Category Results

Figure 4.9 shows the stack ranking results for the Dysfunctional, Functional, and Importance values for the Accessibility information quality dimensions. The full range of descriptive statistics is presented in Table 4.8, and the list of statistically significant differences is presented in Table 4.9.

Looking at these results, a number of interesting points appear:

- Readers have the strongest *negative* reaction (that is, are the most frustrated) when the information in the documentation is not *Accessible.*
- They have the strongest *positive* reaction (that is, are the most delighted) when the information is *Accessible*.
- Readers think that the most important Accessibility information quality dimension is *Accessible*.

All of these differences are statistically significant.

The combination of these results indicates that *Accessible* is the Accessibility information quality dimension that readers want us to focus on to ensure high-quality documentation, which is similar to the representative Accessibility information quality dimension I reported in my 2019 study.

As opposed to readers' very strong positive feelings about the *Accessible* dimension, the *Secure* information quality dimension is the only one that is classified as an Indifferent feature type (as shown in Figure 4.5). For a discussion of this result, refer to the *Documentation Accessibility vs. Documentation* section.

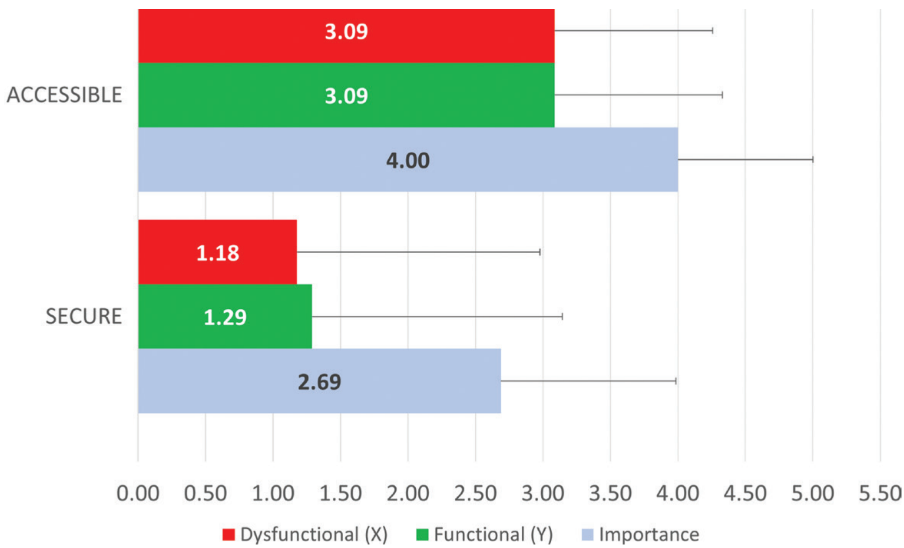

Figure 4.9. Accessibility documentation quality dimension stacked rankings

Table 4.8. Descriptive Statistics for Accessibility Documentation Quality Dimensions

Quality Dimension	n	Dys Mean	Dys SD	Func Mean	Func SD	Imp Mean	Imp SD
Accessible	46	3.09	1.17	3.09	1.24	4.00	1.00
Secure	45	1.18	1.80	1.29	1.85	2.69	1.30

Table 4.9. Statistically Significant Comparisons for Accessibility Documentation Quality Dimensions

Quality Dimensions	*p* value
D_ACCESSIBLE vs D_SECURE	< 0.0000
F_ACCESSIBLE vs F_SECURE	< 0.0000
I_ACCESSIBLE vs I_SECURE	< 0.0000

(D_ = Dysfunctional, F_ = Functional, I_ = Importance)

Discussion

It is important to note that I cannot clearly state (as I did in my 2019 study) which dimension best represents each quality category based on statistical significance (even though many of the within- and across-dimension differences are statistically significant). However, the results still indicate trends in the data that we can use to analyze the DQ definition I proposed there.

Must-Be/Attractive Features Versus One-Dimensional Features

As mentioned previously, almost all the information quality dimensions are classified as One-Dimensional features (except for *Secure*, which is an Indifferent feature), that is, they have a direct, proportional impact on reader satisfaction. But what does it mean that there are no Must-Be features?

I believe that this is a very encouraging result. Must-Be features do not increase customer satisfaction; they can only decrease it. Because these DQ dimensions are One-Dimensional features, improving their implementation in our documentation will have a tangible effect on how readers see the quality of our documentation. These are things that we should invest time and effort in to ensure that they are as well implemented as possible—the return on investment will be substantial. The better we do these features, the more delighted our readers will be. However, because we only have limited time and resources, and cannot improve all of them all at once, we still need to focus our efforts on those features that will have the greatest impact on reader satisfaction to cover all aspects of DQ (that is, that represent each of the ICRA categories). The fact that some of these One-Dimensional dimensions do have characteristics of Must-Be features (for example, the *Accurate* and *Complete* dimensions, whose Dysfunctional values are significantly greater than their Functional values) makes this easier.

But what about the lack of Attractive features?

This result should act as a warning to us as technical communicators. Attractive features, while increasing customer satisfaction, are, by definition, things that customers do not expect. These DQ dimensions are One-Dimensional features, which means that they are expected by readers and cannot be ignored. Even if we do not or cannot implement all of them now, readers still want them to be implemented well in the documentation they use and will be frustrated if they are not—we must plan for them in future releases or when we have the time/resources. While they are not necessarily the representative dimensions of each information quality category (that is, how readers define DQ), they still play an important role in improving reader satisfaction. The fact that some of these One-Dimensional dimensions do have characteristics of Attractive features (for example, the *Concise* dimension, whose Functional value is significantly greater than its Dysfunctional value) can act as a guideline for prioritization.

Documentation Accuracy Versus Documentation Believability

What do readers mean when they say they want the information in the documentation to be accurate, and how does this differ from wanting it to be believable? Based on Wang and Strong (1996), these Intrinsic information quality dimensions are defined as follows:

- **Accurate:** The information in the documentation is correct, reliable, and certified free of error.
- **Believable:** The information in the documentation is true, real, and credible.

No statistical difference was found in this study between the combination of the Dysfunctional, Functional, and Importance values for the *Accurate* and *Believable* dimensions. Unlike in my 2019 study, I cannot clearly state which of these two One-Dimensional dimensions best represents the Intrinsic quality category—both have a higher potential for frustrating readers with their absence than delighting them with their presence (almost like Must-Be features).

However, the difference between the *Accurate* and *Believable* dimensions can still be meaningful. Information in a document can be accurate but not believable, or believable but not accurate. Readers might trust well-presented information, even though it is inaccurate, and they might dismiss accurate information because they do not trust the source (for example, because the information feels like it is presented in a haphazard way, or because they have had bad experiences with the accuracy of the information before (Falla, 2018; Snyder, 1998)). We see this frequently now with the advent of so-called "fake news"—we often accept/reject what we are told based on how we feel about the source, without fact checking it. Watts et al. (2009) make a further point about the difference between accurate information and believable information—accuracy can be measured objectively; believability is subjective: information that is believable to one reader (for example, a novice user) might be less believable to another (for example, an expert).

As an interesting thought experiment, I prompted OpenAI's ChatGPT-3.5 LLM with the statement "Act as a technical documentation user, and tell me which is better—accurate information or believable information," to which the ChatGPT-generated text responded

> As a technical documentation user, I would prioritize accurate information over believable information… Accurate information ensures that users can make informed decisions, troubleshoot problems, and understand the intricacies of a system or process correctly. It helps prevent errors, misunderstandings, and potential risks that may arise from following incorrect instructions or guidelines. On the other hand, believable information may not necessarily be accurate. While

> it might sound plausible, it could lead to incorrect conclusions, poor decisions, or wasted time and effort for users trying to implement the guidance provided (OpenAI, 2023).

In the case of technical communication, the accuracy of information is logically more important than its believability: inaccurate concept/task information is useless to readers, regardless of how believable it is. Without the ability to verify the objective accuracy of the information, all readers have to go on is their subjective feelings of belief; but even so, it is their belief in its accuracy.

In the information quality literature, the *Accurate* dimension is one of a small set of dimensions that almost all frameworks and methodologies include; the *Believable* dimension is hardly ever included. For example, Mouzhi Ge et al. (2011) found that the *Accurate* dimension was included in all of them; the *Believable* dimension was only included in three. Similarly, Corinna Cichy and Stefan Rass (2019) reviewed and compared 12 general-purpose information quality methodologies that contained information quality definitions and assessment and improvement processes and found that the *Accurate* dimension was included in eight of them; again, the *Believable* dimension was only included in three. Clearly, information accuracy is a more critical part of quality than information believability. Wang and Strong (1996) purposely titled their paper "Beyond Accuracy" because they felt that data quality improvement efforts tended to focus too narrowly on accuracy and ignored any other dimensions.

Based on this, it appears logical to state (as I did in my 2019 study) that *Accurate* is the information quality dimension that best represents the Intrinsic quality category and therefore represents how readers define DQ.

Documentation Completeness Versus Documentation Relevance

What do readers mean when they say they want the information in the documentation to be complete? Why does this differ from the result in my 2019 study that stated that documentation relevance was more important? Based on Wang and Strong (1996), these Contextual information quality dimensions are defined as follows:

- **Complete:** The information in the documentation is of sufficient breadth, depth, and scope for the task at hand.
- **Relevant:** The information in the documentation is applicable and helpful for the task at hand.

No statistical difference was found in this study between the combination of the Dysfunctional, Functional, and Importance values for the *Complete* and *Relevant* dimensions. In my 2019 study, there was also no statistical significance between these two Contextual information quality dimensions. Even so, I claimed there that it was logical to assume that the *Relevant* dimension best represented the Contextual quality category. Because documentation is never read in a vacuum and is only used in context, the usability of its information depends mainly on its ability to help readers do the "task at hand", which can be accomplished even if there are issues with how complete the information is. On the other hand, irrelevant information that is complete is still irrelevant.

However, I can also make a counterclaim that, if a concept/task that is irrelevant to the reader is provided, it does not really matter if it is complete or not; but even incomplete information can still be "applicable and helpful" to the reader to some degree.

It is important to consider how we look at information completeness. Batini et al. (2009) found that in the 13 information quality methodologies they reviewed there was "substantial agreement" about how it should be defined, namely, is information missing or not. But how this is measured makes a difference—does this mean that completeness is a binary, black-and-white measurement, "yes, the information is there; no, it is not?" Watts et al. (2009) stated that completeness can be measured objectively, which implies that it is. Information relevance, on the other hand, they say is subjective, and depends on the reader: information that is relevant for one reader (for example, a novice user) might be less relevant to another reader (for example, an expert).

But in Wang and Strong's (1996) information quality framework, *Complete* is a Contextual information quality dimension, *not* an Intrinsic information quality dimension. As Yang Lee et al. (2002) explained, completeness is an Intrinsic dimension only when simply referring to missing information, but it is a Contextual dimension when referring to missing information needed by users for the "task at hand". Information can be complete only when all the relevant information is included; adding irrelevant information will not make a document more complete, quite the contrary (Carey et al., 2014).

In terms of DQ, this is a critical point—the completeness of the information provided to readers has a direct impact on whether they can do what they need to do or know what they need to know. We can make the same claim for the subjectiveness of information completeness that Watts et al. (2009) made for information relevance previously—it also depends on the reader: information that is complete for one reader (e.g., an expert user) might be less complete for another reader (e.g., a novice). John Carroll and Hans van der Meij (1996) put it very succinctly when they say that "completeness is always a matter of degree" (p. 73).

There is clearly a difference between the *Complete* and *Relevant* dimensions. Information in a document can be complete but irrelevant, or relevant but incomplete—which is worse?

- Readers might be knowledgeable enough to skip irrelevant information, but be unable to fill in missing concept/task information OR
- Readers might be experienced enough to fill in missing information but not be sure if the concept/task is relevant to them.

As we can see from the results of this Kano Model study, readers are more frustrated with incomplete information than they are delighted with complete information (almost like a Must-Be feature); the same cannot be said for irrelevant information. In my 2019 study, only the relative importance of the information quality dimensions was measured; here, we are looking at the negative and positive reactions readers have, as well as the potential impact they have on readers' frustration and delight. This extra layer of information enables us to better discriminate between these two Contextual information quality dimensions.

Based on this, it appears logical to state (not like I did in my 2019 study) that *Complete* is the information quality dimension that best represents the Contextual quality category and therefore represents how readers define DQ.

Documentation Conciseness vs. Documentation Understandability

What do readers mean when they say they would like the information in the documentation to be concise? Based on Wang and Strong (1996), this dimension is defined as follows:

- **Concise:** The information in the documentation is compactly represented without being overwhelming (that is, it is brief in presentation, yet complete and to the point).

More information is not necessarily a good thing and can present problems for readers who are trying to apply it and put it into practice. This is a key element of minimalism—not everything needs to be documented; there are some things that we assume readers already know or can figure out easily on their own. Minimalism does not mean writing fewer words, it means making your writing more concise and to the point, knowing what to include and what not to include so readers can focus only on the essentials (Carey et al., 2014; Carroll & van der Meij, 1996; Virtaluoto et al., 2021).

Information that is concise helps readers focus on knowing what they need to know or doing what they need to do. Readers are busy people—they do not usually have time to read through lots of documentation. Reading documentation is not a high priority for them and is often seen as a last resort. Making the information concise helps readers use their time more efficiently.

Compare this to the definition of the *Easy to Understand* information quality dimension, which was the representative Representational information quality dimension reported in my 2019 study:

- **Easy to Understand:** The information in the documentation is clear, without ambiguity, and easily comprehended.

Documentation that is easy to understand uses clear and unambiguous language, presents complicated information as tables or bulleted lists, uses visually effective figures and concrete examples, avoids jargon, and so on. Concise information can do this too, of course, but it relies more on the knowledge level of the reader. Minimalism is, by design, very user-centered, and the prior knowledge and familiarity of the audience with what is being documented determines how the information is written and presented. Documentation that is simply easy to understand but not concise will enable better comprehension for a broader range of readers. While both conciseness and understandability are subjective measures that depend on the reader (similar to the level of documentation completeness discussed previously), easy-to-understand information will be helpful for a much wider audience. Information in a document can be easy to understand but not concise, or concise but not easy to understand. In the former case, the document is still usable; in the latter, its usability is seriously reduced.

As we can see from the results of this Kano Model study, readers are more delighted with information that is concise than they are frustrated with information that is not (almost like an Attractive feature). It is also clear that they are more frustrated with information that is not easy to understand than they are frustrated with information that is not concise. While readers would prefer the documentation to be concise, it is not a "make-or-break" issue for them—but they will not tolerate documentation that is not easy to understand.

Based on this, it appears logical to state (as I did in my 2019 study) that *Easy to Understand* is the information quality dimension that best represents the Representational quality category and therefore represents how readers define DQ.

Documentation Accessibility Versus Documentation Security

What do readers mean when they say they want the information in the documentation to be accessible, but do not care (that is, they are "indifferent", to use the Kano Model terminology) if it is secure? Based on Wang and Strong (1996), these Accessibility information quality dimensions are defined as follows:

- **Accessible:** The information in the documentation is available or easily and quickly retrievable.
- **Secure:** Access to the information in the documentation can be restricted, and hence, kept secure.

The difference between these dimensions is clear. Unlike the dimensions in the other information quality categories, these two dimensions are almost mutually exclusive. While information in a document can be accurate, believable, complete, relevant, easy to understand, and concise, it cannot be both accessible and secure at the same time. If access to the information can be restricted, then it cannot also be available or easily and quickly retrievable.

There might be many good reasons for the information in a document to be secure—intellectual property rights, proprietary data, or regulatory requirements. But, in general, these issues are not the readers' concerns, they are the concerns of the company that created the documentation. As we can see from the results of this Kano Model study, readers do not care about this aspect of DQ.

What they do care about, however, is their ability to find and retrieve the information they need, easily and quickly. There are many best practices for this, for example, comprehensive indexes and tables of contents, well-organized document structures and information chunks (such as those used in topic-based modular documentation), clearly marked headings, optimized search algorithms, easy navigation through the information by reducing the number of required clicks, complete metadata, and so on (Carey et al., 2014; Cheung, 2016; Strimling & Corbin, 2009). All of these will increase information accessibility.

Information accessibility can also enable readers to personalize (or fix) the documentation themselves so it is more accurate, relevant/complete, easy to understand, or accessible—user-created, personalized content is very important to readers, and can help improve DQ (Bowman, 2022; Richardson, 2019).

Based on this, it appears clear to state (as I did in my 2019 study) that *Accessible* is the information quality dimension that best represents the Accessibility quality category and therefore represents how readers define DQ.

Practical Applications

The ultimate goal of this research is to propose concrete solutions that address some of the most important issues faced by technical communication practitioners, and answer the call from Andersen and Hackos (2018) to provide "research findings based on empirical evidence [that] can help practitioners make more informed decisions and stronger business cases for resources, initiatives, or changes needed to improve processes and solve problems" (p. 97). As stated at the very beginning of this chapter, collecting meaningful and actionable feedback from readers about the technical documentation they use and creating consistent and reliable DQ metrics that technical communicators can present to their managers are crucial aspects of improving DQ, and can only be done by understanding how readers themselves define DQ.

By using the focused, clearly defined, and reader-derived definition of DQ proposed in my 2019 study, and refining it using the results of the Kano Model pilot study presented here, I believe that we now have a very strong DQ definition that can be used to do exactly this.

Collecting Meaningful and Actionable Documentation Quality Feedback

In my 2019 study, I suggested a way to turn the readers' DQ definition into a usable feedback collection method, which could be applied to a number of techniques for testing documentation usability (for example, usability edits, surveys, and training classes). According to this, each of the four representative information quality dimensions can be converted into a question; this will enable us to "focus only on the most important issues from the readers' point of view, ask the fewest possible number of questions that can cover all of these important issues, [and] use terminology that can be clearly and universally understood by all respondents" (Strimling, 2019. p. 9). Modifying my 2019 proposed DQ definition based on our Kano Model results, the questions we should ask will now be:

- Could you find the information you needed in the document?
- Was the information in the document accurate?
- Was the information in the document complete?
- Was the information in the document easy to understand?

The answers that readers provide to these questions will be unambiguous, easily understood, and help technical communicators make informed decisions about how to improve their documentation.

Providing Reliable Metrics for Measuring Documentation Quality

Similarly, I previously suggested that the readers' DQ definition could be turned into a way to "classify and sort existing internal or external feedback, [which] can then be presented to management as clear and reliable metrics about the documentation that will help determine where more emphasis might need to be invested" (Strimling, 2019, p. 23). Measuring how accurate, complete, easy to understand, and accessible readers perceive our documentation to be is essential for gauging its quality. The information quality dimensions reflected in our Kano Model results serve as key indicators of DQ and can offer valuable insights into areas where improvement might be needed. Metrics, as Spool (2018) says, are about knowing what to measure, knowing what the measurements mean, and about knowing how to use them to improve our readers' experience. By systematically evaluating DQ based on these dimensions, technical communicators can make stronger business cases for how and where to allocate their limited resources to maximize reader satisfaction, as well as demonstrate the impact that high-quality documentation can have.

Teaching Students about Documentation Quality

But aside from the effect that this empirically based and reader-derived definition of DQ can have on technical communication practitioners, there are also clear practical applications for academics here as well. By using this real-life DQ definition, we can bridge the gap between theory and practice and create evidence-based materials to teach the next generation of technical communicators how to write documentation that is helpful and valuable to readers. Moreover, incorporating real-world DQ feedback and metrics into academic curricula can provide students with tangible guidelines and best practices that they can use when they enter the workforce.

Conclusion and Future Directions

The stated purpose of this paper was to take the reader-derived definition of DQ I previously proposed (Strimling, 2019) and make it more robust by applying the Kano Model of customer satisfaction to it. It was hoped that, by using the Kano Model's unique approach to classifying feature types and customer requirements, I could better determine which of the information quality dimensions presented in Wang and Strong (1996) really represented each information quality category, as it applies to documentation.

Overall, it seems to me that the application of the Kano Model's methodology to the reader-derived definition of DQ I proposed in my 2019 study has indeed enhanced the DQ definition. While not providing outright support for the use of the particular information quality dimensions I proposed there, especially for the Contextual information quality category (that is, emphasizing documentation completeness instead of relevance), nevertheless, there are strong similarities in the trends observed in both studies. Both underscore the value of documentation accuracy, ease of understanding, and accessibility to readers in convincing ways, and show that the context in which documentation is used plays an important role in DQ.

In my opinion, the differences between the results in my 2019 study and the results in this Kano Model pilot study can be attributed to the differences in their emphasis. The Wang and Strong (1996) framework I used there, with its structured and hierarchical approach to identifying dimensions of information quality, focuses on readers' ratings of the relative importance of these dimensions. This approach offers a detailed understanding of reader opinions about what they prioritize in the documentation and serves as a solid foundation for defining DQ.

However, DQ is more than just the importance of these dimensions to readers. Readers might consider many information quality dimensions "important", but that does not necessarily mean that focusing on these will lead to increased customer satisfaction. According to International Organization for Standardization (ISO) 9000:2015, the term "customer satisfaction" is defined as "[The] customer's perception of the degree to which the customer's expectations have been fulfilled" (n.p.). This definition, though, comes with the following important caveats:

- These expectations might not be known to the company, or even to the customer, until the product or service is delivered.
- It might be necessary to fulfill a customer's expectation even if it is not stated, generally implied, or obligatory (that is, a "requirement").
- Even when a customer's requirements are agreed upon and fulfilled, this does not necessarily ensure high customer satisfaction.

Rather than just simply measure the relative importance of the quality dimensions (like I did in my 2019 study), the Kano Model goes beyond this and measures customer satisfaction by categorizing the information quality dimensions into delighters/frustraters, capturing both expected and unexpected aspects of DQ. This focus on measuring customer satisfaction adds another layer to our understanding of DQ, aligning closely with the ISO 9000:2015 definition of customer satisfaction.

According to Feng-Han Lin et al. (2017), there are many ways to understand and prioritize the Kano Model results, and its main strength is that it provides decision makers with guidelines that can help them decide which features might have the biggest impact on customer satisfaction (Berger et al., 1993; Zacharias, 2018). In other words, the Kano Model is an important tool to help us understand what impacts customer satisfaction with DQ, but we cannot consider its results in a vacuum.

In this pilot study, because no demographic data was collected, it was impossible to segment the types of documentation readers who answered the Kano Model survey, which certainly had an impact on the responses. The need for participant segmentation is clearly important and can provide useful insights. For example, Jan Moorman (2012) observed distinct reactions to product features based on users' market savvy. By segmenting responses by profile, such as early, late, and non-adopters, the analysis became much more focused. This kind of segmentation ensures that the analysis reflects the varied needs and perceptions of different user groups. Similarly, Kano et al. (1984) themselves found differences between how men, women, married, unmarried, younger, and older people rated features of television sets.

It is important to remember that "technical documentation readers" are not a monolithic entity—they have different experiences (e.g., they are advanced or novice users), they have different needs (e.g., they want to understand a concept or do a task), and they have different backgrounds (e.g., they do not speak English as a first language, or they are older users). However, because the goal of this pilot study was to see if the Kano Model's approach to measuring customer satisfaction might be useful in improving DQ, the focus here was on capturing general trends and insights that might be broadly applicable, rather than analyzing variations based on demographic characteristics.

Future DQ studies using the Kano Model should, of course, attempt to gather and incorporate detailed participant information and examine the influence of demographic variables on perceptions of DQ. This will enable segmentation of the responses based on relevant reader profiles, which will enhance the robustness and applicability of this study's conclusions, ensure that the findings are more precise and tailored to different reader groups, and contribute to a more comprehensive understanding of how different groups experience and evaluate documentation.

I believe that the combination of Wang and Strong's (1996) information quality framework and the Kano Model can lead to a better understanding of DQ from the reader's point of view. Each approach has its strengths and ultimately complement each other in defining DQ in a clear, comprehensive, and empirically based manner. The broader perspective offered by the Kano Model allows us to go beyond merely looking at the importance of the dimensions to readers and explore their satisfaction levels regarding each dimension's presence or absence in the documentation. By integrating the results presented in my 2019 study based on Wang and Strong (1996), with the results suggested by the Kano Model here, we can get a much clearer picture of what our readers want from the documentation we send them and how they themselves define high-quality documentation—*accurate, complete (*or *relevant), easy to understand,* and *accessible.*

Based on the results of this pilot study, it seems to me that the Kano Model is a useful tool for defining how readers define DQ and determining what they want from the documentation we send them. Its focus on the positive and negative attitudes that readers have regarding certain information quality dimensions opens up a new avenue for research into DQ. This study should be seen as a beginning attempt at applying the Kano Model's well-founded methodology to the field of DQ, and be used as a starting point for building a framework for collecting meaningful and actionable feedback, creating consistent and reliable DQ metrics, and providing guidelines for use in academic technical communication courses to teach students about real-life reader-oriented DQ measures.

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Committee on Publication Ethics AI Guidelines Statement

As per the Committee on Publication Ethics (COPE) guidelines on AI and authorship (https://publicationethics.org/cope-position-statements/ai-author), the author states that the bulk of the material in the *Practical Applications* and *Conclusion and Future Directions* sections was written by the author; however, they include suggestions made by OpenAI's ChatGPT-3.5 LLM. The rest of this paper was written solely by the author.

Note from the TPC Series: The AI policy of the series is to not allow AI in any format. However, since this project was taken on from the STC, we followed their guidelines.

5. Card Sorting as a Way to Prioritize Content for Websites

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Abstract: Prioritizing content is an important part of developing a content strategy. As a research method for websites, card sorting has most frequently been used to categorize content and create an information architecture. In this chapter, using a user experience/user-centered design methodology, I investigate how useful card sorting would be for prioritizing topics as part of developing a content strategy. First, I review the results of a site visit that provide topic ideas for website revision. Then I conduct a card sorting activity where users group content into tiers. Finally, I validate those tiers through user testing, observing users as they complete tasks on a prototype and using active intervention to gather self-reported data. The card sort provided a strong indication of what topics were most important to users, showing me which content needed prime real estate and more focus on the site. In the user test conducted to validate the results of the card sort, only two topics shifted up a tier, the rest (four) remained in their original locations. The results suggest that web writers, content strategists, and technical communicators who have identified appropriate topics can use card sorting to help them prioritize their content.

Keywords: Card sorting, content strategy, websites, user experience

Content strategy "continues to evolve" and endure "growing pains," meaning we need more research to help technical communicators better implement key principles (Bailie, 2019; Sedmak et al., 2019). The broad brushstrokes were largely set throughout the last decade: professionals need to address content throughout its lifecycle, identify effective processes to evaluate and maintain content, and put the right people in place to produce and approve content (Halvorson & Rach, 2012; Kissane, 2011). The methods we use to achieve those goals still need a plethora of research.

We are, however, making progress. Sedmak et al. (2019) created a framework that helps "communicate current state, show the evolution of deliverables, identify content issues, and guide future planning." This approach appears more helpful in keeping track of the scope of an organization's content than the traditional spreadsheet. Researchers have sung the praises of audience analysis tools such as personas to "allow the voice of users to be heard without sacrificing rhetorical appeals or the designers' rhetorical agency" (Friess, 2017; Redish, 2014). We have also seen maturity models introduced to help technical communicators "assess

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content operations, identify gaps, and then develop a content strategy" (Campbell & Swisher, 2023). Sparingly, practitioners have been able to read about other professionals conducting content strategy projects in their own context (Getto & Labriola, 2016; Ting & Ding, 2023).

However, one understudied part of content strategy is what methods we use to prioritize content. Prioritization is a vital part of the process of creating and maintaining effective content (Halvorson & Rach, 2012). For websites, this may be especially important because of users' tendency to skim through content until they find something they want to read (Nielsen, 2006; Redish, 2014). Tang and Huiling Ding (2023) encourage professionals to base prioritization on user research and emphasize that it is vital in intercultural contexts, but what methods best help writers isolate prioritization so that they can make good informed decisions?

We have examples of researchers collecting this data through surveys and ideation workshops (Crane, 2022; Thominet, 2022), both methods having strengths and weaknesses that I will discuss in the literature review.

User testing is another way to get at prioritization, but UX (user experiences)/UCD (user-centered design) best practices suggest it is essential to build the first prototype off of previously collected data (Still & Crane, 2016). Also, using other user research methods in conjunction with user testing can create more valid results, allowing researchers to triangulate and reinforce data (Still & Crane, 2016; Sundt & Eastman, 2019). In my context, there was little sense in creating a prototype without some understanding of prioritization first, so I looked for a method that would allow me to isolate, as much as possible, the prioritization of content. I considered several methods, but the more I read about card sorting, the more opportunity I saw.

First, card sorting had traditionally been used to separate information into categories, which was the very thing I needed a research method for (Nielsen, 2004; Righi, et al., 2013; Sundt & Eastman, 2019). Second, Meghan Casey (2023) suggested card sorting, or what she calls "topic sorting," might be a good method to better understand user's content needs and how they prioritize content. These two facts combined made me curious about how effective card sorting could be, and because there are few studies exploring card sorting's effectiveness for this purpose, I decided to research it myself as I worked through a larger project.

This IRB approved study[1] uses a UX/UCD methodology to investigate how well card sorting helps web writers, including technical communicators, prioritize their content early in the process. While the specific results are not generalizable, the practice of using card sorting to prioritize content may be. That is, if it works in my context, web writers may be able to adapt the practice in their context with success. In the next section, I discuss the literature surrounding content strategy, prioritization, and card sorting.

1. Texas Tech University, 2019.

Literature Review

Communicating through technology is a core competency for technical communicators, and websites are a common technology for which they create content (Society for Technical Communication, 2023). Organizations write, including on websites, "to connect with others inside and outside the organization to accomplish key organizational goals (Hart-Davidson et al., 2007), but unless users find the content they want and can use it for their purposes, they will quickly move on to other options: connection lost. That makes effective content an important part of the user experience (Garrett 2011; Redish 2014). Because of this reality, organizations need to create a content strategy that provides the information users are looking for and sends messages that correspond with organizational goals (Halvorson & Rach, 2012).

Content strategy is what "guides your plans for the creation, delivery, and governance of content" (Halvorson & Rach, 2012). It seeks to direct the process of content development throughout the information's entire lifecycle (Clark, 2016). In this way, content strategy is an expansion of content management in the same way that UX is an expansion of usability (Bevan, 2009). Whereas content management is concerned with "organizing, categorizing, and structuring information resources so that they can be stored and reused" (Hackos, 2002), content strategy takes a broader approach to include every moment of the content lifecycle from conception until archiving or deletion (Clark, 2016; Rockley & Cooper 2012). It answers questions about business needs, content needs, user needs, operational needs, and technology needs, all part of creating, evaluating, and maintaining content products long term (Bailie, 2019).

Most importantly for us, content strategy for the web "typically addresses marketing content and brand messaging" (Sedmak et al., 2019). As we tried to grow our program, we needed to send a clear message about who were and what distinguished us from other writing programs.

Kristina Halvorson and Melissa Rach (2012) divide content strategy into four broad components with a core strategy guiding decisions in each category:

- **Substance**: What messages do we want to send? What content and tactics do we need to effectively send those messages?
- **Structure**: How is content "prioritized, organized, formatted, and displayed?"
- **Workflow**: How does content get evaluated, published, and updated? What people and processes are involved?
- **Governance**: Who is in charge of the content? How are key decisions about content and strategy made?

Substance and structure are the content components while workflow and governance are people components. The content components obviously relate closely to each other. In substance, topics and tactics work together to send messages.

Topics are what we write about while tactics are the methods we use to discuss those topics and send messages (Garrett, 2011; Halvorson & Rach, 2012). Once an organization knows what topics to write about, what messages to send, and how to convey those topics and messages through tactics, they must prioritize those topics and messages to deliver the best experience for their users because not all content is equal in importance to an audience (Casey, 2023; Garrett, 2011). That's what the structure component of Halvorson and Rach's model provides. It tells us that to lay out a page well and to write the most effective content, we must first prioritize that information. Further, Ting & Ding (2023) conclude that one of the most important strategies for web communication in intercultural contexts is to prioritize content using user research and work on prioritized elements before secondary ones.

Understanding what to prioritize is the challenge, and it requires us to "invest in research and testing" (Halvorson, n.d.). Of course, user testing will play a role in prioritizing content, but alone, it is insufficient because web design scholarship calls for an initial prototype to be built off data already collected from the organization and users (Still & Crane, 2016). Web writers are producing content for the first prototype off of something: either their own experience and knowledge, which can be faulty by itself, or through the input of users and data. Ideally, card sorting and user testing will be used together to validate the structures web writers want to put in place (Sundt & Eastman, 2019).

Casey (2023) suggests using the following methods:

- Surveys
- Task identification activities
- Search intent analysis
- Topic sorting

For my context, the most compelling method from previous research was "topic sorting" (Casey, 2023). Topic sorting is essentially card sorting: having users organize cards or sticky notes into categories that correspond with how important they view those topics (Casey, 2023). Her suggestion is a departure from the purpose of most card sorts but because the method has always been about creating categories from items, it makes sense.

For websites, card sorting has typically been used to help create an effective information architecture, organizing content in a structure that users can recognize and use (Nielsen 2004; Righi et al., 2013; Still & Crane, 2016). It offers a "systematic and statistically significant process for answering questions about hierarchy design" (Hawley, 2008). The method has proven effective in empirical studies, improving users' efficiency on websites and reducing errors (Ntouvaleti & Katsanos, 2022), but the way that researchers conduct card sorting will affect results (Sheldon, 2015). Users either sort data into predetermined categories, a method called closed sorting, or are allowed to make their own categories, a method called open sorting (Righi et al., 2013; Sundt & Eastman, 2019). In both cases, they may be given items to sort into the categories or asked to provide their own items. At the end of these sorts, researchers have a good idea of the information architecture that users expect to see on the site.

However, information architecture tends to focus on "structure and functionality," not the content details on each page (Halvorson & Rach, 2012). While this process is essential, a compelling user experience also depends on writers creating compelling content on accurately prioritized topics. This chapter builds off Casey's (2023) suggestion and investigates how card sorting can help web writers prioritize their content and identify appropriate tactics before the initial prototype. The idea is not to replace card sorting for information architecture purposes, but to add another use for an already established method: prioritizing content. I believe this paper fills two important gaps:

1. We do not yet have studies that assess how useful this method is for prioritizing content prior to creating drafts or prototypes of a website.
2. We do not have many examples of what this practice looks like within specific contexts. Practitioners often learn from seeing how others have used methods, giving them a model they can adjust to fit their own needs.

In the next section, I discuss the context and work that led to the card sorting activity, providing necessary context for how I used this method.

Project Background

The university is a private school in the Midwest with between 4,000 and 5,000 undergraduate students. When I arrived at my academic institution over a decade ago, the university website had only two sentences about the Professional Writing (PW) major. A year later, the program faced an enrollment crisis: it had zero incoming students, and the administration was beginning to take notice. The program faculty immediately took steps to address a number of issues, including the website. But while the site improved, it remained static and inflexible for several years. In terms of recruiting, PW was missing opportunities. Like most big decisions, prospective students took months to decide what school they wanted to attend and what they would study. PW faculty needed a strategy to engage students throughout the process, a reason for them to interact with the website and other content multiple times.

The program also went through a significant rebranding that the website did not immediately reflect. The PW faculty wanted a process for how to regularly update the site with important and exciting information about the PW program, and we had lots of ideas. But even on the web, space is limited, at least by convention. Users historically have skimmed through sites to find what they are looking for before reading, and too much content can overwhelm them, driving an audience to other sites (Pernice, 2017). Our webpages should not be a repository for all the information we could ever provide about the program (Redish, 2014).

Instead, we needed to understand both what we wanted to communicate about ourselves to prospective students and what content that audience needed to help them decide on programmatic fit (Garrett, 2011; Halvorson & Rach, 2012).

Putting the work of technical communication into practice, I set off to identify what topics, tactics, and messages we needed to succeed, classic elements of content strategy (Casey, 2023). During the process, it became clear how insufficient it was to gather the necessary topics and tactics without prioritizing them. After all, like all sites, the university's redesign provided priority spaces on program webpages and other spaces that readers would only see if they dug into the details. Our priority content needed to occupy priority spaces, meaning we needed to correctly identify what content was most important and present that information in a form that resonated with users. My research into prioritization methods led me to card sorting.

This card sorting activity was part of a larger project to remake PW webpages on the university website. Concurrent with this research, the university redesigned their entire website, an activity that dramatically changed the way information was presented. These changes provided the perfect opportunity to address the web content needs of the PW program.

The full research project included site visits, organizational analysis, competitor analysis, card sorting, and three rounds of user testing with prototypes of various fidelity, but this paper highlights those methods before the first test that were focused on identifying topics to write about on the PW pages and how to prioritize those topics. It then uses the results of the first test to validate the findings of the card sort.

In the research leading up to card sorting, I did site visits to get a sense of what topics users wanted to engage with on the site. A site visit is an "intensive" method that helps designers identify how users use a product or service in their environment (Still & Crane, 2016). The site visits built the foundation that allowed me to conduct the card sorting activity. In the following section, I detail how I completed the site visits and what the relevant results were to this study.

In the site visits, users browsed the university's current professional writing pages. I asked them to interact with the site as they normally would, engaging with only the content that interested them and ignoring what they would normally ignore if I were not present. All three users were first-year PW majors who had not completed any courses in the program as full-time students. I greeted each user and explained what they would do on the site. I used active intervention and talk aloud protocol (Still & Crane, 2016) as I collected user, task, and environmental analysis during these site visits. For each of these three categories, I took handwritten notes on paper, trying to capture every relevant detail (Gaffney, 2015). Specifically, I collected information on the following.

User Analysis: I wrote down any information that gave me a better understanding of how the user thinks and/or why they performed certain actions. This information was both verbal and non-verbal and collected through observing the user's actions and gathering self-reported data by way of talk-aloud protocol and active intervention. I also took notes on the actions of users as they engaged with the current site.

I gathered information about user preferences on this site, the way they used the site, and their satisfaction and enjoyment of the site. We want users to do more than tolerate a product; we want them to enjoy it (Still & Crane, 2016).

Task Analysis: I documented every task and sub-task the user performed on the site by taking notes by hand, paying attention to both what they engaged with and what they appeared to ignore. Through user analysis, I asked users why they interacted with some content and did not interact with others.

Environment Analysis: While the environment may not affect user behavior much in this context, I still wrote down information about the environment, such as noise levels, other resources the user used, and if anyone or thing interrupted the user.

After users finished browsing the site, they were asked two questions that in part attempted to understand what characteristics made up the brand community of this undergraduate professional writing major (Christiansen & Howard, 2017):

1. What questions do you still have about the program?
2. Who are our competitors?

After users answered these questions, I thanked them for their participation and ended the session.

Because the site visits are not the focus on this paper, I do not provide the detailed results, but a few of the lessons learned are vital to the rest of this research.

While I wanted more information to draw concrete conclusions, the site visits suggested that the skills taught in the program, specifically the writing style they would learn, and career opportunities were perhaps the most important topics to users. Students also seemed interested in the curriculum, a broad description of the program that framed it for them, opportunities to apply their skills outside of the classroom, and what the experience inside and outside the classroom would look like in this major.

The site visits revealed that users typically engage with content in the order in which it appears on the page. Users scanned the top content first and moved their way down the page until they found information they wanted to read. This discovery was not surprising, but it does reinforce that writers need to carefully prioritize content. The most important content (information that best supports organizational goals and addresses user needs) requires space near the top of the page.

Now that I had a list of topics that users want to read about on the site, I needed to identify which topics were the most important to them. My methods were two-fold. I conducted a card sorting activity and will show what that process looked like and how I made prioritization decisions based on the results. My second method was a low-fidelity protype test used to validate that I was writing about the most helpful topics and had prioritized them correctly. This study will show whether the card sorting activity, built on my site visit, help me accurately prioritize topics before my first test.

Card Sorting Method

I conducted the card sorting activity with three users to identify how they prioritized the site's topics. Card sorting typically requires a bigger sample than three users with suggestions ranging from six (Still & Crane, 2016) to fifteen (Nielsen, 2004). I chose to use only three users because the goals of the card sorting activity overlapped with the goals of the site visit. In both, I sought to identify what topics users wanted the site to cover, how they prioritized those topics, and how they wanted those topics presented (tactics). Because I could combine data from the site visit with the card sorting activity for a fuller picture, I chose to use only three users.

I had two female participants who had just joined the PW program within the last few weeks and one male participant who was a prospective student. These were appropriate users because our main audience was prospective students or current students who might have an interest in switching from a current major to PW. So while they were a convenient sample, they were the exact audience the site was meant to address.

Based on what I learned from the site visits, I wrote topics on note cards. For example, I learned in the site visits that users want information about jobs they can get with a PW degree, so I wrote "information about jobs" on a note card. Users then sorted the cards in order of priority in tiers from top (most important) to bottom (least important). The notecards had the following topics written on them that I derived from the site visits:

- Descriptive overview of the program
- Curriculum
- Information about jobs
- Opportunities to apply writing skills as a student
- Content on what PW students write/create
- Content on experience with PW

On the back of each note card, I wrote down tactic ideas (blog, student portfolios, list of jobs, etc.) that came from site visits and the professional writing faculty. The tactics were important because they are the mechanism by which users engage with the topics. For example, a list of jobs that former graduates have obtained is a tactic to provide information on the topic of jobs. Users verbally gave feedback on each idea and had the opportunity to suggest new tactics or variations of those listed. The tactics written on these cards before user input are provided in Table 5.1.

Table 5.1. Topics and Tactics for Card Sorting Activity

Topic	Tactic(s)
Descriptive overview of the program	Basic skills Career direction, Values of program These three list items are summaries of content to cover in the descriptive overview
Curriculum	Link to the catalog, Course Spotlights, Curriculum page with descriptions
Information about jobs	Job list, Professional profiles
Opportunities to apply writing skills as a student	Opportunities list, Student descriptions of opportunities
Content on what PW students write/create	Student Portfolios
Content on experience with PW	Students discussing experience in the program Recent graduate reflections

I took a picture of how users ranked the notecards to document their results. With their permission, I recorded their verbal feedback as they described why they ranked content where they did because a researcher's memory is not good enough to accurately recall what users said and how they said it (Marsh, 2015). The intent of this study was to see if card sorting could help me identify what topics users found most valuable for the site, allowing me to create an effective initial prototype with proper prioritization.

Card Sorting Results

Participant 1's results are shown in Figure 5.1.

Overview of program: Participant 1 stated that she wanted "to know what I'm getting into" and thinks the current construction works well. She did not suggest any new content.

Curriculum: Participant 1 suggested creating sample 4-year plans so students can see what they might take. This information is already in the academic catalog, and it was not clear if she found that sufficient or not.

Information about jobs: Participant 1 said the job list is "important." She stated that the professional profile was an interesting idea and suggested a Q and A format that addressed basic questions: where graduates work, what they do, etc.

Experience in PW: Participant 1 expected this information to be in the form of student testimonials when she read the card but prefers the idea of a blog where students describe their experiences: "I think it really builds off of the overview."

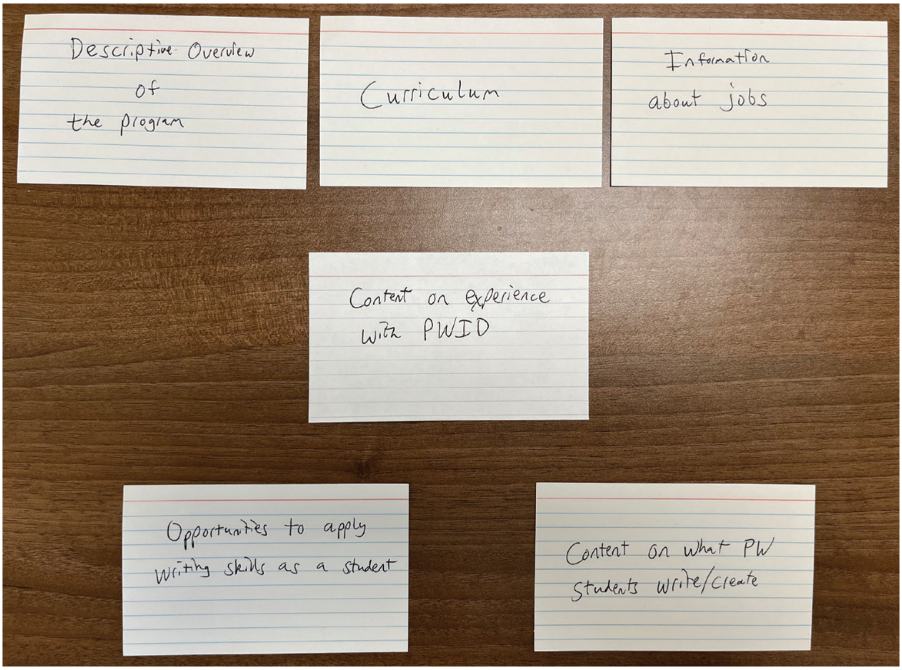


Figure 5.1. Participant 1's results

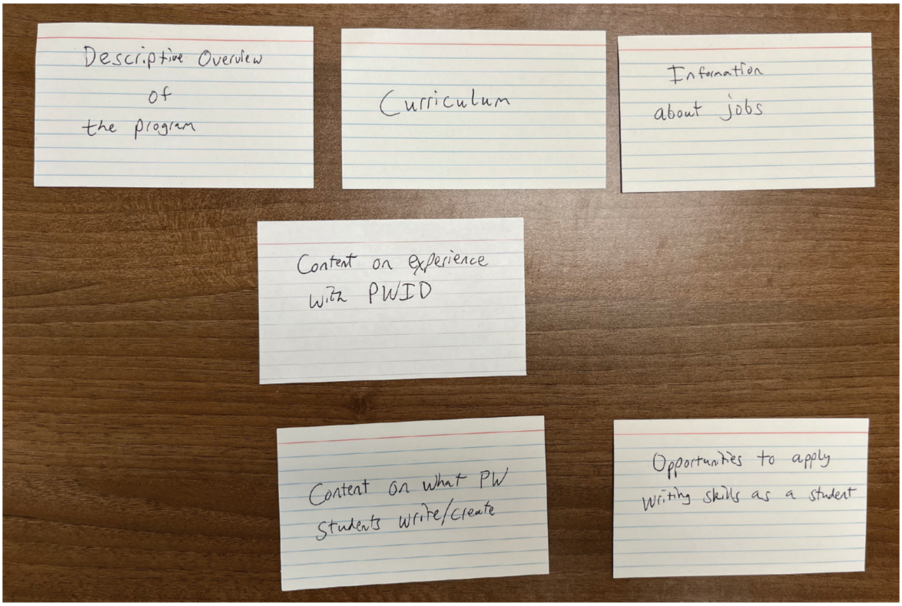


Figure 5.2. Participant 2's results

Content on what PW students write/create: Participant 1 found the student portfolios idea “really valuable.” She did not suggest other ways of displaying student work.

Opportunities to apply writing skills while a student: Participant 1 found the list of opportunities helpful but suggested we add student writing organizations to the list. A new creative writing organization had just formed during the semester of the test, so this information was fresh in her mind.

Participant 1 was focused on getting a broad understanding of what the program was (overview), what those details looked like in the classroom (curriculum), and how she could use her skills post graduation (job information).

Participant 2’s results are shown in Figure 5.2.

Overview of program: Participant 2 stated that the overview should tell “students what they would learn, what they can expect.” She believed the site’s current overview has a structure that accomplishes those goals.

Information about jobs: Participant 2 wanted the job list but also some type of descriptions of those jobs. She did not suggest what form those might come in, just that they would help users understand what these jobs might look like.

Curriculum: Participant 2 said that she “looked a lot at curriculum” because she wanted to write and edit and not do literary critique, something she associated with the English major. Her verbal response seemed to align more with the content on what PW students write/create because she wanted to do one type of writing and work over another.

Experience in PW: Participant 2 stated that it was important to show how students can develop their skills outside the classroom. She felt the blog was an effective place to discuss this topic.

Content on what PW students write/create: Participant 2 did not suggest any other tactics but noted that the portfolios were helpful.

Opportunities to apply writing skills while a student: Participant 2 suggested that students could talk about their professional development opportunities on the blog.

Like Participant 1, Participant 2 prioritized a broad understanding of the program (overview) and jobs. But while she rated curriculum highly, her comments suggested she cared more about the type of writing she would do in the program than the curriculum itself. The curriculum was just a means to better understand the writing style. That means that content on what PW students write/create would have rated highly if she had understood the distinction better.

Participant 3’s results are shown in 5.3.

Information about jobs: Participant 3 believed that information about jobs was the most important piece of information. She wanted to know what careers she would be prepared for. Curiously, she said that she “wanted to be writing more instead of writing about writing.” That seems to relate more closely to what content PW students create than jobs, though maybe she was distinguishing between writing content that mimicked organizational documents and analyzing literature. While I felt confident I understood what she meant in the moment, I could have followed up to clarify. In terms of jobs, Participant 3 prioritized jobs she thought were "important" and that she "cared about" over financial considerations. She found the job list helpful but wanted more information on what those jobs entailed. She did not suggest tactics to convey that information.

Content on what PW students write/create: Participant 3 thought that this category closely related to job information because she wanted to see how her coursework would prepare her for future work. She did not suggest new ways to portray this information, but she was visibly excited about the idea of student portfolios.

Overview of program: Participant 3 believed the overview was "a soundbite of the program to get people interested." As with the other participants, she was satisfied with the three topics covered in the current overview.

Curriculum: Participant 3 wanted to see classes that would teach her what she wanted to learn, even if some classes did not look interesting to her. She found the idea of course spotlights interesting, suggesting they should tell what the class is about and how it fits into the broader curriculum.

Opportunities to apply writing skills while a student: Participant 3 stated that this topic was "nice" but less of a deciding factor when choosing a major.

Experience in PW: Participant 3 conflated this topic with community building within the program. That was not a comprehensive view of how I conceived the category, but because she viewed the topic this way, she thought it was the least important. CS Participant 3 noted that academic information was far more important.

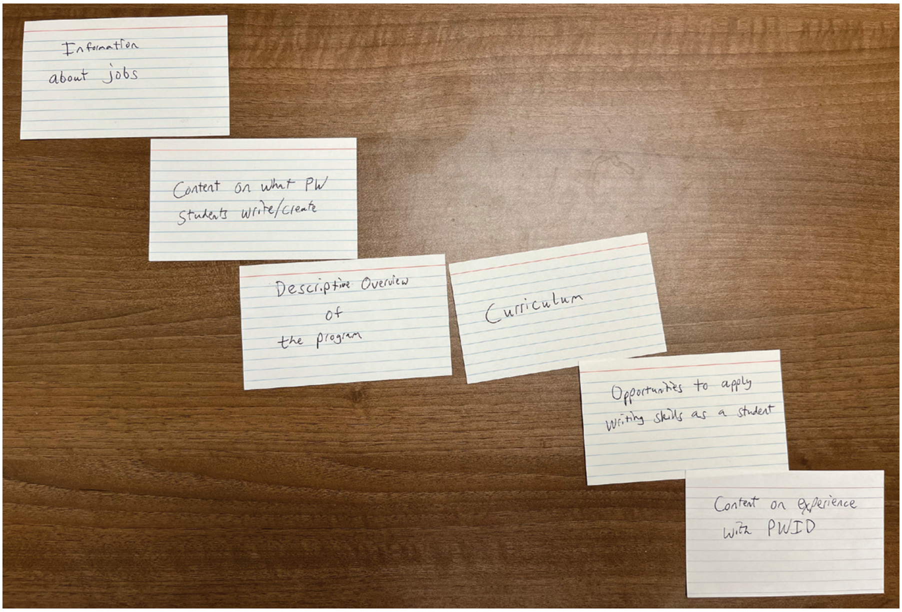


Figure 5.3. Participant 3's results

Card Sorting Discussion

The card sorting activity validated that job information is important and needs prioritized because all three users rated it in their top tier. It was also clear that users want more information than just the job list. Only Participant 1 had a positive reaction to the graduate profile tactic while the other two users wanted descriptions or more information on the jobs, but they did not suggest a tactic. Based on this information, I prioritized jobs as a topic, recognizing that I would need to develop multiple effective tactics because of how important it was.

While content on what students write/create was rated highly by only one user, every user cared greatly about enjoying the program and finding writing that fulfilled them. Participants 2 and 3 both stated that they were looking for a form of writing that they enjoyed in contrast to something else ("writing about writing" and "literary critique"). These responses suggest that while this user group enjoys writing, they prefer specific forms of it and find some ways of writing to be unfulfilling. Based on their verbal feedback, they cared greatly about the type of content they would create as students and my topic was likely worded poorly or not distinguishable enough from curriculum. At the time, I did not seek more clarification because their verbal feedback seemed to clearly show that they cared more about the type of writing than their card sort initially indicated. Knowing that I could validate these results in user testing, I did not seek immediate clarification. In hindsight, this clarification may have been useful, though it seems my initial conclusions were correct.

The other findings were less conclusive, but they pointed me in a reasonable direction. Users consistently rated "opportunities to apply writing skills while a student" as less important than other topics. These users suggested that the content was useful but not as influential in their decision-making process as other topics.

The overview was considered necessary and often influential. Two of the three users ranked the overview in their top tier, and the other user stated that the overview on the current site is what engendered her interest in the program.

Curriculum rated highly for two users, but the comments of one of those users, Participant 2, seemed to suggest that she was more focused on the kind of writing she would do than the courses she would take: she wanted to write professional documents and not literary critique. From card sorting, I prioritized the content in the following way:

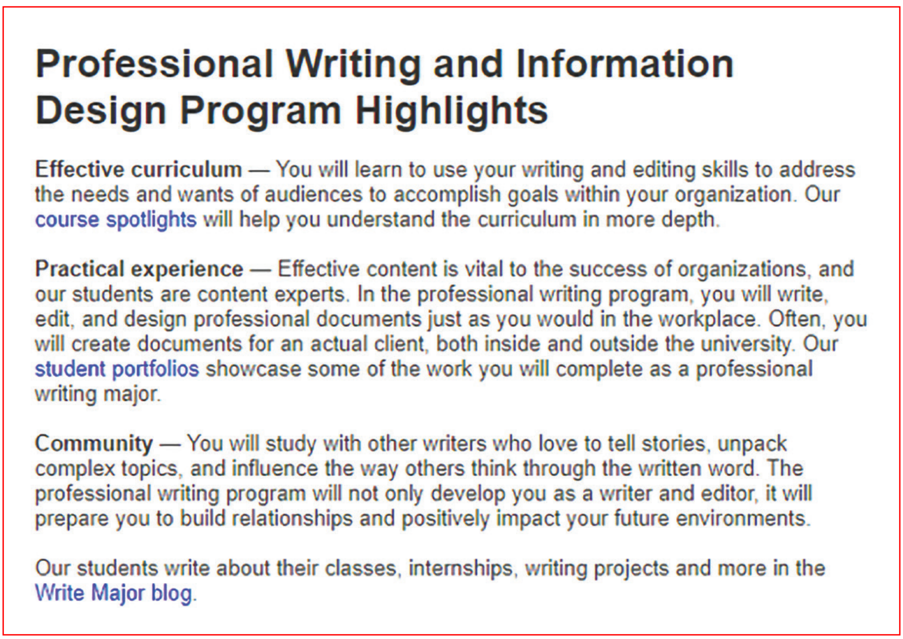
- **Tier 1**: Job information
- **Tier 2**: (1) Overview, (2) content that students write/create, and (3) curriculum.
- **Tier 3**: (1) Experience in PW and (2) opportunities to apply writing skills while a student.

Now that I had an initial prioritization of content, I wanted to see if user's words and actions related to the first prototype would validate this order or not. Essentially, through a low-fidelity prototype test, I evaluated how accurately card sorting helped me prioritize content.

User Test Method

Using what I learned from the card sorting activity, I produced a low-fidelity prototype and user test focused on topics and tactics. The goal of the test was to validate which topics users felt were the most important for writers to address. This prototype contained basic content ideas without any attention given to surface elements. It contained some of the characteristics of a paper prototype in that design was scarce, and it had only basic content ideas and layout (Snyder, 2003). The lack of design allowed me to focus on content (Moran, 2016). Figure 5.4 displays the level of sophistication of this prototype.

The users who participated in this test consisted of four prospective students and one current student who had joined the major within the previous six months. To contact prospective students, I asked the admissions office at my institution to give me a list of prospective students who were interested in writing and would visit the campus during a large-scale recruiting day. I emailed the four prospective students' days before they arrived on campus and asked them if they would be willing to participate. They accepted the invitation, and I set up meeting times with each individual.



Professional Writing and Information Design Program Highlights

Effective curriculum — You will learn to use your writing and editing skills to address the needs and wants of audiences to accomplish goals within your organization. Our course spotlights will help you understand the curriculum in more depth.

Practical experience — Effective content is vital to the success of organizations, and our students are content experts. In the professional writing program, you will write, edit, and design professional documents just as you would in the workplace. Often, you will create documents for an actual client, both inside and outside the university. Our student portfolios showcase some of the work you will complete as a professional writing major.

Community — You will study with other writers who love to tell stories, unpack complex topics, and influence the way others think through the written word. The professional writing program will not only develop you as a writer and editor, it will prepare you to build relationships and positively impact your future environments.

Our students write about their classes, internships, writing projects and more in the Write Major blog.

Figure 5.4. Display of prototype fidelity

The test environment needed to mimic the important characteristics of the real context that users would be in when they engaged with the site (Holtzblatt & Beyer 2016). For the web, this often means a quiet space where users can sit and engage with the site without public distractions (Ritter & Winterbottom, 2017).

For this test, users did the following tasks:

1. Write down a list of questions about the Professional Writing program that you have before you begin.
2. Browse the site. You can read, skim, or do whatever you think you would do if you came across this site at home.

I had users write down the list of questions they had about the program before they interacted with the prototype because websites are like conversations where users come with questions or goals and the site responds (Redish, 2014). I hoped that having students write down questions would give me further evidence to their needs, what topics they wanted, and how they prioritized those topics. Then I ask users to browse the site to get answers to their questions. This task was open-ended: giving users "minimal explanation about how to perform the task" (Lanoue, 2015).

To get self-reported data, I used active intervention. It requires the researcher to ask questions as the user completes tasks (Still & Crane, 2016). The benefit is that users and designers can have a conversation about specific decisions as they happen when the thought process is freshest. Active intervention was well suited for this point in the process because I did not care about the user's natural flow through the site yet; I did care why they decided to click on a content feature and if they found a tactic valuable or not.

I also observed and wrote down on a note sheet the user's path through the document and took notes on their answers to my questions during active intervention. Just as telling, I wrote down content that the user chose not to engage with because it allowed me to ask questions about why they ignored that content (Marsh, 2015). I voice recorded the conversations with the user's permission. Finally, I asked them two post-test questions:

- What questions do you still have about the program?
- What was the most helpful part of the site? Least helpful?

I asked these questions to grasp more fully what questions my initial prototype effectively answered and which content users deemed helpful. For this paper, I'm focusing on whether user testing validated the prioritization of the topics from the card sorting activity.

Low-fidelity Prototype User Test Results

Table 5.2 details the questions that users wrote down.

Table 5.2. Questions Users Had about the Program

User	Questions
User 1	What types of writing do you do? How do I know if I am a good enough writer for this major? Who is a writer? What skills should I have? What will I learn in the classes I will take? What careers can I have?
User 2	What jobs can come out of this major? What are the design parts of this major? How much writing experience is good to have for this major?
User 3	What am I going to be writing? Are the professors nice? How is this different from creative writing (because I really like creative writing)? Will this program be really hard and boring? What jobs am I going to get?
User 4	What are my career options? What do the classes focus on? What have people in this major done after graduation?
User 5	What kind of writing is most prominent with PWID? Where could I go with this major? Do I have to do a lot of creative writing?

When discussing why they wanted to know the kind of writing they would do, users focused on the need to enjoy their work in the classroom and beyond, noting that they did not want to write "essays" (User 5) or more directly, that they wanted to "enjoy it" and avoid boredom (User 3). This focus on enjoying the writing matched what I found in the site visit and card sorting activity.

When users browsed the site, I noted what content they did and did not engage with. It would become unwieldy to note every element that users interacted with and every comment they made, so I will report on the elements that at least four of the five users interacted with. By identifying what tactics the users engaged with and having a conversation about their choices, I was able to draw conclusions about what content they thought was important.

Overview

Four of the five users interacted with the overview. Table 5.3 provides key insights into their activity and response.

Table 5.3. User Responses to the Overview

User	Key Insights
User 1	The core skills presented in the overview "really get at the idea of helping people." She also noted that it was "helpful that it noted where you would work."
User 2	This user did not read the overview.
User 3	She skimmed the overview looking for bullet points. She said there were "too many words" in the overview for her taste.
User 4	He thought the overview "gave a general overview of the program", which is what he wanted from the content in that space.
User 5	She thought the core skills were enticing: "emphasizing writing, editing, and design makes it (the program) clear." This user was interested in distinctions between the PW program and others that might involve writing in the workplace, most notably a marketing degree.

Only one user did not read the overview while three of the four that did found it useful, emphasizing the core skills as important content. This university required an overview of the program on all academic webpages, so using it to properly preview the program and entice readers was essential. It served as the beginning of the conversation between users and site (Redish, 2014).

Student Portfolios

Four of the five users engaged with the student portfolios, the main tactic to help users understand what kind of content they would write or create. Table 5.4 shows some key insights from each user.

Table 5.4. User Responses to the Student Portfolios

User	Key Insights
User 1	"Gives a clear overview of what these people are doing." She said that "I could relate to these people," noting they were writers like herself.
User 2	She found the portfolios important because they "help explain what I'll be doing."
User 3	This user said the portfolios showed the kind of work that students were doing and provided one thing they designed, both relating to her initial questions about the program.
User 4	He liked that the portfolios show "what they do and why they enjoy it" so he could see if his interests aligned with those of current students. The portfolios also gave him insight into realities he had not thought of before, such as the existence of writing and editing internships.
User 5	This user did not click on the student portfolios. She stated that she would have but did not understand what it was. She explained that she did not think it was "example work", which she would have been interested in because she wanted to understand the writing that students did.

Each of the users wanted to view current student work to get an idea of the writing, editing, and design work they would do. All four users who viewed the portfolios expressed positive sentiment toward the tactic and a desire to learn about the kind of writing they would do. The one user who did not view the portfolios did not understand what they were, meaning that all five users wanted information about the writing style they would learn in PW and what kinds of documents they would create.

Blog

Four of the five users viewed the blog, a tactic that could address several different topics. Table 5.5 shows some key insights from each user.

Users clicked on the blog for multiple reasons, looking for answers to their questions from a current student's perspective. As with past research, this test seemed to make clear that the blog has a useful function, but that the topics covered on the blog needed to be refined to properly address user needs. Two users wanted to know about internships while two were interested in understanding the writing that students do or what class projects are like.

Job list

All five users read the job list. Table 5.6 shows some key insights from each user.

Table 5.5. User Responses to the Blog

User	Key Insights
User 1	"Helped me relate to the people in the major."
User 2	This user did not click on the blog but did note that she could see why others would be interested to see the writing that current majors do.
User 3	This user clicked on the blog wanting to hear about internships, which she finds intimidating. She likes to read about "students doing things."
User 4	He wanted an overview of the various experiences that current students have had, including information about internships and class projects. He clicked on one post, stating that it was "helpful to see what this student did." Another sign that my audience wanted to understand the kind of content students write and create.
User 5	Clicked on the blog to "explore the program", but the preview on the PW homepage did not make it clear what information the blog would provide her. An important part of homepages is to give users a sense of what the site offers and guide them toward a productive part of the conversation (Redish, 2014). This user felt the homepage did not preview the blog effectively. She found the tactic useful once she understood its purpose.

Table 5.6. User Responses to the Job List

User	Key Insights
User 1	She said that "it's nice to know it's broad, that I don't need to know what I'm doing right now." User 1 was more concerned with the kind of work she would be doing than the specific job, meaning that writing and editing were more important to her than a job title. She did not see the need for more job information on the site; users could get that information elsewhere.
User 2	She stated that it was helpful to have a list just to know what the job possibilities are. For additional information, User 2 was interested in information about graduates and where they work.
User 3	She said she wanted to see if the jobs aligned with her interests. Even if she did not know what a job entailed (e.g. content strategist), it would be "cool to learn what that is." She does not "care about money" but would click on more information about jobs if it was on a separate page from the list.
User 4	This user felt that the job list showed him career options and allowed him to explore these jobs further. He would be interested in a description of the jobs in some format.
User 5	She described the job list as "helpful." This user would be interested in a separate page with descriptions of these jobs that answers, "how these jobs are specific to Professional Writing majors."

The users found the job list useful, but each also needed more information on what these jobs entailed, though one user felt she could learn about those jobs outside of the university site. Addressing concerns about jobs is essential; every user wanted more information about them.

Three users looked at the course spotlight page, a new tactic meant to answer questions about both curriculum and the type of writing students do in the program. User 5 stated that the course spotlight was "helpful", and User 2 suggested that it focus on subject matter in the classroom.

After users interacted with the prototype, I asked them two follow up questions: (1) what questions do you still have about the program? (2) What was most helpful part of the site? Least helpful?

1. **What questions do you still have about the program?**
    - **User 1:** None
    - **User 2:** None
    - **User 3:** None
    - **User 4:** What are the jobs that I can get?
    - **User 5:** What kind of writing will I do in the program?

There were not consistent themes of missing content according to the results, but the ones presented reflected the initial questions that users had: topics related to writing style and jobs.

2. **What was most helpful part of the site? Least helpful?**

The content that users found most helpful varied. While given the opportunity, no user provided a least helpful piece of content. Users noted the following as the most helpful pieces of information:

- List of jobs (2)
- Blog (1)
- Student portfolios (1)
- Overview (1)

These tactics were also the most viewed content on this prototype.

This test validated some of the topics and tactics that I need to include on the site. It also helped me identify the two most important questions that users ask: what kind of writing will I do in the program and what jobs can I obtain with this degree. Students prioritized their enjoyment of the writing over other factors, such as salary after graduation or career status. User 3 asked whether the program would be "boring." User 1 desired a major that "represented" who she was, almost as if the major was an extension of her identity as a writer. User 4 wanted to "find fulfillment" in his academic studies. Users contrasted the kind of writing they were looking for with other forms they did not appreciate. That contrast told me that they cared deeply about finding a program that allowed them to do the kind of writing and editing they enjoyed.

While personal fulfillment may have been the most important factor to their decision about a major, users suggested the site include more information about jobs. The fact that all five users looked at the job information and wanted more content on the topic validated what the card sorting activity already told me about the topic: it was of the highest priority.

After the test, I re-created my tiers based on the data:

- **Tier 1**: (1) Job information, (2) content that students write/create
- **Tier 2**: (1) Overview, (2) Experience in PW, and (3) curriculum.
- **Tier 3**: Opportunities to apply writing skills while a student.

I moved content that students create into the top tier because users asked so many questions about it and engaged with tactics to learn about the kind of writing they would do in the program. It was clearly a top tier issue, along with jobs. Every student asked questions about jobs and wanted more tactics related to jobs.

The second tier now included the experience in PW because students clicked on the blog so often, two of them were looking for information about writing styles. But they also wanted information about internships, class projects, and the kind of people that studied in this program. Both the overview and curriculum information were viewed frequently by users but not as often as the tier one content.

Finally, outside of a couple comments about internships, students did not mention opportunities to apply their skills outside of the classroom. For that reason, that topic remained in the bottom tier. The results of the test largely validated my prioritization from the card sorting activity. Four of the topics stayed in the same tiers while two topics moved one level. There were no major surprises.

Being able to watch users interact with tactics and ask them questions clarified the previous issue on the kind of writing students would do in the program. While participants in the card sorting activity sometimes did not grasp what the topic was from reading it on a notecard, the users in the user test clearly valued the topic highly, looking at multiple tactics to learn about it.

Conclusions

Based on this information, it appears that card sorting helped me prioritize topics well. It gave me a baseline that I could validate with user testing, and that baseline ended up being quite accurate. The order may have been even more accurate if participants in the card sort understood the topics better. I tried to explain them before they sorted, but participants still struggled to grasp one or two. It's important to note that web content writers need to establish what topics users want before they try and prioritize them, but once they've done that, they can use card sorting as a starting point for creating tiers of content. Practitioners may take away the following from this study:

- Card sorting can help writers effectively prioritize content. In my user test, I merely had to tweak my prioritization structure instead of overhauling it. Because card sorting was effective at identifying how users prioritized content, researchers can start the testing process with a strong baseline that only needs validated instead of constructed from scratch.
- Writers need to write clear topics on the notecards and make sure users understand what each topic means or entails. This practice will improve the validity of card sorting results.
- Writers should have some method of validating the results of the card sorting exercise. While the results in my study stayed mostly the same after the user test, I still needed to tweak my tiers to have the most effective prioritization. Best UX/UCD practice suggests that we "trust but verify" all our findings by diversifying the kinds of data we collect and use multiple methods to confirm our conclusions (Still & Crane, 2016).

Card sorting and the subsequent validation through user testing gave me confidence that I understood what content users wanted to read on my site. This process allowed me to give prioritized content more space on their webpages and place those topics in prime locations to draw more attention to them.

While not the focus of this study, I was also able to get tactic ideas from this card sorting activity. I used those tactic ideas to help me create a prototype where I could observe users engaging with topics, but even on their own, tactics are an important part of a content strategy. Further research may focus more on how card sorting can help web writers develop tactic ideas.

This study was limited by several factors. First, typical card sorts usually have at least six participants, and my study had three. I mitigated this issue by using other methods (site visit and a user test) that had the same goals. In all, I had eleven participants doing activities that were focused on prioritizing topics. The second limiting factor is that my results are not generalizable. What is generalizable is the use of the card sorting method for prioritizing content before the first prototype. Web writers and technical communicators should consider how they can adapt my study to their specific contexts.

Card sorting is not a new method, and yet, it has not often been used to prioritized content topics for a website. Based on my study, web writers should consider using it for this purpose. Doing it well will help them understand what topics they should give priority spots to and write about more.

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6. Breaking from PowerPoint's Defaults: A New Workshop Model Encourages Presenters to Adopt Best Practices in Presentation Slide Design

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Abstract: Although technical communication researchers have established strong theoretical and empirical support for best practices in presentation slide design, encouraging presenters to adopt these best practices has been a challenge. To establish how best to encourage presenters to adopt new slide design models, we compare presentation slides created by students in a senior capstone Chemistry course over three iterations of presentation design workshop: a no-workshop control condition, an original, in-class workshop, and a revised workshop that assigned high-quality videos and a short task working with students' own presentations in advance of our in-class presentation. While our original, in-class workshop had no discernable impact on students' presentations, our revised workshop resulted in almost all students adopting best practices in slide design. Compared to those in the control and original workshop conditions, students in the revised workshop produced slides that were rated higher in coherence and professional design and in following the assertion-evidence model of slide design. However, these changes did not result in students creating presentations that better followed scientific organizational principles. While slide coherence, professional design, and the assertion-evidence model were all highly correlated with one other, they were not correlated with the overall organization of the presentation.

Keywords: PowerPoint, presentation slide design, assertion-evidence model

Complaining about PowerPoint has become a cliché. Despite countless books, websites, and videos on slide design, there is widespread agreement that most presentations are ineffective. Several prominent executives and groups—including the CEOs of Amazon and LinkedIn, former government and military directors, and academic research groups—have banned PowerPoint from their meetings (Yu, 2014). Describing a semi-annual survey that asks audiences to volunteer

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what annoys them about PowerPoint presentations, presentation consultant Dave Paradi concludes that most presentations are “brain dumps” of presenter knowledge that can overload the audience.

Of course, the problem is not so much with PowerPoint as a communication medium as it is with the way people use it. As has been frequently noted in Technical and Professional Communication (TPC) scholarship (e.g., Alley et al., 2006; Garner et al., 2009; Neeley et al., 2009), PowerPoint’s defaults encourage writers to use a short topical phrase as the heading and bullet-point lists in the body of the slide. Designers, researchers, and other experts have been vocal in proposing other alternatives to this default—most notably the assertion-evidence (A-E) model of PowerPoint design. The A-E model consists of creating a slide with a single main point, summarized in a complete sentence in the slide heading. The body of the slide then provides evidence for this assertion, ideally in the form of visual evidence. Figure 6.1 illustrates the difference between a default PowerPoint slide and one that follows the A-E model.

The A-E model of slide design takes advantage of principles from the Cognitive Theory of Multimedia Learning (e.g., Mayer 2002; 2005)—most notably the dual coding principle, which suggests that our brains process visual and verbal information in differing, but complementary, ways (Clark & Paivio, 1991). According to dual coding theory, when our brains attempt to process two verbal inputs simultaneously (as we do when listening to someone present a text-heavy slide), comprehension decreases because the two verbal inputs—listening and reading—compete with one another. By contrast, when we try to process verbal and visual inputs simultaneously (such as when we listen to a speaker present a graph or image), comprehension increases because these two types of information are processed in different channels of our brains. By encouraging presenters to reduce the amount of text on the slide and to emphasize visuals, the A-E model reduces the cognitive load required to understand new content.

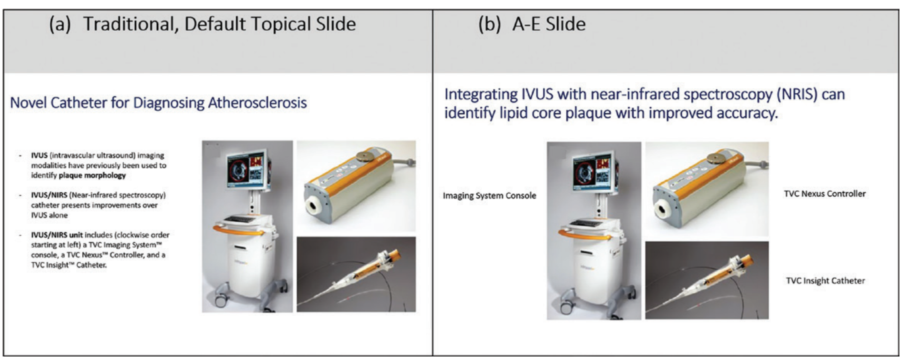

Figure 6.1. (a) A default topical slide based upon a student presentation. (b) A revised version of this slide in the Assertion-Evidence format. Image and content from Ma et al. (2016).

The A-E model does not abandon text altogether. By starting the slide with a single-sentence overview, the A-E model follows cognitive theory principles, helping audiences form a coherent understanding of the main point. This coherence helps audiences deeply and actively process and integrate new and old information (Rudolph, 2017). The sentence heading in the A-E model acts like a well-designed summary of the content to follow—a strategy that reduces cognitive load and helps readers actively process text (Sascha Schneider et al., 2018).

Not only does the A-E model follow sound principles from the Cognitive Theory of Multimedia Learning, but its use has been validated in several quasi-experimental research studies. In one classroom study, Geoscience students participated in lectures taught with presentation slides in one of two formats: either a traditional topic-subtopic format relying on short, disconnected phrases (i.e., the PowerPoint default) or the A-E format with full sentences and visual evidence. Students taught with the A-E slides performed significantly better on multiple choice exam questions than those taught with traditional topic-subtopic slides. When surveyed, the students reported preferring the A-E slides over the traditional topic-subtopic design at a rate of 7:1 (Alley et al., 2005). A separate study found that engineering students taught using slides following the A-E model performed better on tests than those taught the same content using traditional slides (Garner & Alley, 2013). The same was true of computer science students (Wolfe et al., 2006).

Research has also found that students using the A-E model to create their own presentations demonstrated better comprehension of the material than those constructing slides using a traditional format (Garner & Alley, 2016). Most recently, a study of PhD engineering students found that those using the A-E model to present advanced research to faculty and industry experts were perceived as creating stronger presentations than those using other presentation formats (Wolfe et al., 2024).

However, despite the strong theoretical and empirical evidence supporting the A-E model, instructors and trainers frequently report difficulty in getting individuals to change their presentation habits. Adopting the A-E structure requires multiple changes in how presenters think of presentations: (1) the presenter needs to reconceptualize their presentation as a story where each slide presents a single memorable idea in this story (versus creating a data dump of information on a topic); (2) the presenter needs to summarize this main idea in a complete sentence at the top of the slide, thereby breaking prevailing conventions of PowerPoint design where most headings are only a few words; (3) finally, presenters need to learn to present without the crutch of reading their text off of the screen. Inexperienced presenters often find this presentation style challenging to implement and anxiety-producing to deliver.

In a survey of instructors teaching the A-E model, Kathryn Neeley and colleagues (2009) found that most instructors reported that audiences were initially receptive to the A-E model, but expressed resistance when it came time to actually adopt the structure. The most common reason for this resistance was that the structure required more time of the presenter than the default. Presenters also feared that they would stand out or be penalized for violating common conventions. As one instructor working in a professional setting commented, "In many organizations, there is a very, very strong PowerPoint culture that rejects change or anything that is different from what the group is accustomed to" (Neeley et al., 2009, p. 352). Lori B. Miraldi (2021) echoed this point in her study of the diffusion of the A-E model in organizations, noting that workplace norms play a significant role in the extent to which this model is adopted throughout an organization. This resistance perhaps helps explain why an analysis of over 2,000 slides from technical presentations found that almost two-thirds used some variation of the PowerPoint default (Garner et al., 2009), despite ample anecdotal and empirical evidence that this default is ineffective.

These findings support our own experience teaching this model via a Writing Across the Curriculum center at a research university. As with the instructors in Neeley et al (2009), we found that students who attended the many workshops we gave on the model were very interested in and receptive to our material, but when it came to actually using the model in their own presentations, they had difficulty implementing it. Even when instructors changed their grading rubrics to require the A-E model for their presentations, a significant portion of students failed to use it. When some students who worked with our tutors received feedback that they were not using the model, they seemed surprised that we actually wanted them to use complete sentences in the headings: these students had taken our advice to use visual evidence, but not the sentence assertions. For some students, this resistance seemed due to a reluctance to break from PowerPoint's familiar default. Others, however, had difficulty summarizing their slide content in a complete sentence. In some cases, as the instructors in Neeley et al (2009) reported, this was because they did not fully understand the content they were presenting. In other cases, students simply had difficulty thinking of their presentation slides as containing a single main message that helps communicate a story about their work.

After several years of teaching the model in classes, only to realize that many students did not implement it in their own presentations, we decided to change our approach. Our original classroom workshop introduced students to the A-E model and asked them to apply it to a set of instructor-provided slides followed by discussion. Our new approach involved assigning homework in advance of our workshop. We created two short videos for students to watch (six and two minutes long), had students complete a short exercise to share in class, and then asked each student to create 3–5 slides for their own upcoming presentation using the model. We then dedicated class time to reviewing the video concepts, adding new information, and peer reviewing student work. This new instructional approach has several advantages—including more time on task and students working with their own presentations rather than instructor-provided material—but requires much more coordination and effort to implement effectively.

In what follows, we first present our new instructional approach in more detail, describing the videos we created and the theory behind their construction. We then report the results of a quasi-experimental study showing that our new model greatly increased the number of students using the A-E model in their presentations. In addition, we present new data shedding light on how the A-E model affects other aspects of slide design commonly associated with high-quality slides. We end by discussing how our instructional materials can be adopted in other contexts.

This research follows Chris Lam and Joanna Wolfe's (2023) call for more quasi-experimental research in TPC. Quasi-experimental research involves investigating a hypothesis by comparing two or more groups on a number of outcome variables. According to Lam and Wolfe (2023), quasi-experimental research is particularly helpful to individual instructors who want to validate or challenge whether their teaching methods are effective. In addition, quasi-experimental research helps a field by providing replicable, aggregable data that can help establish best practices.

In this quasi-experimental study, we investigate the following hypotheses:

- **Hypothesis 1:** Our revised workshop, which involves assigning student prework in advance of the workshop, will lead to an increased number of presentations using the A-E model compared to our original in-class-only workshop and to a control group of no workshop.
- **Hypothesis 2:** Our revised workshop will lead to presentations that are ranked highly on other aspects of presentation quality (including coherence, professional design, and effective organization) compared to our original workshop and to a control group of no workshop.
- **Hypothesis** 3: Use of the A-E model will be positively correlated with other aspects of presentation quality (including coherence, professional design, and effective organization).

The Original and New Workshop Models

We taught presentation slide design using our original workshop model for a five-year period, presenting to thousands of students in nearly 100 classes. Our original workshop began by showing students some typical poorly designed slides and asking them to volunteer their impressions. We then presented the A-E model, summarized the theory and research supporting the model, and then discussed "before" and "after" slides redesigned to follow the A-E model. These example slides were typically tailored to reflect the class content. We then engaged students in hands-on practice by giving them a series of ten slides describing an informal study and asking them to redesign four of these slides. After this independent work, we asked students to share their redesigns and compared these to our own revisions. This sharing activity gave us opportunities to discuss the pros and cons of different design options and students typically asked lots of nuanced, specific questions about slide design.

As noted earlier, student engagement was typically high during the original workshop, and students were largely receptive to our content. However, despite this positive reception, many students failed to implement the A-E model in their own class presentations—even when use of the A-E model was an item on the presentation rubric. We spoke with several instructors who were our most enthusiastic supporters to brainstorm a better workshop model.

Our new workshop model consisted of assigning videos and exercises as prework and peer-reviewing student work in class. Our first step in designing this new model involved creating the prework videos and exercises. While other videos on the A-E model existed, these videos were long, often twenty to thirty minutes, and featured a "talking head" style of presentation that prior research suggests may be less engaging than other presentation styles (Guo et al., 2014). We therefore opted to create our own video following what research indicates is best practice in educational videos.

In an analysis of over 6.9 million video-watching sessions on educational platforms, Philip Guo and his collaborators (2014) found that student engagement peaked at six minutes, regardless of video length. Students engaged with the content of shorter videos significantly more than the content of longer videos. Other factors positively correlated with student engagement include using animated tutorials where narrators situate themselves "on the same level" as the student rather than talking at the student in "lecturer mode" and using a fast speech rate of above 185 spoken words per minute. Petra ten Hove and Hans van der Meij's (2015) study of popular YouTube instructional videos likewise found that videos with a faster speaking rate (over 170 words per minute) were more popular than those with slower narration, and that popular instructional videos had more text than unpopular videos and included a mix of static and dynamic images.

Our videos attempted to follow the guidelines suggested by this research. Both of our videos were under six minutes and used what José Miguel Santos-Espino et al. (2016) call a "board style" video that features static images and animations. Board style videos are more common than speaker-focused videos in engineering and science, our target audience. We also used complete sentences to keep our video style in line with the A-E model. The video narration used a cheerful, fast-talking narrator who spoke at a rate of approximately 180 words per minute.

Our first six-minute video introduced students to the A-E model and the theory and research supporting it. This video engaged learners by posing questions, moving between bad and good examples of slide design, and asking learners to reflect on their own experience. Following the first video was a short exercise in which students generated potential sentence headings for three slides. This exercise was followed by a second two-minute video segment discussing common exceptions to the A-E model and addressing common questions we had fielded from students in prior workshops.

After watching the videos and completing the short exercise, students were instructed to create four slides using the A-E model for their upcoming presentation. Key to our workshop model is that this assignment was submitted for a grade, ensuring that nearly all students completed their slides before class.

The in-person workshop consisted of a quick review of the video content and pre-work exercise, additional details about the research supporting the A-E model, and additional tips on slide design (such as recommendations for font size and case). The rest of the class period was spent peer-reviewing the slides students brought in for homework and then describing how to organize the presentation as a whole. In the Chemistry class discussed below, this organizational content included covering the Introduction-Method-Results-Discussion (IMRD) and Create a Research Space organizational schemas for presenting scientific research (Reineke et al., 2019; Swales, 2008).

Methods: Assessing the Workshop

To assess the effects of our revised workshop against our prior workshop (and against a control of no workshop), we analyzed the presentation slides of Chemistry students over three different iterations of a capstone course: prior to implementing our workshop, with our original workshop, and with our redesigned workshop. Three independent raters blind to the conditions evaluated the anonymized presentation slide decks on five criteria. These ratings were then analyzed for differences between conditions. All requirements of our University Human Subjects IRB board were followed (IRB STUDY2020_00000281).

The Class and Assignment Context

Chemistry 402 is a required seminar that Chemistry students take in the Spring of their senior year. As part of the seminar requirement, these seniors present a 15-minute technical talk to undergraduates and guests of the Chemistry Department. This course is cross-listed with Chemistry 302, a one-unit seminar taken by junior Chemistry students. These juniors attend weekly seminars and complete evaluation forms providing feedback to presenters. During the three years that this study took place, enrollment in Chemistry 402 ranged from 16 to 26 students.

One to two senior presentations per week were scheduled. Students who had completed an undergraduate research project were encouraged to present on their research. Students who did not have independent research were required to represent a technical talk on a Chemistry topic sufficiently in depth to be appropriate as a capstone requirement. Students interpreted this requirement in various ways: 37% presented on a single research study or interrelated series of studies, 33% synthesized various research studies on a topic, and 30% chose a topic that could not be considered research (such as visualization techniques for classifying fingerprints).

Presenters received feedback on their oral delivery and speaking style, the organization and content of the talk, the quality of their visual aids, and their fielding of questions. In addition to the presentation, each student was required to submit an abstract of approximately 200 words.

Experimental Conditions

We have data from three iterations of the course:

- In the *no workshop* semester, students did not receive a workshop on presentation slide design.
- In the *original workshop* semester, students participated in the original workshop described above, where they learned about the model in class and practiced applying it in a short exercise. In addition to the A-E model, the workshop briefly covered the Introduction-Methods-Results-Discussion (IMRD) structure for organizing scientific papers and the Create a Research Space (CARS) structure for organizing a scientific introduction (see Swales, 2008).
- In the *redesigned workshop* semester, students participated in the redesigned workshop described above. These students watched two short videos, completed a short exercise, and prepared four slides using the A-E model for their final presentation. They also received instruction on the IMRD and CARS organizational structures for scientific research.

Data Sources and Analysis

We randomly selected nine anonymized student presentations from each of the three conditions, for a total of 27 presentations. Three technical communication instructors, who were not privy to the presentation conditions, scored the presentations on five criteria: how closely the slides followed the A-E model, whether or not the slides cohered around a clear purpose, how professional the slides appeared, whether or not the presentation followed the IMRD structure common to scientific research, and whether or not the introduction was effectively presented. Each criterion was evaluated on a four-point scale. Table 6.1 defines our five ratings criteria. Our complete slide rating rubric can be found in the appendix.

Agreement among our three raters was calculated using Intraclass Correlation Coefficient (ICC). ICC is a common measurement of inter-rater reliability, indicating the extent to which ratings from a group of judges hold together. Values range from -1.0 to 1.0, with a value of 1.0 indicating perfect agreement among raters. We report the values for ICC Class 2 for the reliability of the mean of k ratings (Shrout and Fleiss, 1979). ICC levels above .60 are considered good. Table 6.1 shows that our reliability ranges from .62–.97, indicating that our ratings are sufficiently reliable to proceed with analysis.

Table 6.1. The Five Ratings Criteria and Consistency among Raters Using ICC (2, k)

Criterion	To receive a top score a presentation should….	Interrater Reliability
Follows A-E model	Excluding overview and transition slides, at least 85% of the body slides have a complete sentence assertion that encapsulates the slide's main idea	0.97
Coherence	On at least 85% of the body slides, the text and images clearly work together to support a common main point	0.70
Professional design	Over 90% of the slides are legible, uncluttered, and have a professional layout	0.67
Follows IMRD order	Clear signaling of all four IMRD elements in correct order	0.62
Effective Introduction	Contains all of the following Statement of the topic significance Attempt to explain the knowledge gap the presentation is filling Clear statement of the question governing the presentation	0.68

In calculating our results, we averaged the scores of all three raters and used a general linear model of regression in SAS to assess differences in workshop conditions. We also calculated correlations among the five criteria in SAS to shed additional light on how instruction in the A-E model may have impacted other elements of students' slide designs.

Results

Table 6.2 shows that while our original workshop had almost no observable effects on students' presentations, our revised workshop resulted in significant improvements in students' slides. While only one of the nine presentations from the original workshop was judged as using the A-E model, eight out of nine presentations from the revised workshop used the A-E model on the majority of their content slides, $F(2, 26) = 35.37, p < .001$. Thus, Hypothesis 1, that the revised workshop would increase uptake of the A-E model, was fully supported.

Hypothesis 2, that the revised workshop would lead to improvements in other aspects of slide quality, was partially supported. Compared to students in the no workshop and original workshop conditions, students in the revised workshop had slides that were rated as more coherent, $F(2, 26) = 9.43, p < .01$, and more professionally designed, $F(2, 26) = 8.91, p < .01$. However, there was no change in students' use of scientific organizational principles. To test whether students' lack of adherence to scientific organizational principles might be due to some presentations lacking a clear research base, we reran the analyses to remove the non-research presentations. Even when non-research presentations were removed from the analysis, any changes to students' use of scientific organizational principles were slight and non-significant (IMRD Order: 2.9 for no workshop vs. 3.2 for revised workshop; Effective Intro 2.7 for no workshop vs. 3.0 for revised workshop). Thus, the workshop improved slide coherence and design, but did not produce significant improvements in overall presentation structure.

Table 6.3 presents correlations for all study variables for just the research and synthesis presentations (i.e., non-research presentations are excluded). Table 6.3 partially supports hypothesis 3—that the A-E model would be correlated with other elements of slide quality. The A-E model was strongly correlated with rater perceptions of slide coherence and rater perceptions of slide design. However, implementation of the A-E model was not significantly correlated with either use of IMRD organization or a strong introduction. Adding the non-research presentations into the model did not change the results. Thus, while instruction on the A-E model helped students produce more coherent individual slides, it did not necessarily seem to encourage them to consider how those slides were organized.

Table 6.3 also shows that coherence and professional design were strongly correlated with each other, but neither was correlated with use of the IMRD order or an effective introduction. In addition, Table 6.3 indicates that following an IMRD structure and having an effective introduction were strongly correlated. These findings should not be surprising, since the criteria to some extent overlap (i.e., well-designed slides should be coherent; part of following IMRD structure is creating an effective introduction).

Table 6.2. Average Slide Ratings (1 = Poor; 4 = Excellent) by Workshop Condition

Condition	**Use of A-E model**	**Coherence**	**Professional Design**	**IMRD Order**	**Effective Intro**
No workshop	1.1	2.2	2.2	2.7	2.6
Original workshop	1.4	2.3	2.0	2.5	2.5
Revised workshop	3.4**	3.1**	2.9*	2.8	2.5

**p* < .01; ***p* < .001*

Table 6.3. Pearson's Correlations for Rating Criteria for the Research and Synthesis Presentations

	Use of A-E Model	**Coherence**	**Profession-al Design**	**IMRD Order**	**Effective Intro**
Use of A-E model	1.00				
Coherence	.75**	1.00			
Professional Design	.72**	.84**	1.00		
Follows IMRD	.17	.36	.10	1.00	
Effective Intro	.16	.27	.13	.63*	1.00

p* < .01*p* < .001*

Discussion

One of the biggest challenges in improving presentation slides lies in getting presenters to abandon old habits and adopt new methods. Supporting Hypothesis 1, we found that introducing students to the A-E model in advance of class and requiring them to bring a small number of slides based on their own work to the workshop session greatly increased the number of students who used the A-E model in their course presentations. While no students in the control group, and just over 10% of students in the original workshop, used the A-E model on the majority of their slides, nearly 90% of the students in the revised workshop did so. Thus, Hypothesis 1 was supported.

Partially supporting Hypothesis 2, we found that slides created by students in the revised workshop were perceived as more coherent and more professionally designed than those of students in the original-workshop and no-workshop conditions. Likewise, partially supporting Hypothesis 3, we found that use of the A-E model, slide coherence, and professional design were all highly correlated. These finding suggests that the A-E model imposes a heuristic on presentation creators that encourages them to follow other, related elements of good slide design. Because the A-E model encourages less text, presentation creators must think carefully about what their slides' message should be, thus encouraging coherence, and the sparing use of text and effective use of images are both elements of good slide design.

However, in partial contradiction to Hypotheses 2 and 3, the A-E model did not appear to influence the overall organization of presenters' slides as a whole. In fact, ratings of the A-E model, coherence, and professional design—while highly correlated with one another—were only weakly and non-significantly correlated with IMRD organization or creation of an effective introduction, suggesting that focusing on principles of individual slide organization has minimal impact on the overall order and structure of the presentation as a whole.

We should note that students did receive instruction in both IMRD organization and creating effective introductions in both the original and revised workshops, but this instruction only took place in class. None of the pre-work in the revised workshop touched on conventional scientific organizational principles. It may be that our in-class instruction needed to improve to provide more guidance on how to apply these organizational principles to synthesis projects. However, this finding might also suggest that in-class instruction alone may not be sufficient to effect major changes in presenters' slide design practices.

There are many reasons why our revised workshop may have increased uptake of the A-E model. Among the factors that changed from our original workshop were:

- Students were introduced to the A-E model in high-quality short videos and then again in an in-class lecture, thereby increasing and reinforcing their exposure to the material. Some research has found that supplementing in-class learning with short videos leads to gains in student learning (Lancellotti et al., 2016).

- Students worked with their own material rather than instructor-provided material in applying the A-E model. This use of students' own material likely helped ensure that they would be able to understand exactly how to apply new slide model to their own content.
- Students started by completing just four A-E slides to be used in their final presentation, which may be less intimidating than creating an entire presentation in an unfamiliar format.
- Students received feedback on their slides using the model, which may have reinforced their commitment to continue using the A-E model.
- Students who did not use the model effectively received early peer feedback, allowing them to correct their usage.
- Seeing their peers use the model and improve their own slides may have increased students' self-efficacy in their own ability to use the A-E model since research has shown that seeing a novice perform an unfamiliar task and correct their mistakes can lead to more learning gains than watching an expert or doing the task oneself (Raedts et al., 2006; Rijlaarsdam et al., 2008).

While there is nothing in our study design that can tell us which of these factors was most influential in changing student practices, what is clear is that their combination changed presenter behavior and improved the quality of their presentations.

This study, of course, is small and suffers from the limitations (and naturalistic advantages) of most quasi-experimental classroom projects. Most notably, there was far more heterogeneity in the topic focus of student presentations than we would have liked (a challenge we try to tease out in our results). There was also great variability in when students presented, although it is unclear how this timing affected student uptake: some students presented almost immediately after our workshop, while others presented months later, but with the benefit of seeing the presentations that went before them. The course was cross-listed so that students in their junior year saw the presentations of their upper-classmates, which could have influenced their behavior the following years (although this is an unlikely explanation since there were virtually no A-E presentations to observe). All of these variables could be controlled with a true, experimental laboratory study, but with the disadvantage that the way individuals behave in a lab when they are highly aware that they are being studied is very different than how individuals behave in naturalistic settings, such as creating presentations for course credit.

Another, perhaps larger limitation is that we did not have the opportunity to observe or record students' actual delivery. Thus, we have no data on how the A-E model affected presentation delivery or how the A-E model influenced audience reception of presenters' work (though refer to J. Wolfe et al., 2024 for a pilot study on this audience reception of research presentations using the A-E model). Future research should examine these and other variables related to presentation quality.

Implications for Practice and Future Avenues for Investigation

First, we encourage other instructors and practitioners to use our materials. Our workshop videos, exercises, and the slides we use in our in-class workshop can be accessed at https://wacclearinghouse.org/tpw/liminality/. Watching the videos, completing a short exercise, and developing four slides based on the presenters' work takes most learners 30–40 minutes. We hope that our results have shown that this prework is worth the investment.

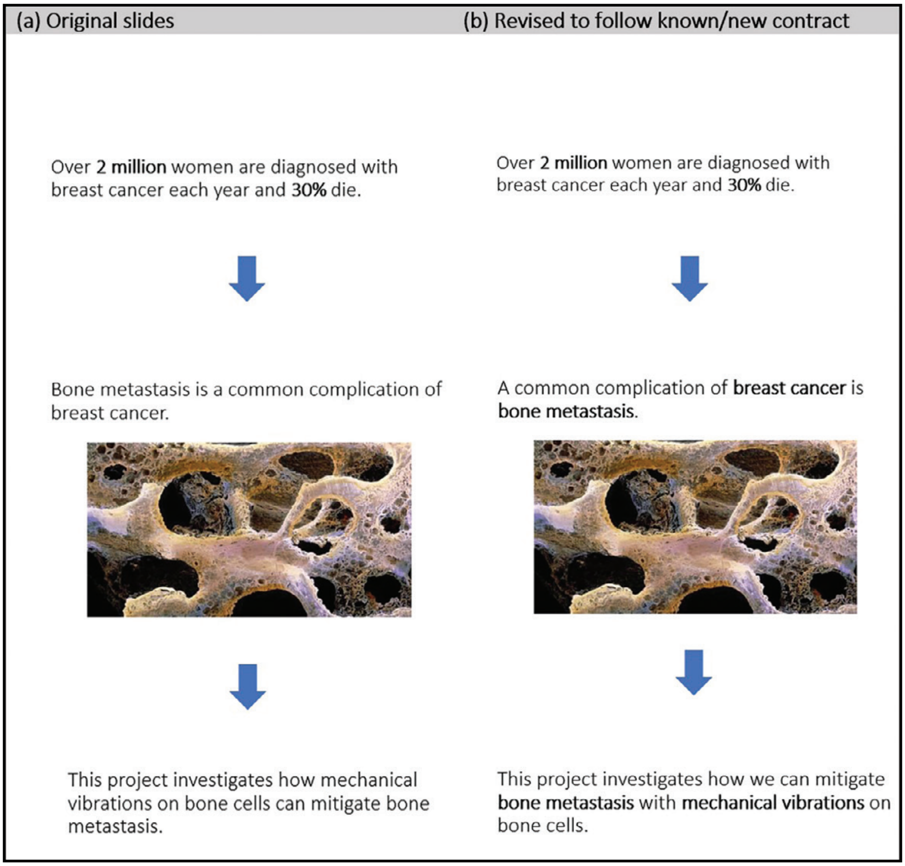

Figure 6.2. Applying the Known/New Contract to Slide Design: (a) Slides that do not follow the known/new contract; (b) slides that have been revised to place known information that has already been introduced to audiences at the beginning of the single-sentence heading. New information is placed at the end of the sentence. By encouraging presenters to begin their sentence headings with information that connects to the previous slide, we may be able to encourage presenters to move from thinking about the coherence of individual slides to coherence across sequences of slides.

Our results also suggest that more work is needed to teach presenters principles that will help them organize their overall presentations. One strategy that may be useful in bridging the organizational principles of individual slides with the organization of the entire presentation is the known/new contract (also called the given/new and old/new contract). This principle has been taught in many writing style guidebooks (e.g., Williams, 1989; Wolfe & Reineke, 2025) and we have found it useful in helping presenters think through the relationship between one slide and the next. For instance, Figure 6.2 illustrates the difference between slides that do and do not follow the known/new contract. The known/new contract reinforces the principle of coherence that is already embedded into the A-E model. As presenters move from thinking about individual slides to sequences of slides, they can then be introduced to strategies for structuring the entire presentation.

Our workshop model might also be usefully applied to other communication topics. The typical in-class workshop introduces learners to topics and practices them in class. Our revised, flipped workshop moves the initial instruction and implementation to pre-work. The workshop is then dedicated to reviewing student work, correcting their understanding and application, and extending their knowledge base. This model requires much more effort on the workshop organizer, including creating high-quality workshop materials and communicating the pre-work to students. However, the improvements in student work can lead to greater learning gains. Future work will be needed to tell which topics and principles are most worth this additional investment in effort.

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Appendix

Table 6.4. Scoring Rubric for the Presentation Slides

Criterion	A score of four	A score of 3	A score of 2	A score of 1
A-E model	Over 85% of content slides have a complete sentence *assertion that encapsulates the main idea	50–85% of content slides have a complete sentence assertion that encapsulates the main idea	Few slides have complete sentence assertion that encapsulates main idea	Almost no slides have complete sentence assertion
Coherence	> 85% of text and images on the slide clearly work together to support a main idea	50–85% of text and images on the slide clearly work together to support a main idea	25–50% of text and all images clearly work together to support a main idea	< 25% of text and all images clearly work together to support a main idea
Professional Design	Overwhelming majority of slides are professional with appropriate quantity of text and images and all text and images are legible	Most slides are professional with appropriate quantity of text and images. All slides are legible	Some completely illegible or unprofessional slides, but most are ok	The majority of slides are overly cluttered, illegible or unprofessional

Criterion	A score of four	A score of 3	A score of 2	A score of 1
Follows IMRD	Has clear signaling of all four IMRD elements that are generally in the expected order.	Has weaker signaling of IMRD elements but is clearly making an attempt	Has very confusing signaling of IMRD elements	Has virtually no attempt at IMRD
Effective Introduction	Clearly describes the significance of the research or topic, identifies a gap in previous research/knowledge and has a clear research or other governing question	Is missing one of the elements of a 4-point response	Is missing two of the elements of a 4-point response	Has none of the elements articulated in the 4-point response.

** Note: Must be a complete sentence. Headings missing verbs do not count.*

7. Where Do I Go from Here? A Rhetorical Analysis of Norwegian Wayfinding Signs

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Abstract: This chapter examines the Norwegian use of wayfinding design and explores ways technical communicators can learn from this style of design to create more effective visuals. Norwegian wayfinding design encapsulates the clean, uncluttered design that is typical of Scandinavia, and it differs in several ways from that of the United States and many other Western countries. I examined 451 examples of Norwegian wayfinding signs from roads, city centers, busses, ferries, hotels, restaurants, and other public areas and compared them with equivalent signs in the United States for reference. Then I examined how the Norwegian signs matched up with the principles of effective wayfinding outlined by Anna Charisse Farr et al. (1997). I argue that American and Western technical communicators and graphic designers could utilize many of the techniques utilized by Norwegian wayfinding designers to make their signs more recognizable and readable.

Keywords: Wayfinding, Norway, visual design, usability, information architecture

Travel to an urban center, enter a public building, or drive along a roadway anywhere in the world, and you will likely be inundated with wayfinding signs. Signs, like many other elements of technical communication, tend to be ignored until the user needs assistance. However, these signs do much more than just help a traveler find the subway, indicate hazards in the road, or tell them on which floor they can find their dentist's office. Taken together, they also form the public narrative of the municipality and country in which they are located (Gibson, 2009, p.18).

Wayfinding is a sub-genre of information architecture, which is at the core of technical communication (Gibson, 2009, p.15). Although technical communicators rarely design wayfinding signs specifically, wayfinding is closely related to other fields within technical communication, such as web design, risk communication, and the design of safety information.

The exploration of wayfinding and its parallels to technical communication is not a new one, but it is one that is less often visited and deserves more attention. Saul Carliner (2001) explored wayfinding and other informational displays within museums to make suggestions for more effective web design. He found

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that there are several marked parallels between museum exhibit design and how people navigate the web in terms of what made them stay at an exhibit and what attracted their attention. In more recent years, Brian C. Britt & Rebecca K. Britt (2021) examined the medium and narrative in the role of mobile wayfinding, in which they found that having a plausible narrative, or cohesive story about the wayfinding experience in a tour situation may help users to navigate the physical space more effectively. Gabriel Lorenzo Aguilar (2022) explored the redesigning of maps to help migrant women safely find water within the Arizona desert. In his article, Aguilar argued that some of the most important issues with designing visuals lies in the audience and what information about the user population is emphasized and what is minimized or not explored. Although each of these studies provide valuable information about wayfinding and its links to technical communication, particularly with usability studies, there are more applications that can be explored as we enter the age of augmented reality (AR) and virtual reality (VR).

Anna Farr and her collaborators (1997) described wayfinding as "The process of finding your way to a destination in a familiar or unfamiliar setting, using cues given by the environment" (p.716). Wayfinding design both affects outdoor spaces, such as city centers or roadways, as well as indoor spaces, such as airports, public transportation hubs, and public buildings. Similar to other types of visuals created by technical communicators, such as healthcare symbols and signs in medical facilities, safety information in instructions and manuals, wayfinding markers in augmented or virtual reality maps or tours, and symbols on websites, wayfinding information requires careful planning and knowledge of the audience as well as the physical or digital context of the visual.

Wayfinding consists of three processes: decision-making, decision execution, and information processing. At the decision-making phase, the user formulates a plan of action. For example, she may view a sign telling her that the museum she wants to visit is straight ahead. Then, the user executes the decision. In our example, the user then begins to walk straight down the road, as indicated by the sign. Finally, the user processes the information. She looks at environmental cues to determine where the museum is, such as navigating turns in the road and looks for the museum in the distance (Farr et al., 1997, p.716).

Wayfinding, according to Farr et al.'s definition (1997) is a process consisting of steps rather than just a type of sign. Any sign that helps the user complete these processes is considered a wayfinding sign. Specifically, according to David Gibson (2009), there are 4 main types of wayfinding signs:

1. **Identification signs:** Gibson states that identification signs are "visual markers that display the name and function of a place or space, whether it is a room, individual building, or gateway" (2009, p.48). An example of an identification sign would be the sign that shows the name and purpose of a building on a college campus.

2. **Directional signs:** These signs provide directional cues along a route (Gibson, 2009 p.50). An example of a directional sign could be a sign showing the direction in which a visitor must walk to get to certain departments in a hospital.
3. **Orientation signs:** Orientation signs show a user where they are in a physical space in relation to other routes, buildings, and so forth (Gibson, 2009 p.52). A mall directory sign is an example of an orientation sign because it shows the user where they are in a mall in relation to the stores and amenities located inside the mall.
4. **Regulatory signs:** Regulatory signs display the specific rules and laws governing a space (Gibson, 2009 p.54). A speed limit sign on a highway is an example of a regulatory sign.

Although wayfinding signs encompass an array of types of signs, both privately created, such as signage within a hospital, and also those created by a local, state/provincial, or federal government, not every sign is a wayfinding sign. Examples of signs that are not wayfinding signs include advertising billboards along highways, and signs that provide general information that does not fall in one of the types of wayfinding signs, such as a sign that announces that a city is the home of an exceptional sports team or birthplace of a famous person.

Like other aspects of usability, such as usability on the web, it is tempting for designers to blame the user for wayfinding errors. Wayfinding sign designers sometimes chalk up poor usability of their design to the user for having a poor sense of direction, for not paying attention to wayfinding markers, or even for not being intelligent enough to understand a "simple" sign (Passini, 1996). However, wayfinding difficulties are not usually caused by user inattention or lack of cognitive ability. Instead, these errors are most often caused by poor wayfinding signs (Passini, 1996).

Despite our best efforts, wayfinding design, like any form of design, is not universal. Although technical communicators strive to create practical visual design that is as easy to understand by as broad of an audience as is possible, there are many factors involved in creating these designs, including wayfinding signage (Bloom-Pojar & DeVasto, 2018; Farr et al., 2012 p.720; Horton, 1993). In the field of rhetoric, Rachel Bloom-Pojar calls the gap between the need for a visual and the creation of the resulting visual or sign a "translation space," which is any space "where translation work is required for negotiating meaning across modes, languages, and discourses" (as cited in Bloom-Pojar and DeVasto, 2018). In this "translation space," the designer must account for the lived experiences, cultural understanding of the context and symbols, as well as their priorities and needs in the space where the visual is presented (1999). As Aguilar (2022) pointed out in his study of the use of maps with Mexican migrant women, discovering the information about the audience takes examining what we know about the audience in a systematic way.

Opinions differ on the minimum level of universal comprehensibility a symbol should have (Devlin, 2014, p. 430). The International Organization for Standardization (ISO) standard for understanding healthcare symbols, for example, is 67%, while the American National Standards Institute (ANSI) standard is 84% (Hashim et al., 2014, p.508). While healthcare symbols can be used in a variety of contexts, they can also be used as wayfinding symbols within a hospital or clinic. For example, a symbol of an infant may mark a maternity ward, or a currency symbol may direct a patient to the billing department (Horton, 1993). Similarly, many wayfinding functions have moved online to the realm of mobile applications and websites, which falls within the purview of technical communication (Britt & Britt, 2021).

No matter how carefully a designer works to create a "universal" sign or symbol, the visual is a cultural artifact and is created from the designer's frame of reference. Signs depend on specific cultural knowledge and frames of reference that may be unique to the country (Hall, 1993, p.86). How we interpret signs and other forms of "instructions" depends on "hidden assumptions, social customs, cultural norms, kinds of conformity, forms of training, traditions of use and educated propensities" (Hall, 2014, p.142). However, Derek Handley et al. (2022) posited that rhetorical fields like technical communication provide powerful creative (as well as analytical tools) which can help inform how best to use cultural identities in local and urban planning.

This study is an effort to examine wayfinding signage in Norway and extrapolate how Norwegian wayfinding design can better inform other areas of design in technical communication. In this chapter, I will discuss the importance of wayfinding signage design, the principles of designing effective wayfinding signage, the methods in which I collected and analyzed examples of wayfinding signs in Norway, and finally, I will discuss the results of my analysis and review the best practices for technical communicators planning visual design elements. In particular, I will explain how signs and symbols with minimal text, with graphics that closely match the hazard or concept being shown are beneficial for other areas of design in technical communication, as well as how the considerations of usability and accessibility permeate good wayfinding design, and how color and the consideration of the environment in which the graphics will be used is an important consideration for effective wayfinding.

Importance of Wayfinding

The importance of effective wayfinding signage cannot be overstated. Virtually every public and many private spaces require a wayfinding scheme (Gibson, 2009, p. 17). Urban accessibility, including wayfinding, is even included as a key initiative on the United Nations Agenda 2030 for Sustainable Development (Fogli et al., 2019). Wayfinding design is especially important in city centers; educational facilities such as schools and universities; transportation centers such as airports, subway systems, public busses and ferries; healthcare facilities such as hospitals and clinics; sports arenas; mixed-use facilities, and hotels (Gibson, 2009, p. 18; Hashim et al., 2014).

Wayfinding signs are a key factor in the accessibility of a building or city. People tend to avoid areas with bad wayfinding schemes (Passini, 1996). In the past, architects have created shopping centers and other commercial buildings that were intentionally difficult to navigate in the hopes that people would spend more time there, and therefore, spend more money. However, modern architecture moved away from these labyrinthine plans because of consumer pushback (Passini, 1996). Instead, both architects and wayfinding designers have moved to make building navigation clear and accessible for the people who will frequent the building.

Good wayfinding design can also impact user behavior in positive ways. Oddrun Hagen and Maya Rynning (2021) found that effective wayfinding signs led to increased cycling in Norway, which is part of the nation's Zero-Growth Initiative to reduce greenhouse gasses. Similarly, Dea van Lierop et al. (2017) found that effective signage led to increased customer loyalty and satisfaction, and as a result increased usage of public transportation. In addition, effective signage can also increase recycling behavior, and help users deposit their waste in the appropriate receptacle. This is vital for companies and municipalities, as "A single piece of contaminated material can send an entire batch of recyclables to landfills" (Bell, n.d., n.p.). Perhaps most importantly, good wayfinding design facilitates building and city or highway safety during emergency evacuations. According to Robert Passini (1996, p.320), emergency evacuations arc much more difficult in confusing settings. Wayfinding decisions have to be made quickly and problem-solving behavior may be confounded by anxiety induced stress. It has been repeatedly observed that people in emergencies tend to use familiar routes rather than rely on fire exits exclusively reserved for these situations. When an emergency occurs, users need clearly-labeled, comprehensible signs to be able to exit the building quickly and safely.

Insufficient or unclear wayfinding can also be expensive. Ralph Michels (2025) estimated that the total annual cost due to (adjusted to 2025) $556,000 with about 166,000 attributed to costs for staff giving directions (n.p.). These costs are known in industry as the "cost of confusion." Lost productivity is a major component of the costs a business or municipality incurs when workers have to take time out of their assigned work duties to help patients or visitors find their way. In addition, much like poor web design, poor wayfinding design can also contribute to missed appointments, missed flights, and user dissatisfaction with the organization responsible for the poor wayfinding design.

Principles of Effective Wayfinding

Like other aspects of visual design in technical communication, the discipline of wayfinding design is closely linked with semiotics, which is the "theory of signs"

(Hall, 2012, p. 5). All forms of communication are underpinned by semiotics. Symbols, gestures, and even words are all signs that convey a meaning to the user (Hall, 2012). In semiotics, signs are composed of two elements: the signifier and the signified. The *signifier* is the symbol. For example, Hall (2012) noted in wayfinding, the signifier could be a stop sign at an intersection. The *signified* is the meaning of the signifier. In this instance, the stop sign indicates to the user that she must stop the car and yield the right of way to any vehicles that arrived at the stop sign before her. A good match between signifier and signified occurs when the user is able to understand the meaning of the sign and perform the required action (Hall, 2012, p.26).

Many factors affect the quality of the match between the wayfinding sign and the user. As Carliner (2001) noted in his study of museum exhibit design, it is vital that the wayfinding sign designer clearly understands the stakeholders who need to be able to interpret their signs. As previously mentioned, culture can affect the user's perception of the wayfinding sign. The user must be familiar with the type of wayfinding sign and its context to understand what it means. The stakeholder's culture and even the effects of social distancing and government regulations in light of the COVID pandemic can affect how they perceive space and use spatial information (Hall, 1992; Vikas, 2020; Whorf, 1956/1941). In addition to culture, the user's reading ability and knowledge of the target language contained on the sign affects their ability to understand signs containing text (Horton, 1993). Age and visual acuity can also play a role in the user's understanding of a wayfinding sign because their eyesight may be affected, making some signs more difficult to read because of color contrast or the size of the text and symbols (Hashim et al., 2014). The education of the stakeholder may also play a role in how well they understand signs, particularly signs showing abstract concepts. Users with more education may be more accurate in identifying the meanings of signs (Hashim et al., 2014). In addition, the complexity of the environment and environmental conditions such as the presence of other signs, or "sign clutter," and the amount of light and visibility may affect the user's ability to see and interpret the sign (Farr et al., 1997; Gibson, 2009).

Gender can also play an important role in the perceived satisfaction in wayfinding. L. Brooke Keliikoa and their collaborators (2018) found that women may be more likely than men to use wayfinding signage when navigating in unfamiliar areas (p. 25). Further, Carol Lawton and Janos Kallai (2002) found that women in both Hungary and the United States showed a marked preference for wayfinding schemes that were related to routes marked by landmarks rather than routes using the cardinal directions. Lawton and Kallai also found that women in both Hungary and the United States tended to perceive the threat of attack or robbery from strangers as higher than the actual crime rate may warrant (p. 393). In the field of technical communication, Aguilar (2022) found that map design with women in mind plays an essential role in the safety of female migrants when seeking water in the Arizona desert. This difference in gender has been noted by many studies across cultures, including in less developed cultures, and across urban versus rural settings (p. 389). These differences may be due to a cross-cultural tendency to allow boys more freedom of movement in childhood. These gender differences should be noted in wayfinding schemes as well as other situations, such as web design, in which users of all genders may be required to locate information and "travel" (whether virtually or physically) to places that are unknown or perceived as potentially dangerous.

Farr et al. (1997) outlined seven principles of effective design which can be applied to wayfinding design (pp. 719–720). Many of these principles mirror aspects of effective technical communication, including mobile wayfinding design and wayfinding in healthcare settings.

- Equitable use: the design can be used by stakeholders with varying abilities.
- Flexibility in design: the design accounts for a range of individual preferences and backgrounds.
- Simple and intuitive use: The design is easy to understand, "regardless of the user's experiences, knowledge, language skills, or current concentration level" (1997, p.719).
- Perceptible information: The sign's design provides the information to the stakeholder, regardless of the conditions in the environment or sensory abilities.
- Tolerance for error: The design accounts for, and minimizes, possible hazards or accidental actions on the part of the user.
- Low physical effort: The sign must be easily interpreted with a minimum of physical effort for the user.
- Size and space for approach and use: The size must have adequate space for the approach and use of the sign regardless of physical characteristics of the user such as posture and body size.

These guidelines seem simple and intuitive, but when applied to a complex environment with many stakeholders, they are much more difficult to apply.

Wayfinding in Norway

As previously stated, to understand the effectiveness of wayfinding signs, one must understand the potential stakeholders, or users, of these signs. Similar to the US, Norway has a diverse population in terms of age, disability, ethnicity, and immigration status (Modig 2021). Signs that seem simple and clear in one cultural context may be indecipherable in the next (Hall, 2012, p.26). Therefore, it is important to understand the characteristics of Norwegian graphic design as well as their cultural characteristics and the characteristics of the stakeholders utilizing these signs.

Norwegian Graphic Design Characteristics

Norwegian graphic design shares many characteristics with Scandinavian design as a whole. According to Scandinavian Standard, an online design magazine, Scandinavian design is "is characterized by a minimal, clean approach that seeks to combine functionality with beauty. Its focus is on simple lines and light spaces, devoid of clutter" (2022). Similarly, Norwegian design focuses on minimalism and strong, clean lines. Norwegian graphic design, led by the Oslo School of Architecture and Design, has focused on problem-solving and accessibility (Innovative Design, n.d.) Graphic design is also the largest discipline in design in Norway. Fully 1/3 of design workers are employed in a graphic design field (DOGA, n.d.). Because graphic design with a focus on accessibility and minimalism is a hallmark of Norwegian design, we could reasonably expect their wayfinding design to be accessible, clean, and devoid of clutter.

Norwegian Cultural Characteristics

The Norwegian people highly esteem their history and value civic engagement. Tolerance, respect, and equality are core Norwegian values (AFS Intercultural Programs/USA, n.d.). The social norms in Norway can best be described by *Janteloven,* or "Jante's Law." This social standard was developed from the literary works of Aksel Sandemose, a Danish-Norwegian author who was active in the early to mid-20th century (Couto, n.d.) Jante's Law consists of 9 "rules" that govern appropriate thought in Norwegian society, including "You are not to think you are anything special," and "You're not to think you are smarter than we" (AFS Intercultural Programs/USA, n.d.). In essence, these "rules" state that no one person should hold themselves above any other person in Norwegian society.

The desire for equality is also evident in Norwegian communication. "Communication is direct, participative and consensus orientated" (The Culture Factor Group, n.d., n.p.). Mondå Forlag (2022) stated that Norwegians use concise, simple, and direct communication and dislike vague statements and figures of speech. This is in line with Edward T. Hall's description of a communication from a low-context culture, "a low context communication is [. . .] the mass of the information is vested in the explicit code" (Hall, 1989). Given that Norwegian culture values direct, explicit communication, we could expect that information contained in their wayfinding signs would be similarly direct and explicit.

Norwegian Stakeholders

Norway today is a very diverse nation because of its history of accepting immigrants (Modig, 2021). In 2021, one of every three Norwegians living in Oslo was either an immigrant or a first-generation Norwegian. Most of these immigrants arrived to fill labor shortages or as refugees, with the largest numbers coming from Poland, Lithuania, Sweden, Syria, Somalia, Germany, Eritrea, Iraq, the Philippines, and Thailand (Modig, 2021, p.3). Immigration has slowed somewhat in recent years due to COVID, but the overall immigration rate is expected to stay steady through 2060 (Modig, 2021, p.3).

Like many other industrialized nations, Norwegians are also a rapidly aging population because of a longer-living population and declining birth rates (Modig, 2021, p.5). Currently, the population that is age 67 and over hovers around 16%, but by 2050 this percentage is expected to increase to over 20% (Modig, 2021, p.5). Despite the fact that the "grey tsunami" is not quite as pronounced in Norway as it has been in other European countries, the labor shortage resulting from the state-supported retirement at age 55 for Norwegians has contributed to many senior workers exiting the workforce, reinforcing the need for immigrants to fill labor shortages in many fields (Eikeno & Oserud, 2022).

A significant number of Norwegians also live with a disability. According to The Norwegian Directorate for Children, Youth, and Family Affairs (n.d.), 15–20% of Norwegians are disabled. For comparison, this number is less than the current United States Centers for Disease Control and Prevention (CDC)(2025) estimate that 26% of Americans live with a disability. However, the Norwegian Government has addressed the large number of disabled Norwegians and their legal accommodations in the Equality and Anti-Discrimination Act of 2018 (Lovdata, n.d.). Included in its provisions, the Act stipulates that "Public undertakings and private undertakings focused on the general public have a duty to ensure that their general functions have a universal design" (n.p.). The Act defines universal design as "accommodating the main solution with respect to the physical conditions, such that the general functions of the undertaking can be used by as many people as possible, regardless of disability" (n.p.). Wayfinding signs are part of the public infrastructure, and therefore, should accommodate the disabled.

Methods

Sample

In the summer of 2022, I was fortunate to have been awarded a Fulbright-Hayes fellowship to study Norwegian culture and governmental systems. I spent a month in Norway, dividing my time between Oslo, Bergen, and Tromsø. As a group, the Fulbright scholars spent the majority of their time attending lectures in various locations around these cities. Perhaps because I had spent a frustrating layover in Amsterdam trying to navigate the train system from the airport to my hotel with no data access on my phone and only the Dutch textual description of the route to assist me, I became sensitive to wayfinding signs when I arrived in Norway. Because of my elevated attention to wayfinding signs, I immediately noticed that the design of the wayfinding signs was markedly different in Norway from the wayfinding design in the United States. For example, the signs often had visual symbols instead of text, and they sometimes included more color than similar signs in the United States. As a result, I began to wonder if the Norwegian method of wayfinding design better matched the known principles of effective wayfinding design than those of the United States, and what lessons technical communicators in the US could take from the Norwegian practices.

To investigate this question, I began taking photos in public spaces around Norway. In all, I took 216 photos on city streets, buses, ferries, airports, hotels, government buildings, commercial spaces, and museums. I focused only on places that were publicly accessible, and that were related to travel and public sites rather than healthcare, as those were the places that were accessible to me. When I returned to the United States, I located a comprehensive cache of all approved Norwegian road signs from Trafikkskilt, a Norwegian website produced by The Norwegian Public Roads Administration. Although I had taken photos of many of the signs contained on this website, added together I now had a sample of over 450 wayfinding signs. I focused on publicly available wayfinding signs because I theorized that these signs were most likely to be the signs that the average Norwegian encountered on a daily basis. These were also the signs that I, as a visitor, had regular access to, which may better simulate a traveler's experience navigating unfamiliar areas in Norway.

My exploration of Norwegian wayfinding would be incomplete without a contrastive element. For this sample, I turned to wayfinding signs from the United States that displayed a similar message or use to tease out the differences in design and explore the lessons in Norwegian design that technical communicators could then apply to wayfinding in other physical or virtual spaces. Because the United States is much larger both in terms of population and physical space than Norway, it was difficult to narrow down and conduct a systematic study of representative cities, such as I was able to do in Norway. As a result, I examined road signs that were approved in the US by the Manual on Uniform Traffic Control Devices (MUTCD) 2012 Supplement, which at the time of this writing is the most current version of the MUTCD available. Other signs, such as wayfinding signs on U.S public transportation systems, or even signs indicating road hazards, appeared to be more variable and were not regulated by the U.S. Department of Transportation Federal Highway Administration. To find examples of these signs, I turned to signs that were available on the for sale via American commercial websites, as well as conducted web searches of the American sign that corresponded to the Norwegian example, making sure to disregard any outliers or unusual examples. When possible, I then tried to locate an example of the American sign in actual use, such as the examples in Portland, Oregon and New York City included later in this article.

Analysis

To analyze the Norwegian wayfinding signs, I utilized Farr et al.'s (1997) seven principles of effective universal design as well as several criteria mentioned in the literature as being factors influencing the effectiveness of a wayfinding sign (Hall, 2014; Horton, 1993). Examples of parallels in Farr's principles and the literature in technical communication include the use of literal figures (Horton 1993; Kostelnick 2019), the simplicity of the design (Tufte 2001), and the use of color (Horton, 1993). Although Farr's principles are, at the time of this writing, more than 20 years old, the principles of wayfinding in a physical space have remained relatively stable. Furthermore, these principles of effective wayfinding were easy to understand and mirror the principles that we use in technical communication to facilitate effective visual design and wayfinding in virtual spaces, such as web sites and mobile apps.

I then related the findings to lessons that technical communicators could extract and apply to other aspects of visual design for a physical or virtual space, such as augmented reality (AR) or virtual reality (VR) spaces, in a similar way to Saul Carliner's (2001) analysis of museum exhibit and wayfinding design. Carliner (2001) used comparative analysis within a grounded-theory methodology framework to compare the wayfinding signage in museums to wayfinding methods used in web design. In addition to being a foundational work in technical communication, Carliner's (2001) methods and direct examination of effective wayfinding methods offered a direct match to what I hoped to achieve when comparing Norwegian and U.S. wayfinding signs.

The world of technical communication is fast-paced and frequently updated as technology changes, but the principles of effective physical wayfinding can still apply to other aspects of design that are more familiar to technical communicators.

Results

As a whole, Norwegian signs matched up with Farr et al.'s (1997) characteristics of effective wayfinding design, as well as the additional characteristics from technical communication literature. Because many of these characteristics overlap, I will discuss the individual attributes of Norwegian wayfinding design and link these attributes to the corresponding principles of effective design that they encompass. I will also provide appropriate examples of wayfinding signs that display each characteristic from the sample of Norwegian signs that I used in this study, as well as an image of its corresponding sign from the US

Signs that Rely on Graphics and Use Minimal Text

Similar to web design and design in health care facilities, wayfinding signs often rely on visuals to facilitate understanding with as much of the public as is possible. As Bloom-Pojar and DeVasto (2019) point out, "Visuals are not necessarily transparent, objective, or universally understood. However, because visuals can be more readily understood by a wide variety of cultures than text, graphics can be a useful way to convey important information when a wide variety of cultures are being addressed."

Because 419, or 93% of the Norwegian signs in my sample of 451 signs did not include

text, they did not rely on the user's language or reading abilities. When the signs did include text, they often used both Norwegian text as well as English text, and the only signs labeling streets were text-only. This is in stark contrast to signs in the US, none of which in my exploration included a language other than English. All U.S. signs approved for federal use in the Manual on Uniform Traffic Control Devices for Streets and Highways (United States Department of Transportation, 2012) were also strictly in English when text was included on the sign. Of the Signs included in this manual, 364 of the 398 signs included text, or approximately 91.5%. The remining 8.5% of the signs used graphics only, which is in stark contrast to the 93% of Norwegian signs that only used graphics (United States Department of Transportation, 2012). Refer to Table 7.1.

Graphics-only signs match Farr at al.'s (1997) principles of equitable use, which states "the design can be used by stakeholders with varying abilities." as well as their principle of simple and intuitive use, "The design is easy to understand, "regardless of the user's experiences, knowledge, language skills, or current concentration level" (p.719). The graphics can be used by stakeholders with no reading ability in the main nguage or languages of a country or region, or who are illiterate in any language. As William Horton (1993) proposed, signs with limited text are more likely to be understood by residents or visitors from a variety of cultures and with varied reading and language abilities (p. 682).

Figure 7.1 shows a Norwegian sign intended to warn travelers about a drawbridge ahead in the road. The image shows a drawbridge spanning a body of water with no text and minimal detail. In contrast, drawbridge signs approved by the U.S. Department of Transportation Federal Highway Administration must be diamond-shaped with a "black legend and border on a yellow background)" (U.S. Department of Transportation, 2009, p.103). Figure 7.2 shows an example of such a sign in Portland Oregon, United States.

Table 7.1. Contrast Between the Use of Text on Norwegian Versus U.S. American Wayfinding Signs

	Norwegian Wayfinding Signs	**U.S. Wayfinding Signs**
Sample Size	491	398
Graphics only	419 (93%)	34 (8.5%)
Monolingual text reflecting the nation's most-used language	4 (11.7% of the signs using text used Norwegian only, which represents (0.008% of the total sample)	364 (91.5%)
Bilingual text	30 (88.3% or 0.06% of the total sample used Norwegian and English text)	0 (0%)

Figure 7.1. Norwegian drawbridge road sign (Norwegian Public Roads Administration).

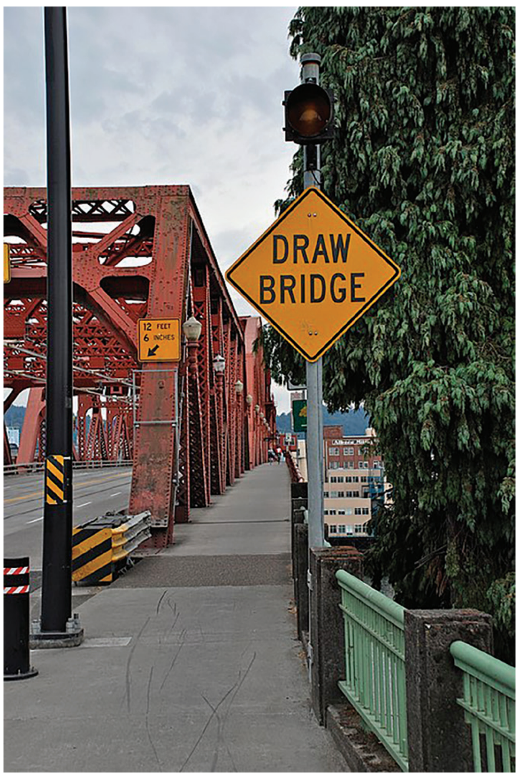

Figure 7.2. Drawbridge sign at Broadway Bridge in Portland, Oregon, United States (Wikimedia Commons).

The Norwegian penchant for minimal or no text on public signs also extended to locations other than roadways. Figure 7.3 was taken on a public bus in Bergen, Norway. This sign is intended to warn the reader about the gap between the bus steps and the platform. The sign contains no text, but only a clear image of an adult and child crossing from the platform to the bus with an arrow indicating the gap between the two. In contrast, Figure 7.4 shows a warning sign in the New York City subway, which is text-only and states "Watch the gap." When I rode the New York City subway for the first time as a young adult from an urban setting without a robust transportation system, I had no idea what "Watch the gap" meant and discerned the warning information from the yellow stripe near the platform rather than the warning sign, offering a personal illustration of the point that visual indicators of a warning can be more powerful than textual information.

Figure 7.3. Public transportation platform warning sign, Bergen Norway. (Taken by author.)

Figure 7.4. Subway platform warning sign in New York City (Champeny, 2023).

Pictures on Signs Should Match the Object Being Depicted

When a designer creates signs, they must be careful to depict concrete concepts or objects rather than abstract concepts when possible (Hashim et al., 2014). The research in wayfinding literature matches research within technical communication about using the human figure with simplified details (Horton, 1993) and using the human form and simple figures to humanize visuals and make them more relatable to the user (Kostelnick, 2019). For example, rather than trying to depict the abstract danger or hazard the object presents, effective wayfinding design principles would recommend showing a graphic of the actual hazard. The U.S. Department of Transportation (2009) mirrors the need for a physical representation of an abstract hazard, such as showing a depiction of the animal in a non-vehicular warning sign in which a particular type of animal may be present (p.130). Wayfinding should be literal to be effective across cultures (Hall, 2014, p. 11). None of the Norwegian signs in my sample showed an abstract concept such as "danger" or "caution." Instead, they showed the hazard and allowed the user to draw the conclusion themselves that the hazard represents danger. In contrast, American road signs often show text or a symbol such as "P" to indicate parking which have no direct relationship to the concept being displayed to the stakeholder (Hall, 2014, p. 32).

Figure 7.5 is a Norwegian traffic sign used to show the danger of rockslides on the road. Because the image shows rocks falling off a mountainside (the danger) onto a flat surface, the sign would clearly indicate to stakeholders of most cultures that they must watch for rockslides on the road or path. In contrast, figure 7.6 shows a rockslide sign approved by the U.S. Department of Transportation (2012, p.185). The rockslide sign from the United States matches the guidance offered by the MUTCD, for hazard signs, which, to reiterate, states that warning signs must be diamond-shaped with a yellow background and a black legend and border (U.S. Department of Transportation, 2009, p.103).

Figure 7.5. Norwegian Rockslide Road Sign (Norwegian Public Roads Administration).

Figure 7.6. American Rockslide Area sign (Roadtrafficsigns.com).

Figure 7.7. Do not throw garbage overboard sign, taken by the author on the Hurtigruten coastal ferry, Norway.

Examples of Norwegian signs found on public transportation also bore out their preference for making the graphic match the action as closely as possible. Figure 7.7 depicts the prohibited action of throwing trash over the side of the boat. This sign, taken on the Hurtigruten, the Norwegian coastal ferry, shows a person dumping objects overboard, with the red "X" over it. The text beneath reads, "Do not throw trash overboard" in both Norwegian and in English, but the literal rendering of the prohibited action may make the sign more readily understood by passengers who cannot read the caption.

In contrast, Figure 7.8 shows a sign offered for sale for use on ferries and other marine transportation by the company Campground Signs, which despite the name, offers signs for a wide variety of public and private settings. In this figure, there is no visual depicting the prohibited action. Instead, the text describes the law prohibiting the action of throwing trash overboard (Annex V of the MARPOL Convention as well as U.S. Law) and concludes with a vague threat of "heavy fines." This sign, both because of its lack of a visual and its heavy use of legal text, would be impossible to understand if the user could not read legal English. As a result, the sign has limited usefulness.

Yet again, the Norwegian style of literal graphics is in line with Farr et al.'s (1997) principle of equitable use and principle of simple and intuitive use because the graphics literally depict the item or hazard rather than relying on a cultural construct of a symbol that represents danger or caution. In addition, by showing a literal, yet simple image of what the danger is, the signs reduce the possibility of a user from a different culture misconstruing what the image on the sign depicts. In this way, Norwegian signs also reduce the possibility for error, which matches Farr et al.'s (1997) guideline of tolerance for error, which states, "The design accounts for, and minimizes, possible hazards or accidental actions on the part of the user" (pp.719–720).

Figure 7.8. Do not throw trash overboard sign, offered for sale in the United States (SmartSigns).

Color on Signs Should be Culturally-Appropriate, High-Contrast and Should Reduce the Physical Effort to Read Signs

The use of color, and the perception of colors, can vary from culture to culture (Gibson, 2009, p. 90; Horton, 1993). Norwegians, similar to Americans, view the colors red, white, and blue as symbolizing their flags, as well as the concepts of freedom and peace. In addition, the colors red, white, and blue have historical context in Norway, as blue is recognized by its association with Sweden, and red and white by their association with Denmark. At various times in history Norway has been part of both of these countries (Gundersen, 2019).

Because of Norway's strong identification with red, white, and blue, it isn't surprising that the majority of the Norwegian wayfinding signs in my sample use red, white, and blue, as well as black for text and to frame images. In contrast, wayfinding signs in the United States often use green and white for highway signs, but orange and black for wayfinding signs within a city or to indicate potential hazards. According to the Builder Space website, green is typically used in the United States to indicate wayfinding information that is less important because green is less distracting to drivers on the road. In contrast, yellow or orange hazard signs are meant to draw the user's attention immediately (Valle, 2021).

While neither the Americans with Disabilities Act (ADA) nor does the Norwegian Equality and Anti-Discrimination Act of 2018 make recommendations in regard to the colors used in public signage, the ADA does recommend a 70% or greater contrast between the colors used on signage, particularly between the ground color of the sign and the text or figure colors (Gibson, 2009, p. 90). The contrast percentage of colors can be checked using luminance checkers, such as the one provided online by the Accessibility Developer Guide's online relative luminance tool. The color contrast doesn't just depend on the colors used; they also depend on the intensity of the colors. The green and white and black and yellow/orange color combinations of American signs have an appropriate color contrast, as do the blue and white and red and white of Norwegian signs. As a result, the color schemes used in wayfinding design by both countries are appropriate for most people with visual disabilities such as color blindness. Because of the judicious use of color, Norwegian signs are again in line with Farr et al.'s (1997) principles of perceptible information, as well as their principle of low physical effort, which states "The sign must be easily interpreted with a minimum of physical effort for the user" (pp. 719–720).

One method in which Norwegian designers reduce the physical effort needed to interpret a sign is through the use of red and green to indicate prohibited versus permitted, or desired, actions. Norway, like the United States and many other countries, uses a red, yellow, and green stoplight system on roadways. This indicates that red is recognized as a color meaning "stop" or "prohibited," while green is interpreted as "go" or "permissible." The position of the lights reinforces these differences, even for users who have red-green color blindness. Figure 7.9 shows an example of the use of red and green on a Norwegian sign to indicate prohibited versus permissible actions. This sign was located next to an elevator in a public building in Oslo, Norway. The user's eye is drawn to the photos on the right, showing first a figure running in green, then a visual of people on an elevator with a large red X over it, and finally, a figure of people taking the stairs in green. While the contrasting red and green colors will not be helpful to someone with red-green colorblindness, the explanatory text serves to clarify the meaning of the graphic, which may be necessary for the color-blind. The explanatory text to the left explains the meaning of these visuals in greater detail, stating in both Norwegian and in English "in case of fire do not use elevator, use the stairs" (Refer to Figure 7.9). While this sign arguably may have benefitted from a graphic indicating fire rather than relying on the text to indicate that the purpose of the graphic was instructions in the case of fire, the visuals clearly indicate that one should take the stairs instead of the elevator.

In contrast, signs indicating that elevators should not be used in the case of fire often do not use color at all, or do not use red and green to indicate prohibited versus preferred actions in the case of a fire. Figure 7.10 shows a typical example of a sign found in public buildings in the United States. While the sign does show a person fleeing a fire by going down the stairs, because it only has one visual showing the stairs and not one indicating that a person should not use the elevator, a non-English reader may not understand that they should avoid the elevator during a fire.

Figure 7.9. Fire emergency visual in Oslo, Norway. (Photo taken by author.)

Figure 7.10. Elevator out of service sign from the United States (ADA Sign Depot).

Figure 7.11. Polar bear warning sign in Svalbard, Norway (Texarkana Gazette, 2023).

The environment in which the wayfinding signs are used also has an impact on the legibility and readability of the sign (Gibson, 2009, p. 90). Most outdoor wayfinding signs in both Norway and the United States rely on reflective paint to be readable at night, but Norway's red, black, and white signs are more visible regardless of reflection. The light in the Arctic regions, including Norway, can vary significantly from season to season. The summers in Norway are bright, with the sun setting for only a few hours in most of Norway in the summer, while the Polar night in the winter takes on a blue cast rather than the black of night that most sub-Arctic people imagine (Northern Norway Film Commission). As a result, the red and white signs with black figures and lettering stand out even in the blue winter light in Norway in a way that the green and white or even orange signs in the United States likely would not (see figure 7.11, which was taken during the Polar night period in winter in Norway). However, American green and white wayfinding signs depend on reflective white paint to make the letters and figures stand out at night. Without the reflective paint highlighting the white lettering, the American signs are very difficult to read in low light (See figure 7.12, which was taken at night). This paint tends to wear out over a period of 5 to 15 years, making older signs virtually unreadable after sunset (Turken, 2021).

Norwegian design considers the environment and the qualities of the light whereas the United States and many other countries consider color mainly as it relates to the purpose of the sign when they develop color schemes (Valle, 2023). The result is that Norwegian wayfinding schemes match Farr et al.'s (1997, p. 719) principles of low physical effort to read. The Norwegian signs also provide more equitable use, as outlined by Farr et al.'s effective wayfinding design principles (1997). On the other hand, the readability of American wayfinding signs may depend on where you are in the country, the time of year if outdoors or the ambient lighting if indoors, and the age of the sign.

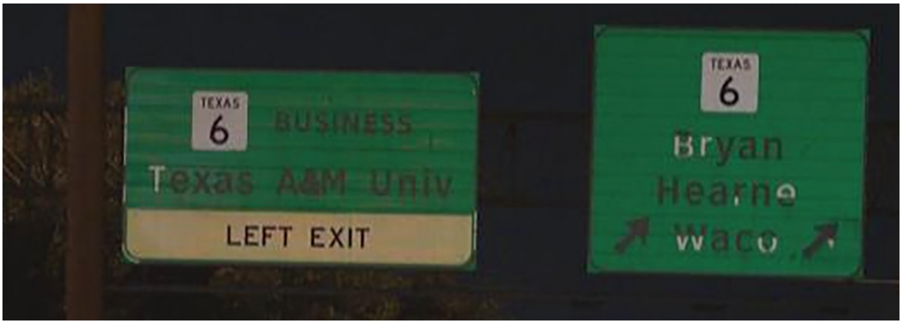

Figure 7.12. Faded highway signs in Texas, United States (Hogan, 2019).

Discussion and Implications for Technical Communication

This study has the potential to be of practical use to wayfinding designers, as well as of use to technical communicators. As the United States and other countries update aging infrastructures, they would do well to consider Norway's practical and effective use of wayfinding design to replace their less effective wayfinding schemes. In addition, technical writers could apply many of these design principles and findings to a variety of visual design genres, such as websites, mobile apps, augmented reality (AR) programs and virtual reality (VR) programs, safety and risk communication, and health information such as patient information materials and infographics.

Lesson 1: Use Signs and Symbols with Little to No Text

The use of graphics-only, text-based, or both graphic and text-based information is still often debated. On one hand, graphics are more easily understood in an international context and when the audience is diverse (Horton, 1993). On the other hand, when legal aspects enter the picture, such as in health care settings or emergency scenarios, a certain amount of text may be necessary to reinforce the meaning of the graphics (St. Germaine, 2016). Further, the use of graphics alone may be confusing (Horton, 1993).

Norwegian wayfinding design illustrates how graphics with limited text can function well according to both effective wayfinding principles as well as the conventions of effective technical communication, even in a multicultural setting or situations where the graphic or sign is used in an emergency scenario, such as Figure 7.10 in which the sign gave instructions to avoid the elevator and use the stairs in the case of a fire.

Lesson 2: Graphics Match the Object Being Depicted

Signs and symbols, as well as infographics and websites, should use figures that represent the concept or hazard in a literal way to account for differing reading skills, differing language skills, and for multiple cultural frames of reference. Even international websites with a great deal of traffic, such as Google, tend to create arguably ambiguous symbols and graphics that reflect more of their branding than effective wayfinding to represent areas of the website, and as technology expands and the need for new services, such as video chat, cloud storage, AI functions, and augmented reality features expands on websites, technical communicators could design symbols and graphics that correspond with the feature and will indicate to a wide demographic where exactly clicking on the symbol will take them.

Lesson 3: Consider Usability and Accessible Design When Designing Symbols and Graphics

Audience analysis is at the core of technical communication (Johnson-Sheehan, 2018). Usability and accessibility have increasingly become a concern in website design as organizations strive to meet the guidelines set forth by the Americans with Disabilities Act (ADA), or the analogous disability laws in their own countries. As Carliner (2001) demonstrated when he applied lessons from museum exhibit design and applied them to web design, the current research in the field of usability and accessible web design should continue to inform other areas of technical communication involving graphics and public information.

Lesson 4: The Use of Color and Physical Effort to Read Signs and Symbols

As discussed, American wayfinding designers sometimes seem to use color haphazardly or without a clear understanding of the audience to whom they are addressing. Although the field of technical communication does discuss the use of color and the environment in which the sign or symbol will be seen in more detail, especially when it comes to websites and safety information, cultural conventions in the use of color deserves more consideration.

Additionally, technical communicators should continue to examine the role of disability and the amount of physical effort needed to view physical signs, infographics, and AR and VR wayfinding symbols and schemes, Instead of reacting to ADA guidelines and retroactively redesigning websites and physical information to accommodate this need, technical communication should continue to advocate for universal design, which allows users of all abilities to participate in the design process (Edelberg & Verhulsdonck, 2021). Implementing universal, participatory design from the beginning of the design process will proactively address accessibility issues for all users, including design issues discussed in this paper such as creating color schemes that are accessible and readable under a variety of environmental conditions, as well as for users with visual disabilities such as color blindness.

Limitations of the Study and Further Research

Although American signs were remarkably similar in design and other characteristics, such as the amount of text and use of color, the sheer number of possibilities for public signs in the United States, with the exception of the signs by U.S. Department of Transportation (2012), make this lack of systematic data collection a limitation of the study. Further research could examine subsets of American visual design in various genres, or even in public wayfinding in a particular city or region.

Additionally, Norwegian graphic design is an aspect of Scandinavian design, and other countries and even German and Dutch design have also received accolades in various fields. However, because my fellowship limited my experience to Norway, I could only consider Norwegian design. Further research might explore other aspects of Scandinavian design or European design, as well as design in the global south and other less-explored areas. Further research could also be conducted to ascertain whether the wayfinding schemes typical of each country appealed more to a particular gender.

Sign clutter surrounding wayfinding signs or pages in virtual environments can also impact the user's attention. Because I was only studying the characteristics of individual signs, I did not have the opportunity to explore the impact of the presence of surrounding signs and its impact on the user. However, this is an area that may merit further research, especially since it has parallels to Edward Tufte's research on "chart junk," or clutter on charts and graphs that does not add new information (Tufte, 2001).

Further research could also continue the discussion about the shapes of wayfinding signs and other information may also have an impact on the user's ability to perceive and understand the information. For example, the triangular shape of many of the warning signs approved by the Norwegian Public Roads Administration contrasted with the diamond shape chosen by the U.S. Department of Transportation such as in Figures 7.1, 7.3, and 7.7. I was not able to locate an explanation for this design choice, nor an explanation of if the rationale for this choice of shape other than aesthetics. However, exploring the shapes of icons, symbols, and signs may inform not only wayfinding, but also web and app design choices.

Finally, it would be valuable to study the connections between physical wayfinding and other aspects of visual design more specific to technical communication in more detail. For example, future research might address designing symbols in a cross-cultural context for new services on the web, or study the design of symbols in other more specific settings, such as in emerging genres of mobile apps such as mobile learning, augmented reality, and AI-based apps.

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8. Communicating Science to the Public: A Comparison of Lexicogrammatical Features in Student-Produced and Popular Science Writing

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Abstract: Technical communicators often communicate scientific findings to a broad audience, but little empirical research has analyzed the linguistic features of popularized science texts. We compare the lexicogrammatical features of student-written scientific reports with science press releases (SPRs). We compared a corpus of SPRs with a corpus of student-written scientific reports using key feature analysis (Biber & Egbert, 2018), a statistical method that measures the effect sizes of different lexicogrammatical features across the corpora. The features identified as key for both corpora were grouped according to their functional themes. Science press releases used lexicogrammatical features related to information density, informational reports of past events, and timeliness. Student-written science reports used lexicogrammatical features related to expression of stance, scientific style, coherence and development of arguments, and writing prompt. Based on our findings, we provide six recommendations for teachers, students, and practitioners who want to mimic the style of SPRs as a form of science popularization: (1) tell stories with active voice, (2) include others' words by using quotations and communication verbs, (3) avoid technical jargon, (4) use adjectives of time to highlight the importance of research, (5) minimize expressions of authorial stance, and (6) report facts rather than make arguments.

Keywords: Science communication, popularization, press releases, corpus linguistics, key feature analysis

One of the important tasks that technical and professional communicators perform is communicating scientific findings to a general audience (Carradini, 2020; Mogull, 2018). While many scholars in the field have studied public communication of science in different modes, including online forums (Cagle & Herndl, 2019), film (Spoel et al., 2008), and press releases (Weber, 2020), little empirical

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research has been done to better understand linguistic variation in popular vs. academic science writing. Such research is needed because it can be used to inform best practices for communicating science to the public.

In this chapter, we address this need for more empirical work by analyzing the lexicogrammatical features associated with two registers of scientific writing: student-written reports and scientific press releases. *Lexicogrammar* is a term from functional linguistics that "[emphasizes] the interdependence of vocabulary (lexis) and syntax (grammar)" (Nordquist, 2020, para. 1). The results of the research presented in this article contribute to a description of the ways in which popular science writing (in the form of press releases) differs from the more traditional scientific reports students often produce. These results can help instructors, scientists, and science communicators better understand how to write in ways that meet existing expectations for writing toward nonexpert audiences.

Literature Review

In this section, we review the need for students and practitioners to communicate to popular audiences. Traditionally, science students are taught to produce a limited number of scientific text types such as methodology recounts and research reports; however, these texts are often not accessible to nonexperts. Teaching these students—many of whom are required to take technical communication classes—how to popularize their work can help them learn to communicate scientific information that more people can understand. Teaching popular-science-writing principles can also help aspiring technical communicators to more effectively communicate information from subject-matter experts. We focus in this study on the press release as an example of popularized science writing. We further elaborate each of these points in turn below.

The Need to Communicate Science to Nonexpert Audiences

Science and technology are crucial aspects of daily life. In the US, the number of college students majoring in science, technology, engineering, and mathematics (STEM) is increasing, in part because STEM careers represent a significant proportion of the U.S. labor force (Burke, Okrent, & Hale, 2022). Academic research is also growing rapidly. Today, more research articles are being published in academic journals than ever before (Hyland & Jiang, 2019). Moreover, recent issues such as the COVID-19 pandemic, the growing threat of climate change, and advancements in artificial intelligence have brought science and its communication to the public to the fore. In short, the 21st century is one marked by the production of scientific information and the need to communicate it.

However, the language that scientists use to communicate with one another, in particular through research writing, does not cater to nonexperts (Bazerman, 1988; Halliday & Martin, 1993). Because of this, when communicated with broad, diverse audiences, scientific information often undergoes a process of "popularization." Put simply, science popularization refers to the process of communicating scientific information to nonexperts, usually resulting in some local and global revisions to the content (Gotti, 2014). Although the stereotypical view of popular science sees its audience as being passive and incapable of understanding authentic science (Hilgartner, 1990), contemporary scholars view the process as more complicated (Myers, 2003; Paul, 2004). Popular science is not a simplification of real science but a "discursive reconstruction" (De Oliveira & Pagano, 2006, p. 628) and "recontextualization" (Calsamiglia & Van Dijk, 2004, p. 370) of scientific information for a new rhetorical context. Thus, popularizing science requires not just revising its linguistic features, such as jargon and syntax, but also revising its rhetorical features as well, such as purpose and organization (Fahnestock, 1986; Hyland, 2010).

Three decades ago, Ann Mauzy (1994) described the need for technical communicators to communicate complex information to diverse, nonexpert audiences: "The stakes…are high," she wrote. "Communicators need to target the public as the *most important audience* and to urge scientists to do the same" (p. 143, emphasis added). This need to prioritize the public is only increasing. Web 2.0 technologies have broadened the methods by which scientists and technical communicators can reach lay audiences (Luzón & Pérez-Llantada, 2019). Social media, science blogs, TED Talks, and science podcasts are examples of these expanding contexts. Traditional methods used to popularize science, too, remain crucial. Sharon Dunwoody (2014) argued that science journalism represents an important source of "independent, evidence-based information" in an age where ordinary citizens are bombarded with one issue after another (p. 27). Indeed, global scientists regularly communicate with journalists to share their research (Peters et al., 2008), and the internet allows for faster and cheaper publication of science news online.

However, more research is needed to better understand the skills involved in popularizing science. Particularly if we are to train aspiring technical communicators—as well as the many STEM students who regularly enroll in technical communication courses—to engage in this process, practical insights into the linguistic features of popular-science discourse would aid in developing materials for training students how to share scientific research with broader audiences. Below, we home in on one form of popular science, namely press releases sharing science news, and the kinds of writing that college-level students are expected to produce. Ultimately, we argue that examining the linguistic and functional similarities and differences between these two kinds of discourse can provide helpful insight for researchers, instructors, and students of technical communication.

Science Genres and Student Writing

Professional scientific activities demand vehicles through which their processes and results can be effectively communicated to others. One way of describing these vehicles is through genre, or the "ways of recognizing, responding to, acting meaningfully and consequentially within, and helping to reproduce recurrent situations" (Bawarshi & Reiff, 2010, p. 3). Naturally, there is a plethora of genres frequently used to communicate science, but the most influential and prestigious has been the research article (RA) (Hyland & Salager-Meyer, 2008; Samraj, 2016). Charles Bazerman (1988) examined the earliest developments of the RA (called "experimental reports"), illustrating the connection between generic form and social function. For example, as reports took on an argumentative function, serving to adjudicate disputes and generalize knowledge, writers began to situate their work within a longer scientific conversation more fully, include more precise methodological description, and write longer articles. John Swales's influential work on move analysis (e.g., Swales, 1981, 1990), a framework which seeks to uncover the communicative functions motivating portions of text, also bolstered the study of the RA and its role as the premiere site of the investigation of scientific discourse.

From a linguistic perspective, M. A. K. Halliday and J. R. Martin's (1993) influential work on scientific discourse highlights the science writer's tendency to turn parts-of-speech like verbs and adjectives into nouns (called "grammatical metaphor"), a process which developed over time to suit the needs of communicating empirical work to technical audiences. Others too have noted the nominal style of scientific writing (Wells, 1960), its tendency to create lengthy, complex noun phrases by way of stacked modifiers (Biber et al., 1999, Ch. 8), and the "clearer" style bestowed by maintaining actions as verbs (Williams, 2009). Moreover, these features are not just stylistic but also functional. Douglas Biber and Bethany Gray (2016) argued that this style allows for compact, informationally dense prose useful when writing for increasingly specialized audiences (p. 207). In short, scientific discourse functions to effectively communicate science to other professionals, and the RA is the premiere genre used to communicate it.

Students studying in colleges and universities must also contend with the RA. Susanne Pelger and Pernilla Nilsson (2016, p. 440) stated that students in science classes are often expected to write empirical reports in the style of a scientific paper, a fact which they see as problematic, since it limits the students' skills in communicating science, especially to diverse audiences. This makes some sense. A key characteristic of empirical reports is their technical audience (Gotti, 2014). And yet writing toward general audiences has pedagogical benefits, as well. Being able to recognize the similarities and differences of popular and professional science discourse reflects a learner's awareness of their rhetorical and linguistic characteristics (Hyland, 2010; Parkinson & Adendorff, 2004). The STEM students in Wendy Crone et al. (2011), Pelger (2018), and Pelger & Nilsson (2016) were found to improve audience awareness and develop a new perspective on their own research as a result of popularizing their own research.

We argue that this benefit can extend beyond science students to technical writers as well, and that the science press release is one text type through which students can gain such practice. Next, we discuss the theoretical underpinnings of the study, namely register analysis, and how it can be applied to a study of the language of press releases and student writing.

From Genre to Register

The current study seeks to examine features of the science press release and compare it to student-produced science writing. The features we examine reflect the theoretical lens we adopt. Specifically, we adopt a register-studies perspective by examining lexicogrammatical features of two corpora of texts.

Put plainly, register analysis emphasizes the lexical and grammatical features of texts and how they vary across text types. While genre studies often examine longer stretches of text like rhetorical moves (e.g., Swales, 1990), register studies focus on the variation of linguistic features between text types and attempt to connect those features to the situational context in which the texts were produced (Biber & Conrad, 2019). In other words, linguistic choices are not just formal but also functional, reflecting the situational characteristics of discourse like audience, purpose, topic, modality, and more. We see this approach as complementary to the already substantial body of genre work on science and non-science written genres.

We compare student-produced science writing with science press releases in order to understand which lexicogrammatical features distinguish the press releases from the scientific reports that many students are taught to write. Even though these text types differ with respect to the audiences they aim to reach, they both share the same primary communicative purpose, namely to disseminate scientific information. For this reason, we argue that the comparison undertaken in this study is valid and capable of producing useful results. The results of this analysis allow us to explicitly teach these linguistic features to students when helping them learn how to write science press releases as a way to communicate science to a broader audience.

In the next section, we review relevant background literature on the press release, before presenting our research questions.

Communicating Science through Press Releases

Scott Mogull (2018) argued that technical communication teachers need to teach students to write for broad audiences and even advocated for technical communication classrooms to act as places for scientists to learn how to popularize their work (2011). One text type that teachers can use to help their students learn how to write science popularizations is the press release. While a selection from the ever-expanding catalog of new-media registers might seem more relevant or exciting to teach students, traditional sources of news media such as the press release continue to play an important role in the process of communicating science. According to the National Academies of Sciences, Engineering, and Medicine (2017),

> Despite the growing impact of new media, much of the scientific information Americans receive through media still originates from traditional journalism, including information transmitted via links on social media. Therefore, science communicators need to understand the tools used by journalists to shape scientific information, especially that related to contentious societal issues. (p. 69)

In addition, technical communication scholars have identified the press release as a text type that students should learn to write. For example, Jon Balzotti and Derek Hansen (2019) asked their students to write a press release as part of a pedagogical case study, and Mogull (2018) devoted a whole chapter on writing press releases in his guide on science and medical writing.

Press releases exist between two different fields—media studies and professional communication (Jacobs, 2014)—and have two primary purposes: to promote and to inform. Paola Catenaccio (2008) described this dual purpose, noting that while press releases must contain informative material, they must also simultaneously "persuade journalists that they are newsworthy [and] they must persuade the general public that the company is profitable/trustworthy/offers something they need, etc." (p. 14). The reach of press releases is broad because they are taken up by journalists who report on the findings described in the press release (Granado, 2011; Maat, 2007; Jacobs, 1999) and sometimes publish much of the language of the press release itself. Research has shown that scientific medical articles that are accompanied by a press release are more likely to receive news coverage (Stryker, 2002), and high-quality press releases result in higher-quality coverage (Schwartz et al., 2012). This second finding offers further evidence that journalists do in fact rely on press releases when writing about scientific research.

Studies have discussed the importance of press releases and the role they play in communicating scientific findings to a wide audience. For example, research on the content of scientific press releases has found evidence for exaggerated claims (Sumner et al., 2016) and helping the public gain a useful albeit incomplete glimpse into science in the making (Weber, 2020). Other studies have investigated pragmatic aspects of press releases including the use of metadiscourse markers (Liu & Zhang, 2021) and metapragmatic features like self-reference and pseudo-quotation (Jacobs, 2014), while still others have examined the relationship of the press release to other, related texts in its "genre chain" (e.g., Maat, 2007). However, few studies have analyzed press releases on a lexicogrammatical level. One exception is Pititul Chavanachid and Passapong Sripicharn (2019) who analyzed variation in linguistic features and move structures of press releases. We argue that register analysis provides a sound framework for analyzing the lexicogrammatical features characteristic of science press releases.

A Register Analysis of Science Press Releases and Student Writing

We adopt a register perspective to survey the lexicogrammatical features descriptive of science press releases and student writing as they relate to one another. The aim is to provide empirical insight into how science press releases are written to appeal to broader audiences, insights which may prove useful for both practitioners and researchers.

With these details in mind, the current study seeks to answer the following research questions:

RQ1: What lexicogrammatical features are descriptive of science press releases relative to student writing?

RQ2: What lexicogrammatical features are descriptive of student writing relative to science press releases?

Although these questions are largely linguistic, we also seek to describe how their answers can inform our understanding of the communicative functions of the registers. Linguistic analysis coupled with a description of the available situational characteristics of the texts being analyzed is one method for accomplishing this goal (Biber & Conrad, 2019).

Methods

To answer RQ1 and RQ2, we used a statistical method from corpus linguistics called key feature analysis (Biber & Egbert, 2018), which compares frequencies of about 150 lexicogrammatical features in texts from the two registers. To better understand how those features relate to communicative functions, we grouped the features identified as key for each register and interpreted them functionally. In this section, we describe how we collected our corpora, and we provide a detailed description of key feature analysis. In the following section, we present the thematic groups of key features and their functional interpretations.

Corpus Collection

To answer this study's research questions, we collected two corpora. The first corpus consists of press releases reporting on published scientific research. We call this corpus the science press release (SPR) corpus. The second corpus consists of undergraduate and graduate student science writing. We call this corpus the MICUSP subcorpus, since it consists of a subset of the student writing publicly available from the Michigan Corpus of Upper-Level Student Papers (MICUSP) (The Regents of the University of Michigan, 2009).

The SPR corpus includes 2,943 press releases produced by institutions that report on published academic research, mainly U.S. universities, scientific societies, and health organizations. All texts were collected from the "news releases" section of EurekAlert!, a nonprofit news organization operated by the American Association for the Advancement of Science (AAAS). Text collection was performed in December 2022, and all texts were published in the year 2021 or 2022. An initial, larger corpus was collected and then cleaned by removing picture/video articles, duplicated texts, and texts less than 300 words or longer than 2,000 words. The mean text length in the corpus is 700 words (*SD* = 252).

The MICUSP subcorpus includes 153 texts collected from the online repository of MICUSP, a corpus collected in 2009 to represent A-level papers written by University of Michigan students across discipline, genre, and level of education (The Regents of the University of Michigan, 2009). These student papers stem from a variety of classrooms and writing prompts, but all texts included in our sub-corpus were written by final-year undergraduate and first-, second-, and third-year graduate students from one of seven disciplines, namely natural resources and environment, biology, nursing, civil and environmental engineering, industrial and operations engineering, physics, and mechanical engineering. All texts were classified as "reports" by the corpus collectors and include textual features like headings and subheadings, citations and references, figures and tables, and formulae. In general, these student papers are informational, with the main focus being to objectively report on a chosen scientific topic. (An exemplar text can be found at https://elicorpora.info/view?pid=BIO.G0.02.1.) The mean text length in the corpus is 2,667 words (*SD* = 1,788). Table 8.1 summarizes the descriptive information of the two corpora.

As Table 8.1 shows, the SPR corpus has about 2 million words across about 3,000 texts. The MICUSP subcorpus has fewer but longer texts, resulting in about 400,000 words across 153 texts.

Table 8.1. Descriptive Information for the Scientific Press Release (SPR) Corpus and MICUSP*

	SPR Corpus	**MICUSP Subcorpus**	**Total**
# of texts	2,943	153	3,096
Years of publication	2021–2022	2009	2009, 2021–2022
# of words	2,061,562	408,019	2,469,581
Mean text length	700	2,667	-
SD text length	252	1,788	-

** Descriptive information about the scientific press release (SPR) corpus and the MICUSP subcorpus used in this study. The texts in both corpora focus on scientific topics, though they are written for different purposes, which accounts to some to degree for the variation in the corpora: the SPR corpus is composed of a higher number of shorter texts, while the MICUSP subcorpus is composed of a lower number of longer texts.*

Texts in the MICUSP subcorpus were written a little over ten years prior to the press releases. The texts in both corpora generally discuss scientific topics, though their more specific purposes differ. SPRs are written for wide audiences and function to report on recently published research from researchers within the writer's organization. The MICUSP student papers are written for an instructor and can report on either empirical or nonempirical work. Some MICUSP papers have subsections like introductions, methods, and findings, while SPRs generally lack such distinctions. In short, we expect that differences in form and content between these corpora will result in the reliance on different linguistic features, which we describe next.

Key Feature Analysis

We adopted key feature analysis (Biber & Egbert, 2018; Egbert & Biber, 2020) to investigate the lexicogrammatical profiles of the two corpora. Key feature analysis involves using computer programs to part-of-speech tag and syntactically parse the words and clauses of texts. We tagged our corpora using the Biber Tagger (Biber, 1988), which tags texts for about 150 different grammatical and lexicogrammatical features. To give an example of the features that the Biber Tagger identifies, five features, their tags, and examples are shown in Table 8.2.

Table 8.2. Five Features Identified by the Biber Tagger*

Feature Tag	**Full Name**	**Examples**
mod_poss	Modal of possibility	*can, may, might, could*
vb_past	Past tense verb	*said, was, ate*
vb_mental	Mental verb	*think, know, believe*
conj_advl	Adverbial conjuncts	*however, therefore, thus*
passive_short	Short passive voice verb	any finite passive verb phrase without a stated agent

* *A sample of five grammatical and lexicogrammatical features that can be identified using the Biber Tagger. These features include simple grammatical features (e.g., past-tense verbs) as well as functional lexicogrammatical features (e.g., short passives, like* The test was taken.*)*

The Biber Tagger provides normalized frequencies of all features in each text. Normalizing raw frequencies is important because it allows the researcher to compare the occurrence of features across texts and corpora of different lengths. In this study, normalization was calculated as follows:

$$normalized\ frequency = \frac{Raw\ frequency}{Length\ of\ text} \times 1000$$

For example, if 7 modal verbs occurred in a press release of 600 words, the normalized frequency in that text would be 11.67 per 1,000 words (ptw). Normalized frequencies are calculated per text rather than per corpus to allow the researcher to apply inferential statistical tests, which often require means and standard deviations.

Next, we describe the statistical analysis applied to the tagged corpora.

Statistical Analysis

Key feature analysis involves comparing the standardized effect sizes of certain features across corpora. The standardized effect size adopted here is Cohen's *d* (Cohen, 1988). Although many effect sizes exist (e.g., Hedge's *g*), we chose Cohen's *d* because our sample sizes were large enough to avoid bias (see Lin & Aloe, 2021), and because of its ubiquity in key feature analysis (e.g., Biber & Egbert, 2018) and corpus linguistics (e.g., Brezina, 2018). Cohen's *d* is defined as follows:

$$d = \frac{M1 - M2}{\sqrt{\frac{SD1^2 + SD2^2}{2}}}$$

where, "M" refers to the mean normalized frequency of a feature, "SD" refers to its standard deviation, and "1" and "2" refer to the reference corpus and comparison corpus, respectively. In written English, *d* is calculated by subtracting the mean of the reference corpus from the mean of the comparison corpus, which is then divided by the square root of the sum of the squared standard deviations divided by two. As an example, if the frequency of modal verbs in Corpus #1 is $M = 11.67$ and $SD = 5$, and the frequency of modal verbs in Corpus #2 is $M = 7.5$ and $SD = 3.5$, then $d = 0.97$.

Cohen's *d* can be positive or negative and is usually interpreted as follows: a large effect is ±0.8, a medium effect is ±0.5, and a small effect is ±0.2. Biber and Jesse Egbert (2018) examined all key features with $d > \pm 0.3$, while Egbert and Biber (2020) examined key features with $d > \pm 0.8$. Because the SPR corpus and MICUSP subcorpus share more similarities than differences, we did not expect to encounter particularly large *d* values. Thus, we set the cut-off point at $d > \pm 0.5$, or a medium effect, which Jacob Cohen (1988) considered to be "one large enough to be visible to the naked eye" (p. 26). A qualitative review of our key features with medium and large *d* values also suggested that this cut-off value captured important differences between the corpora.

Cohen's *d* values were calculated using the *lsr* package (Navarro, 2015) in R (R Core Team, 2020). Data visuals were produced using the *ggplot2* package (Wickham, 2016).

Results and Discussion

In this section, we report on the findings of the key feature analysis. First, we provide an overview of the key features. Then we explore the positive key features of the SPR corpus and the MICUSP subcorpus. Excerpts are provided to illustrate the key differences between the language of science press releases and student science writing.

Key Features of the SPR Corpus and MICUSP Subcorpus

Twenty-two key features with Cohen's *d* values larger than 0.5 or smaller than -0.5 were identified between the SPR corpus and MICUSP subcorpus. This means that these features are most key when examining how the two corpora differ with respect to their linguistic profiles. Nine of these features had positive Cohen's *d* values, meaning that they were more frequent in the SPR corpus. The remaining 13 had negative Cohen's *d* values, indicating that they were more frequent in the MICUSP subcorpus. Figure 8.1 visually compares these features.

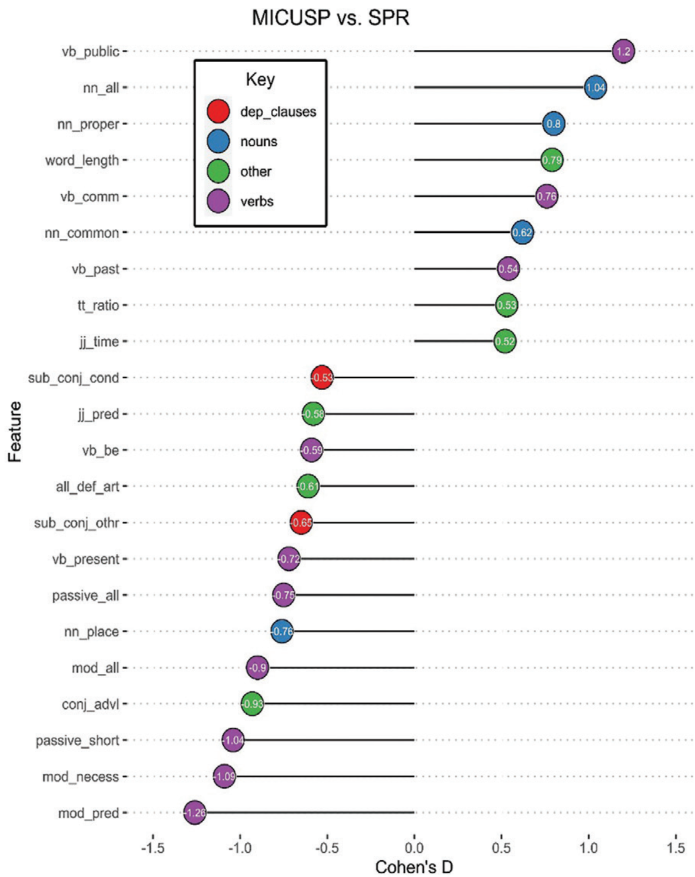

Figure 8.1. A visual comparison of the key features in the SPR corpus and the MICUSP subcorpus. The nine features with positive Cohen's d values are shown with lines extending to the right. The 13 features with negative Cohen's d values are shown with lines extending to the left.

Figure 8.1 shows that features referring to verbs, such as prediction modals (mod_pred), short passives (passive_short), and present tense verbs (vb_present), represent the most frequent structural category. Most verbal features were descriptive of the student writing, though public verbs (vb_public) were notably frequent in the press releases. Four key features referred to nominal structures, three of which were descriptive of the press releases, including common and proper nouns. Two types of dependent clauses were more frequent in the student writing, including conditional dependent clauses (sub_conj_cond; e.g., *if…then…*) and dependent clauses expressing other semantic categories, such as time, place, and manner (sub_conj_othr; see Biber et al., 1999, pp. 818–819 for examples). A range of other structures were also found to be key features, including adjectives of time (jj_time) and definite articles (all_def_art) in the press releases, and predicative adjectives (jj_pred) and linking adverbials (conj_advl) in the student writing. Finally, word length (word_length) and type-token ratio (tt_ratio) were key features of the press releases. These features are measured on a continuous scale using decimals, so a larger Cohen's *d* value means longer words and greater lexical diversity.

Below, we examine these key features more closely by looking at their uses in discourse. First, we explore the positive key features descriptive of science press releases before examining the key features of the student science writing.

Positive Key Features of Science Press Releases

Examining the key features with larger, positive Cohen's *d* values helps to highlight the important lexicogrammatical features frequent in SPRs. Table 8.3 organizes the nine key features of the science press releases thematically. The labels for each group represent our functional interpretations of the features.

Table 8.3 presents three thematic groups: information density, informational reports of past events, and timeliness. We discuss each theme in turn below.

Table 8.3. Key Features of the SPR Corpus Relative to the MICUSP Subcorpus, Grouped Thematically*

Theme	**Features**
Information density	Type token ratio, word length
Informational reports of past events	Public verbs and verbs of communication, past tense verbs, all nouns, proper nouns, common nouns
Timeliness	Adjectives of time

** The key features of the SPR corpus when compared against the MICUSP subcorpus. The features (shown in the right column) were grouped thematically and given a label (shown the left column).*

Information Density

Information density includes two features, namely type-token ratio (TTR) and word length. TTR refers to the ratio of unique words in a text to all words in a text. The greater the number of different words in a text, the larger the TTR and more lexically diverse that text is. Similarly, word length speaks to the lexical characteristics of texts by measuring the average number of letters in a given word. In this study, the science press releases tended to be more lexically diverse and have longer words; thus, TTR and word length were positive key features. The following excerpt from an SPR exemplifies these features.

> **Text Sample #1:** Science Press Release
>
> If the crosslinking occurs in water, the material can then simply be dried in a mold. The result is a tough, transparent, solvent-resistant bioplastic. Its mechanical properties can be varied by changing the proportion of PEG. This allows for the production of bioplastics with high mechanical strength at room temperature in any shape desired, and without toxic chemicals or complex processing steps such as liquefaction, extrusion, or blow molding. Their breaking stress exceeds those of many commercial plastics. One problem left is that they swell in water. If ELP is crosslinked in a water/glycerol solution, the material gels into soft, elastic bioplastics.

The press release from which Text Sample #1 comes has an overall TTR of 38, meaning that 38% of its words were unique (i.e., not repeated), and an average word length of 5.6 letters. The above excerpt, taken from the longer text, has a TTR of 77 and an average word length of 5.9 letters. As the excerpt suggests, SPRs with higher TTR and long words often perform the function of explanation. That is, the writer explains a scientific concept, the procedures of a research study, or some other detail, resulting in a more diverse (and sometimes technical) vocabulary with more letters. This purpose contrasts with the reporting of others' words and ideas, which is the main function of the second thematic group of key features.

At the same time, readers are unlikely to be significantly affected by the longer words and greater lexical diversity of the SPRs. The mean TTR of the SPR corpus is 32.2 (SD = 2.16) and the mean TTR for the MICUSP subcorpus is 31 (SD = 2.42). Because the SD values are small relative to the mean values, which are not identical in size, the resulting Cohen's *d* is large enough to be a key feature. A similar point can be made for word length, which represents a medium effect size despite showing practically small differences (M = 5.41 letters per word compared to M = 5.19). Thus, while these differences may have a cumulative effect when viewing texts from the perspective of a corpus, they are nonetheless practically small, representing mere percentage point differences between the two text types.

Informational Reports of Past Events

The four key features listed with "informational reports of past events" in Table 8.3 relate more clearly to the functions of science press releases. The title given to this thematic group is borrowed from Biber, Mark Davies, James Jones and Nicole Tracy-Ventura's (2006) study of written and spoken Spanish-language texts. The authors identified a cluster of linguistic features, including proper nouns, past tense verbs, long words, and attributive adjectives, in a corpus of literate text types like business letters and newspaper reportage. The authors showed that these features were often used to report past events, which can also be seen in this study. Proper nouns and past tense verbs were key features of the SPRs, while adjectives of time and longer words were also present but listed under other thematic headings. To the features functioning to report past events, we also add common nouns and verbs of communication.

Informational reports of past events in press releases are characterized by direct and indirect reports of others' words and ideas, utilizing especially past tense verbs documenting study procedures and verbs of communication. Sentences with these features often have human subjects and descriptions of their academic and professional affiliations, resulting in more proper nouns. The following excerpt from a science press release illustrates these features. Verbs of communication are bolded, past tense verbs are italicized, and proper nouns are underlined.

> **Text Sample #2:** Science Press Release
>
> In obese mice whose tumor stress granules *were* blocked, 40% *were* cancer free after 300 days, with no sign of the cancer anywhere in the animals' bodies. "This magnitude of response is extraordinarily rare," **says** <u>Dr. Grabocka</u>. These experiments *showed* that stress granules *were*n't just present in cancer cells, they *were* actually driving the growth of cancer at the very start. "This is the first direct evidence linking stress granules to cancer progression," **says** <u>Dr. Grabocka</u>. Importantly, <u>Dr. Grabocka's</u> lab also *identified* drug targets that could stop the formation of stress granules in obesity-related pancreatic cancer. The next steps are to test existing small-molecule inhibitors to see if they can be translated for use in humans. "Conditions of cellular stress, like obesity, increase the number of stress granules present in cells, and may drive the formation of pancreatic and other cancers," **says** <u>Dr. Grabocka</u>.

Text Sample #2 represents a typical example of report writing in an SPR. The writer weaves direct quotations from the study's author, often using the verb *say*, with details of the study's procedures and findings, often in the past tense. While not shown in this short excerpt, human actors are first introduced along with their affiliations, after which their names are repeated along with other proper nouns referring to academic journals (e.g., *Nature, Cell*), locations (e.g., *US, China*), and certain technical vocabulary (e.g., *Alzheimer's, Parkinson's*).

Among this discourse is a variety of common nouns. Some of the most frequent are nouns referring to general research processes, including inanimate (e.g., *research, science, data, result, finding*) and animate (e.g., *author, team, professor, group, scientist*) words. Some common nouns are slightly more technical, referring especially to the health and biological sciences (e.g., *cell, cancer, disease, medicine, brain*). The presence of these common nouns suggest two characteristics of SPRs. First, the greater presence of nouns is often attributed to informationally dense, highly literate registers (Biber & Gray, 2016). At the same time, the key nominal features in the SPR corpus are decidedly nontechnical, referring to named entities and common nouns. As a result, SPRs represent an informationally dense register that is also accessible to many, as it narrates the scientific process by focusing on people, their past actions, and broad details of the research.

Timeliness

The final key feature discussed here is adjectives of time, which are adjectives that refer to chronology, age, and frequency (e.g., *new, young, rare*). It might seem that many of these adjectives would also be useful for reporting past events, as they add contextual detail to the statements of press releases. For example, adjectives like *older, old, past, prior*, and *late* were used by SPR writers to mark events or situations as occurring in the past. However, the primary reason for grouping adjectives of time under the theme of "timeliness" is because the most frequent adjective in the SPR corpus was *new*, which was more than twice as frequent as the second most frequent adjective, *national*. Indeed, over 70% of the SPRs (N = 2,098) included at least one instance of the adjective *new*, often near the beginning of the article. The high frequency of *new*, along with certain other adjectives (e.g., *current, recent, present, increasing, latest*), suggests that an important function of science press releases is to make new research appear timely and relevant. The following excerpt illustrates this use of *new* (bolded), while other words contributing to the sense of timeliness are also underlined.

> **Text Sample #3:** Science Press Release
>
> As people transitioned to working from home at the onset of the coronavirus pandemic, journal submissions from academics <u>increased</u> across the board. But a **new** study from Northwestern University found as men's scholarly productivity <u>increased</u>, women physicians were submitting less. The research reflects <u>wider trends</u> in academic publishing and is the <u>first</u> study to find such patterns in family medicine. The study contributes to a <u>growing</u> body of evidence that the pandemic caused unique career disruptions for women as they became stretched thin during remote work, causing stress, burnout and anxiety.

This excerpt represents the first four sentences of its respective press release. The first sentence contextualizes the not-yet-introduced study by mentioning the effects of the COVID-19 pandemic on working trends and then transitioning into a sentence introducing the "new study," which fits within "wider trends" in academia. The study is then referred to as the "first" one to accomplish what it did. In short, certain adjectives of time often coincide with other features, which together form a discourse of timeliness that helps to sell a study, its authors, and its findings to readers.

Positive Key Features of Student Science Writing

The previous section focused on the nine key features descriptive of the SPR corpus. In this section, we turn to the 13 key features descriptive of the MICUSP student papers. Table 8.4 organizes these 13 features into four thematic groups with labels representing the rhetorical functions of each one.

Table 8.4. Key Features of the MICUSP Sub-Corpus Relative to the SPR Corpus, Grouped Thematically*

Theme	**Features**
Expression of stance	Prediction modals, necessity modals, all modals *Multi-functional:* BE verbs, predicative adjectives, present tense verbs
Scientific style	Short passives, all passives, definite articles
Coherence and development of arguments	Adverbial conjuncts, conditional subordinating conjunctions, other subordinating conjunctions
Writing prompt	Place nouns

** The key features of the MICUSP sub corpus when compared against the SPR corpus. The features (shown in the right column) were grouped thematically and given a label (shown the left column).*

Table 8.4 presents four thematic groups: expression of stance, scientific style, coherence and development of arguments, and writing prompt. We describe each theme and provide illustrative text samples.

Expression of Stance

Expression of stance includes the largest number of features. Stance refers to the ways that speakers and writers express their feelings, attitudes, judgments, and assessments in discourse (Biber et al., 1999, p. 966), often through adverbials (e.g., *unfortunately*), modal verbs (e.g., *may*), and complement clauses (e.g., *the fact that…*). While more frequent in spoken language, stance remains an important interpersonal function for academic writers as well (Hyland, 2005).

As Figure 8.1 illustrates, modal verbs were among the most significant of the key features in the MICUSP student papers. Specifically, the necessity modals *should, must,* and *have to*, as well as the prediction modals *will, would, be going to,* and *used to*, were frequent, occurring (in aggregate) 8.3 times per one thousand words (ptw) in the student writing but just 3.09 times ptw in the science press releases. In the student papers, the functions of these modal verbs were closely tied to the specifics of their writing assignments. To illustrate this, consider the following two excerpts from different student papers. Prediction modals are bolded and necessity modals underlined.

> **Text Sample #4:** MICUSP Student Writing
>
> Wolverine Consultants had put together a construction management plan that **will** guide the team throughout the design and construction of the Wight-Green Building. We **will** be responsible for scope and change order management, keeping track of all change orders and forwarding all information on to subcontractors. An analysis of the bid market **will** be conducted and a packaging strategy **will** be put together. We **will** monitor milestones in the schedule to properly manage the design, bidding and construction schedules.

> **Text Sample #5:** MICUSP Student Writing
>
> Plug-in hybrid electric vehicles (PHEVs) should also be seen as a potential first step towards a long-term pathway to transition to vehicles powered by hydrogen fuel cells. The key drivers for PHEV policies should be: Promoting the adoption of PHEVs is an important component of reacting to all of these drivers but additional policy measures are necessary in order to maximize the economic security and benefit to the US. If U.S. taxpayers are willing to adopt policies that promote PHEVs, there should be some consideration of this adoption as something that will benefit the U.S. economy in the long term.

In Text Sample #4, the purpose of the report is to describe a future project. This demands a greater use of *will* to indicate future time and make predictions. In Text Sample #5, the purpose of the student paper is to present electric vehicles as a potential solution to an energy problem. As a result, the student writer frequently adopts the modal verb *should* to make recommendations for how their implementation could be made. Thus, the characteristics of these writing tasks in part motivate the use of certain modal verbs, reflecting the importance of situational characteristics of language production (Biber & Conrad, 2019).

Another set of key features which played a role in expressing stance in student writing included certain predicative adjectives and the verbs that connect those adjectives to their subjects. Like modal verbs, adjectives can express stance meanings like likelihood, attitude, and evaluation (Biber, 2006). In the student papers, such adjectives were frequently found in the predicative position along with the present tense form of BE. To illustrate this, Table 8.5 lists the top ten predicative adjectives in the MICUSP subcorpus. Adjectives expressing stance meanings are bolded.

Table 8.5. Top Ten Most Frequent Predicative Adjectives in the MICUSP Subcorpus*

Predicative Adjective	Normalized Frequency per 1,000 Words
important	0.35
likely	0.20
difficult	0.18
necessary	0.15
possible	0.13
present	0.10
available	0.10
able	0.09
responsible	0.07
similar	0.07

* *The ten most frequent predicative adjectives in the MICUSP subcorpus in order of frequency (normalized per 1,000 words). Adjectives expressing stance appear in bold.*

Six of these predicative adjectives express stance meanings related to likelihood (*likely, possible*), evaluation (*important, difficult*), necessity (*necessary*), or ability (*able*). In student papers, these adjectives were linked to their subjects by way of a copular verb, usually the BE verb, meaning that the three key features of BE verbs, predicative adjectives, and present tense verbs co-occurred to express stance. To illustrate these features in discourse, consider the following excerpt from a student paper. Predicative adjectives expressing stance are bolded, while other stance expressions are underlined.

> **Text Sample #6:** MICUSP Student Writing
>
> Even if the US were to foot the bill for the entire malarial control program in Sub-Saharan Africa ($824 million annually), malaria control <u>would</u> cost 1/6 of the amount the United States spends annually on funding for cancer-research [9]. While cancer research is **important** and <u>will</u> save many lives in the future, malaria control <u>can</u> save millions of lives right now. It <u>can</u> also help bring impoverished countries out of debt and help them become participants in a strong global economy, and provide trade and investment opportunities for American businesses.

Text Sample #6 illustrates how the present tense form of BE can co-occur with predicative adjectives to express stance. The student writer uses the evaluative adjective *important* to characterize the noun phrase *cancer research* by linking the two with the present tense copular verb *is*. Around this expression can also be found other stance expressions, such as the modal verbs *will* and *can*. Expressions like these were key features of the student writing relative to the science press releases, suggesting that writers of press releases either withhold their stance to a greater extent or express stance in other ways.

Scientific style

Scientific style was characterized by short passives, all passives, and the definite article. The frequent use of passive voice in academic writing has been well researched, in part due to the social functions that the passive fulfills. Specifically, the passive voice is said to diminish the role of the individual researcher on the results in order to portray experiments as replicable by others in their academic community (Ding, 2002). Given the tendency of SPR writers to use narrative style in reporting academic research, it is unsurprising that passive voice verbs were key features of the students' academic writing. Table 8.6 presents the normalized rates of long passives, short passives, and postnominal passives, where long passives include a *by* prepositional phrase indicating the agent of the verb, short passives exclude this phrase, and postnominal passives are nonfinite passives postmodifying nouns.

Table 8.6. Normalized Rates of Three Kinds of Passive-Voice Verbs in the MICUSP and SPR Corpora*

Type of Passive Voice	MICUSP Subcorpus (ptw)	SPR Corpus (ptw)
Long passive	1.99	1.95
Short passive	14.1	8.91
Postnominal passive	3.43	3.87
Total	19.5	14.7

**A comparison of the rates of three different kinds of passive-voice verbs in both the MICUSP subcorpus and the SPR corpus. The frequences for each type of passive are normalized per 1,000 words.*

Table 8.6 demonstrates that the greater use of passives overall in the student writing is largely due to short passives, as rates of long and postnominal passives were similar between the corpora. Not only did the student writers use more passives, they also used passive verbs that were qualitatively different from those used by SPR writers. For example, while the student writers relied most on BE *used*, the SPR writers relied most on BE *published*. Examples are shown below (1–2):

1. Purple loosestrife plants **are used** to treat health problems such as diarrhea, dysentery, ulcers and sores. [Student paper #106]
2. The study, "Field and full-scale laboratory testing of prototype wildland fire shelters," **was published** online in the International Journal of Wildland Fire. [SPR 1534]

Clearly, the passive form of *publish*, such as in (2), performs a function specific to registers needing to specify the periodical in which an academic study was published. The passive use of *use*, on the other hand, such as in (1), is particularly common in empirical research writing (Millar, Budgell, & Fuller, 2013). In short, SPRs not only use fewer passives overall but also use them for different purposes.

As a final note on the theme of scientific style, we also categorized definite articles (*the*) here. Definite articles are used with either countable or uncountable nouns and signal that the referent of the noun is known to the reader. Due to its nominal style, definite articles are used most often in academic writing (Biber et al., 1999, p. 267), resulting in an informationally dense style of discourse that can convey an academic *feel* to the discourse. The following excerpt from a student paper illustrates this style. Noun phrases determined by *the* are underlined, their head nouns are italicized, and their definite articles are bolded.

> **Text Sample #7:** MICUSP Student Writing
>
> Epilepsy, one of **the** most common neurological *disorders*, is characterized by **the** sudden *onset* of recurrent *seizures* due to **the** synchronous *ring* of *populations* of *neurons*. Due to **the** debilitating *nature* of *seizures* and **the** *fact* that approximately 1% of **the** *population* suffers from *epilepsy*, much *research* has investigated **the** *dynamics* of **the** *onset* of *seizures* with **the** *hopes* of developing *methods* of *seizure prediction* [1]. This *research* relies primarily on **the** *analysis* of *electroencephalogram (EEG) recordings* which record **the** neural *activity* of epileptic *patients*.

This extract from a student paper includes many nouns determined by *the*. While *the* is frequent in part because there are many nouns overall, another motivating factor is the many phrases and clauses postmodifying these head nouns. That is, the nouns can be determined by *the* because their referent is in the material postmodifying them. For example, the head noun of the second bolded instance of *the* above is *onset*. While *onset* has not yet been introduced in the paper and thus should not be determined by *the*, the postmodifying information makes it clear what *onset* the writer is referring to, namely *the onset of recurrent seizures due to the synchronous ring of populations of neurons*. As this example suggests, writing that uses a lot of definite nouns postmodified by phrases and clauses conveys a technical style of discourse, and this style was more often found in the MICUSP student papers than the SPRs.

Coherence and Development of Arguments

The third major thematic group of key features in student-produced science writing is the coherence and development of arguments, which includes linking adverbials and several dependent clauses. Linking adverbials (labeled *conj_advl* in Figure 8.1) refer to phrases that signal the logical relationship between clauses or phrases. While there are several semantic groups of linking adverbials (see Biber et al., 1999, pp. 875–879), the most frequent linking adverbials in both corpora function to compare and contrast ideas (*however, instead*), present logical results or inferences (*thus, therefore*), and enumerate on ideas (*first, also*), the latter of which was particularly frequent in the student papers. To see these phrases in action, consider the following excerpt (linking adverbials bolded).

> **Text Sample #8:** MICUSP Student Writing
>
> **Furthermore,** the observed mechanisms used by the host species to counteract the parasitism, may force genetic changes that will later make possible a genetically based form of isolation. **However,** they caution that the balance between low error rates and finding a conspecific mate create many difficulties; when colonization does occur the cost of finding a mate that knows the same song as you may be too high to make the colonization viable. **Therefore,** they assume that many colonization events probably occurred in the indigobird species before being successful. Conclusively showing that the observed diversification in indigos is due only to a learned song was beyond the scope of their paper; **however,** this theoretical work only supports the genetic evidence.

Three of the four sentences in Text Sample #8 begin with a linking adverbial, including those enumerating on ideas (*furthermore*), offering logical conclusions (*therefore*), and contrasting ideas (*however*). Such sentence-initial adverbials allow the student writer to develop clear arguments by explicitly marking the relationship between ideas. The relative lack of such connectors in the SPRs suggests that those texts either do not explicitly label the relationships between ideas as often or do not elaborate arguments as frequently.

Like these linking phrases, two kinds of clauses used to organize ideas were also found as key features in the student writing, namely adverbial clauses expressing conditions and their outcomes and those expressing a variety of other relationships, such as time, place, and manner (e.g., *after, while, until, since*). Interestingly, such clausal adverbials have been shown to be characteristic of more formal contexts of spoken English, such as teacher talk in university classrooms (Biber, 2006), and both linking and clausal adverbials are characteristic of lower levels of university-level student writing (Staples et al., 2016). Thus, in contrast to the discussion of passive verbs and definite articles earlier, the key features related to developing arguments found in the MICUSP subcorpus are comparatively representative of student writing.

Writing Prompt

Finally, nouns referring to locations (*nn_place* in Figure 8.1) were key features of student writing. Review of these nouns suggested that they largely relate to the specific topics of student papers, especially those relating to environmental issues. Nouns such as *forest*, *environment*, *field*, *area*, and *space* were common due to the topics that students chose to write about. Thus, a student corpus with a wider variety of writing prompts may not replicate place nouns as a key feature of that register.

Conclusion

In this study, we set out to identify the key features of scientific press releases relative to student-written scientific reports. Our reason for doing so was to better understand how these two registers differed linguistically. The key feature analysis presented in this study resulted in 22 lexicogrammatical features, ranging from verbal features to nominal features to clausal features. Nine of these features were descriptive of the science press releases, meaning that they were key features due to their being consistently more frequent in SPRs. These nine features of the SPR corpus were arranged into three thematic groups pertaining to information density (longer words, greater lexical diversity), informational reports of past events (past tense verbs, public verbs, communication verbs, proper nouns, common nouns, all nouns), and timeliness (adjectives of time). These features reflect the fact that press releases, despite being written for broader nontechnical audiences, are still informationally dense, highly literate texts, as evidenced by their longer, more diverse words and density of various kinds of nouns. They also reflect one of the main functions of press releases: to report scientific research as news. Writers frequently introduce new actors and their professional affiliations into the report, resulting in many proper nouns. Past tense public verbs are also frequently adopted to report their words.

The remaining thirteen key features were descriptive of student-produced science writing. These features were organized into four thematic groups: expression of stance (modals, BE verbs, predicative adjectives, and present tense verbs), scientific style (passives, definite articles), coherence and development of arguments (adverbial conjuncts, subordinating conjunctions), and writing prompt (place nouns). These features suggest that student-written science reports share features characteristic of scholarly academic writing, namely the use of passive voice, modal verbs to express stance (e.g., attitudes of certainty or uncertainty), and features like adverbial conjuncts and subordinating conjunctions to develop coherence throughout a text. These texts were also constrained by the writing prompt, which is characteristic of student-produced writing.

The results of our study can be used to inform pedagogical guidelines for people who want to communicate science to a popular audience by writing science press releases. This group may include students (both from science and technical communication backgrounds), professional scientists, and practicing technical communicators who frequently work with scientists to communicate expert information to a wider audience. To this end, we conclude this chapter with takeaways for teachers and practitioners wanting to emulate the language of popularized science press releases. Many of these recommendations follow established guidelines for writing to general audiences. The recommendations we make here are based on the findings presented above.

- **Tell stories using active voice.** Our study found that press releases often included active voice verbs with human subjects as their agents. These linguistic choices are not only stylistic but functional as well. The active voice allows science writers to tell stories with human actors who perform actions, think thoughts, and express language. In contrast, the student reports included more passive voice verbs, especially those ellipsing the agent. Thus, writers who want to conform to expectations of press releases should consider using the active voice when possible and understand how it connects to the purposes or demands of the situation. Joseph Williams (2009, Ch. 2) includes helpful questions that students can use to help determine when and how to use the passive voice clearly.
- **Include others' words by using quotations and communication verbs.** Like journalistic writing, press releases often include direct quotations from experts and other third parties. Incorporating their perspectives into press releases is essential. Linguistic devices for doing this include communication verbs like *say*, *remark*, and *report*, as well as the reporting clause syntax (i.e., "…", *said the researcher.*). These features can help students and practitioners new to press releases integrate others' words and ideas into their texts.
- **Consider avoiding technical jargon.** The science press releases examined in this study relied heavily on nouns, a characteristic feature of literate, informationally dense discourse (Biber & Gray, 2016). This finding was also supported by the higher type-token ratio and word length in the press releases. At the same time, the frequent nouns used in the press releases were decidedly nontechnical, suggesting that students and practitioners should be careful when including technical jargon in their press release writing. Technical terms can be expanded into longer phrases or clauses that explain the meaning intended by the original language.
- **Highlight the importance of research with adjectives of time.** In an environment inundated with more and more research (Hyland & Jiang, 2019), popularizers need to persuade readers that their press releases report on meaningful studies worth reading about. This study suggests that one way science press releases accomplish this is by using adjectives of time like *new, increasing,* and *latest* to communicate these findings, which were ubiquitous in our corpus. These offer a simple and compact means to motivate the necessity of one's reporting.
- **Minimize expressions of authorial stance.** While virtually all registers express stance in some way, we found that science press releases use

significantly fewer of two kinds of stance expressions relative to the student papers: modal verbs and predicative adjectives. This can be interpreted as press release writers abiding by the journalistic norms of objectivity and balance (Dunwoody, 2014), which in turn reduces the role of the writer in interpreting and evaluating information. Therefore, we recommend that those learning to write press releases carefully consider the ways they insert their opinions and judgments when communicating research to broader audiences.

- **Report facts rather than make arguments.** The notion that science press releases may make lesser use of stance expressions due to their function to report facts and circumstances rather than make arguments was also born out in the comparatively fewer number of linking adverbials. That is, because the student reports served, in part, to make arguments and flesh out those arguments, they used more linking devices like *first, also*, and *however*. Moreover, compared to (student or expert) research writing, press releases are much briefer, so avoiding unnecessary wording is helpful for meeting length requirements.

The six guidelines presented above could be adopted into an assignment appropriate for a typical introductory technical communication class. An instructor could ask students to find a published scientific report on a topic they are interested in and then write a 500-word press release announcing the study. In addition to describing the rhetorical makeup of press releases, the instructor could also introduce the linguistic features associated with the recommendations in the list above in examples of science press releases and share them with students. Doing this could help students develop their abilities to recognize the linguistic features that distinguish press-release writing from the kinds of science writing many of them have been taught to produce in the past. The features from the list above could also be converted into a rubric used to assess the assignment so students are encouraged to practice using as many of the recommendations as they can in their press releases. An assignment like this one, specifically focused on science communication, could also help students more clearly see science communication as a topic relevant to technical communication (see Carradini, 2020).

Limitations and Future Research

While we believe the findings and resulting recommendations shared above are valuable, they are not without limitation. For example, unlike other studies that compared the content of research articles and their accompanying press releases (e.g., Sumner et al., 2016), we studied a broad sample of press releases and a broad—but unrelated—sample of student-produced science writing. In doing so, we are not able to make claims about how specific content is changed as it is reconstructed from one context to another. Similarly, since the corpus of student writing lacks granular detail (e.g., on specific writing assignments, classroom settings, etc.), we were limited in our understanding of the situational characteristics for this corpus. Moreover, differences in the formal characteristics of the corpora (i.e., number and length of texts) likely shape our results as well.

However, a comparison like the one presented here is still useful because it identifies specific linguistic features of press releases that differ from features common to the academic writing many students are taught to produce. Teachers can explicitly point to these differences in teaching students to write science popularizations and ask students to use them in their assignments.

Another limitation results from the study's purely textual focus. Because we examined only the texts of student reports and science press releases, we are unable to confidently determine authorial intent or the reasons authors may have chosen to use the linguistic features we observed. Future studies might interview writers of science press releases or students writing popular texts for the first time to better understand how they produce their texts.

In a similar vein, we are also careful to note that we did not assess effectiveness in this study. That is, we identified the linguistic features with frequencies that varied significantly between science press releases and student-produced scientific writing, but we make no claims as to whether using these features will improve the effectiveness of press releases or science popularizations in general. However, the findings presented here provide an initial step in understanding how the language of science writing and science popularizations differ. Future research can build on these findings by conducting experiments (see Graham, 2017) to determine the extent to which the use of these features are effective in communicating to a popular audience.

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9. The Argumentative Structure of Paragraphs and the Importance of Models in Undergraduate Recommendation Reports

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Abstract: Paragraphing has long been a concern in technical communication, but few empirical studies exist that study how paragraphs function in technical report genres and reflect student notions of persuasion. We provide an analysis of paragraph structure in student-authored recommendation reports, alongside pedagogical and practical implications, using a corpus of 1937 paragraphs from 74 student-authored recommendation reports coded at the sentence level by position (heading, sentence, list item, table, and image) and structure (the rhetorical function of the sentence within the paragraph). We combined sentence-level structural codes into a distinct structural string for each paragraph, leading to eight distinct coherence patterns. Students tended to use the three simplest patterns, but also relied heavily on headings for argumentative structure, and closely followed the paragraphing structure of report models that they were given by their instructors. We suggest that technical communication instructors should consider presenting students multiple models of paragraph structure and the report genre to foster variation, complexity, and adaptability in structural elements, given that the needs of future practical rhetorical situations for students are difficult to predict. Practitioners can also use these patterns and categories to analyze their own writings and that of others, allowing greater conscious control over structural elements.

Keywords: Technical Reports; Paragraph; Structure; Argumentation; Pedagogy

While the nature and function of paragraphs tend to recur as a concern in the related fields of technical communication and composition studies, this concern remains underexplored by empirical research. To further technical communication's understanding of paragraph structure and related pedagogy, this chapter explores paragraph structure in an area of pressing need: namely, the introductory level technical communication course taught at many American universities. While we consider the field of technical communication to collectively have a strong understanding of page design and genre expectations, we feel there is more to be learned about internal paragraphing structure and sentence-to-sentence argumentation.

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We examined a corpus of 3,184 structural elements identified as (paragraphs, headings, lists, and images) from 74 student-written recommendation reports in an introductory technical communication service course, taught by four different instructors in the spring 2019 semester. We coded each element both positionally and with attention to our perception of its rhetorical function within each paragraph and then analyzed the resulting structural patterns that emerged.

Our key findings are fourfold. First, students mimicked their teacher's provided models closely, with students in the same classes tending to follow the same paragraph structure and overall report structure, suggesting that models provided (or not provided) by the respective instructors strongly influenced how they structured paragraphs.

Second, most paragraph structure was relatively simple. The most used patterns in the corpus, comprising over two-thirds of the total paragraphs, were of three types. The first used topic sentences as the first sentence and then created a chain of cohesion with each new supporting sentence linked to the last—a "sequential" pattern. The second had all following sentences support that initial topic directly—a "nonsequential" pattern. The third pattern was single-sentence paragraphs, usually related to a heading. The popularity of these three paragraph types is not reducible to just their simplicity, however, as their use appears closely related both to the concentration of analysis in certain sections of the reports and even more so to the specific models provided by instructors.

Third, headings and lists did much argumentative work by replacing longer paragraphs. 60.83% of the 3184 structural elements we coded were prose paragraphs; the rest of the structural work in these reports was done by headings, subheadings, and lists. Reports without extensive headings, nested or otherwise, tended to have longer paragraphs.

Finally, exceptions to the first three observations tended to be more readable and persuasive. While most reports relied on headings, subheadings, and lists, the stronger reports, in our collective subjective opinion as instructors, used longer, more complex paragraph structures, especially in the concluding analytical sections.

Given these observations, we recommend that technical communication instructors offer multiple models of paragraph and report structure when teaching recommendation reports and similar complex genres. Our findings suggest that students will follow whatever model of paragraph usage is presented and produce predictable results. However, at least in our corpus, simpler models did not tend to lead to the structural and rhetorical flexibility that we would prefer a strongly argued and detailed report to contain, suggesting an almost inverse relationship between the model usage on one hand, and strong arguments and content on the other.

Literature Review

Compared to the long formal study of English sentence structure and style, examinations of paragraphing first appear comparatively late in prescriptive 18th and 19th century textbooks, most notably Alexander Bain's (1866), forming a complicated tradition that continues to exert influence well after composition studies and technical writing established themselves as academic disciplines (Connors, 1997; Duncan, 2007; Kitzhaber, 1990; Tebeaux, 2011). Mike Duncan (2007) classified the major historical theoretical and pedagogical approaches to understanding paragraphs in writing-centric fields, such as technical communication, into three camps:

- The *prescriptive* approach (Bain, 1866) uses Bain-derived terminology like "emphasis," "force," and "coherence" that stem from the 19th century faculty psychology tradition to teach paragraph writing deductively. This approach stresses necessary topic sentence usage to increase objective comprehension by inexpert audiences and has a "generative" branch (Christensen, 1965) that claims hewing closely to such principles helps composition and eventually leads to more complex structures.
- The *descriptive* approach (Rodgers, 1966) values a no-rules, rhetorically expedient "functional" view of structural elements that may or may not reflect the chaos of actual usage, but has the advantage of a far wider range of techniques and an emphasis on stylistic mastery.
- The *cognitive* approach, found in cognitive psychology and computational linguistics and to a lesser extent in composition studies by way of visual rhetoric concepts, focuses on readability and cohesion at the expense of the pedagogical worries and rhetorical concerns of the *prescriptive* and *descriptive* approaches.

Ian McGee (2018) merged these three positions into a more comprehensive view that reflects the paragraph's myriad roles as "a discourse marker, a highlighting technique, a structural device, a unit of cohesion, an aid to readability, a crutch for developing writers, a pedagogical problem, or all these and more" (Duncan, 2020, p. 155). While it remains tempting to treat paragraphs as only conceptual patterns of arrangement in the long textbook tradition of the discourse modes (Connors, 1997; D'Angelo, 1974), paragraphs via McGee are too complex a phenomenon that we can reduce to just one of their many aspects; integration of their myriad aspects is desirable. Accordingly, McGee (2018, 2016), Eilzabeth Tebeaux (2011), and Duncan (2007, 2020) all call for more empirical work on paragraph usage.

The parallel cognitive approach to paragraphs is extensively represented elsewhere (Duncan, 2007, p. 484-486) but does not directly speak to the pedagogical and practitioner concerns of the writing-centric fields. And while several exploratory empirical studies exist in technical communication and composition studies, with the seminal work of Richard Braddock (1974) regarding topic sentence usage the most cited, treatments of paragraph usage remain rare since the 1990s (Baker, 1994; Bush, 1995; Colby, 1971; Markel et al., 1992; Popken, 1984, 1988, 1991; Thompson, 1986), with the report genre suffering likewise (Roundy, 1985; Rude, 1995). Few of these studies were empirical, with Braddock and Randall Popken the major exceptions, and even those focused chiefly on the presence or absence of topic sentences.

A common, if indirect, pedagogical strategy for teaching paragraph use in technical report writing is through providing and examining models of complete reports for students. This approach is a contemporary version of the classical rhetorical practice of imitation (*mimesis* or *imitatio),* which Dale Sullivan (1989) characterized as "an essential pedagogical method even as late as the early nineteenth century" (p. 5). While *mimesis* and *imitatio* have multiple meanings in the classical tradition, imitation in writing pedagogy is commonly understood to mean the practice of emulating models (Corbett, 1971). The goal of imitation is not to engage students in simply copying exemplary texts, but rather to guide them in developing an effective style (D'Angelo, 1973). More recent approaches to imitation have taken it in broader directions, including discussing its (in)compatibility with the process movement in writing pedagogy (Farmer & Arrington, 1993) to arguing for its centrality in forming civically engaged students and citizens in a democratic society (Terrill, 2011).

Within technical and professional communication, several scholars have explored connections between classical rhetoric and technical communication pedagogy (e.g., Brizzee, 2015; Bourelle et al., 2015; Dubinsky, 2002; Reynolds, 1992). However, few studies focus on imitation in particular. A notable exception is Alan Jones and Terrance Freeman's 2003 study on the use of models in introductory physics reports. The authors argued that imitating models helps students develop their report writing skills through a process of "scaffolding their own writing on the linguistic structures contained in the models" (p. 182). However, instructors must take care to provide students with appropriate models and teach students how to use those models effectively (Jones & Freeman, 2003).

Aside from imitation through models, contemporary discussion of paragraph usage remains at the textbook and style level in technical communication, with the traditional discourse modes (Connors, 1997) still often used to explain paragraph structure in a myriad of writing textbooks, though the advice has slowly trended toward being more *descriptive* since the 1960s. Space remains for substantial data-driven empirical investigation that could direct pedagogy, rather than the lore of the textbook tradition and personal experience.

Method

Our study explores the function and structure of paragraphs located within recommendation reports assigned in an introductory level technical communication course. Given our interest in capturing the organic nature of each sentence and how those sentences functioned in a broad sense within and across paragraphs, we built a large corpus of student paragraphs from these reports and coded the sentences in the corpus with an iterative, grounded theory approach.

Participants

After obtaining Institutional Review Board approval (#13-19) in Fall of 2018, we began soliciting participants. Opting into the study was twofold, requiring first instructors and then individual students to consent to the study in writing. The course in question for all papers was a sixteen-week undergraduate upper-division class in report writing. This course serves as a requirement for many different majors at the University of Houston-Downtown, an American university that is federally designated as both a Minority-Serving Institution (MSI) and a Hispanic-Serving Institution (HSI). The course, TCOM 3302: Business and Technical Report Writing, is limited to 23 students per section, from a broad and diverse spectrum of junior and senior-level students across the university, and these sections are taught by a mixture of tenure-track professors, full-time lecturers, and adjunct professors. A recommendation report of some kind is a major required assignment that is also used for institutional assessment. All sections were taught face-to-face in the spring semester of 2019. The advent of the COVID-19 pandemic delayed our resulting analysis.

Data Set

We initially collected 88 reports across multiple sections taught by six full-time faculty members. Some reports were discarded due to being incomplete or not conforming to the genre features of a recommendation report; we wanted to reduce the variable of genre to offer more authoritative and focused results. We did not collect any data about the instructor's grading of the reports, only the text of the final assignments. The final data set was n=74 for students and recommendation reports with 3,184 structural elements, including but not limited to paragraphs, headings, and images.

Coding Scheme

Our first attempt at creating a coding scheme for the reports resulted in positional and structural data for all the sentences in the reports. Positional data included six objective codes for each textual unit: the text of each sentence, the type (prose, heading, list, etc.), a number for each individual student paper, and the specific paragraph, page number, and report section. Collecting this positional data allowed for easier analysis and data manipulation later in the process and allowed us to concentrate on our efforts on structural coding.

In contrast to positional data, our structural codes were subjective and comprised of eight codes: directs, supports, restates, complicates, refutes, pivots, transitions, and wanders. Together, we derived these codes inductively from the data by reading the reports and conducting open coding to discern the function of each sentence within the context of the paragraph in which it was situated. Sentences could be double coded.

Given the subjective nature of the structural codes and the large number of sentences to be coded, we conducted intercoder reliability (O'Connor & Joffe, 2020) with five norming sessions in which we coded the same 11 reports. Each norming session yielded robust discussions of different patterns being discerned in the corpus and reinforced the agreed upon coding scheme. We determined reliability by dividing the number of agreements by the total number of agreements plus disagreements (Miles & Huberman, 1994). Using this calculation, we reached a 93% rate of reliability for the last four reports that we coded in our last two norming sessions. With evidence that our coding scheme was reliable, we then subdivided the remaining 63 reports among three of us, which resulted in each coder individually coding 21 reports separately. While we each had our own reports to code, we still met on a regular basis to discuss our preliminary results, general observations from our coding, and eliminate typos in the growing database.

Our eight structural codes reflect a rhetorical understanding of argumentative structure and the larger work of the fields of informal logic and rhetoric (Perelman & Olbrechts-Tyteca, 1969; Toulmin, 2003; Walton, 2008). Namely, we approached the paragraphs in these reports with the assumption that the *claim* is the fundamental building block of argumentation, defined loosely as any statement or utterance that holds a position with seriousness. Therefore, given the professional nature of the report genre, we considered any sentence, heading, or image (all argumentative structures in the context of the report) to constitute a serious *claim* or *claims*, and when these structural elements are arranged on the page, they in turn form different patterns of *claims,* with each sentence performing a different function depending on its position in the paragraph and in relation to other paragraphs and argumentative structures. Given this, it is important to note that our total paragraph count includes headings, lists, and images in addition to traditional prose-based paragraphs. All these visual elements also do argumentative work in tandem, and accordingly, we felt they must be included and considered together when discussing how paragraphs function. If we treated only prose paragraphs in our coding, we would miss how they work together (or fail to do so) with other visual elements on the page to accomplish rhetorical goals.

Early studies of paragraph usage often focused on the T-unit (Christensen, 1965) as the principal linguistic atom of paragraph structure, but we judged a coding scheme built around principles of informal logic and Toulmin's *claim* to be more promising. For example, we considered the useful past distinction between "theme" and "rheme" (Thompson, 1986), sometimes called "topic" and "point," with the former noting the presence of a topic being discussed, and the latter representing the claim made about that topic, to be valuable when considering the role of sentences in a paragraph. However, such a distinction has a weakness in close analysis; namely, labeling a sentence as having only "theme" or "topic" content brushes past both the practical and epistemological implications that a "theme" or "topic" is also a *claim* that has its own rhetorical characteristics, as well as a particularly special argumentative role in the seemingly data-driven recommendation reports of this study. We avoided, therefore, labeling any of these sentences as having just "topical" or "informative" content, and assumed, rather, that they all have some rhetorical function and purpose (Joswiak & Duncan, 2020) and that each sentence, heading, or image holistically constitutes a *claim*, no matter how many or few T-units, clauses, or other internal units it might contain.

In other words, these eight structural codes attempt to map how argumentation "flows" in a linear fashion from a reader's viewpoint through each paragraph, from sentence to heading to other *claims*, and to a more limited extent, between paragraphs as well. While paragraphs are traditionally (and still are, typically) classified by type in the so-called modes of discourse, i.e. "narrative" or "expository" paragraphs, our coding scheme sets such categories aside in favor of a more *endoskeletal* view of argumentative structure. Our intention, therefore, was not to have these codes "explain" the paragraphs in the corpus, detail how they were composed via this or that process or use them as a window into what the students were thinking, but rather *to explore how their final form on the page attempts to do argumentative work.* Studying this "flow" is an easier and more demonstrable goal when the entire corpus is from a single genre (the recommendation report) and the positional data allowed us to filter for differences in different sections of the report with different rhetorical goals.

Table 9.1. Structural Codes

Code	**Label**	**Definition**
DIRECTS	Px	The sentence makes a claim that "directs" or orders at least some of the rest of the content of the paragraph.
SUPPORTS	Sx	The sentence makes a claim that supports another claim in another sentence and in a way that is dependent on the other sentence's claim; the claim supported may be before or after the SUPPORTS sentence (usually before).
RESTATES	Rx	The sentence restates or explains the claim of a previous sentence in new language without performing the role of PIVOTS or COMPLICATES.
COMPLICATES	Cx	The sentence attempts to question or make an <u>earlier</u> claim problematic in some fashion but does not REFUTE it.
REFUTES	Fx	The sentence rejects an <u>earlier</u> claim (usually a DIRECTS or SUPPORTS) even if just temporarily and does so unambiguously in a way different from COMPLICATES.
PIVOTS	Vx	The sentence moves the paragraph in a new, tangential direction with a claim that differs substantially from previous DIRECTS, but does not challenge it as with COMPLICATES or REFUTES.
TRANSITIONS	Tx	The sentence primarily serves to set up a new topic in a following paragraph.
WANDERS	Wx	The sentence does not have any obvious coherence to previous sentences.

For example, the paragraph in this piece just before this one could be coded as p19.p19.r2.s3. The digit after the initial DIRECTS code (p19) is positional (noting it is the 19th paragraph in the hypothetical report and taking place of the 'x' placeholder) but the remaining digits are relational, referring to other sentences. The second sentence is also coded "p19" as it completes the thought of the first sentence and does DIRECTS work; the third sentence is coded as "r2" as it restates and clarifies the initial DIRECTS sentences, with the second sentence (the "2") closest; the fourth sentence "s3" supports the third. This short text string, p19.p19.r2.s3, forms an analyzable shorthand that gives a quick structural snapshot; it's the 19th paragraph and has four sentences: the first two sentences direct in tandem, the third restates, and the fourth supports. Most of the paragraphs in the corpus were less complex than that paragraph, but the coding scheme we developed allowed for many different kinds of emergent patterns. This level of coding granularity, coupled with the entire corpus entered sentence-by-sentence into a database along the positional data, allowed us to make increasingly complex database queries and juxtapose our experience of reading the sentences with the implications of macrostructural data.

Results

Table 9.2 gives a broad overview of the initial positional coding by structural type. We added several subcategories for different types of headings and list elements. LI (List Item) was any bulleted or numbered text, with LH (List Heading) indicating a heading immediately followed by a list item code, and LHP (List Heading in Paragraphs) indicating a heading embedded in the end of a paragraph.

Table 9.2. Positional Code Totals

All S (Sentence) Codes	**6850**
H (Heading)	512
H2 (Second Level Heading)	449
H3 (Third Level Heading)	153
All Heading Codes	**1114**
LI (List Item)	878
LI2 (Second Level List Item)	92
LH (List Heading)	50
LH2 (Second Level List Heading)	10
LH3 (Third Level List Heading)	8
LHP (List Headings In Paragraphs)	100
All List Codes	**1138**
All Images	**133**
Total Positional Codes	**9235**

After we completed the positional coding, we structurally coded the individual sentences. The total number of structural codes (8048) is slightly higher than the total of sentence and list elements (7988) due to 60 sentences that received two or more structural codes.

Table 9.3. Structural Code Totals

Code Name and Label	**Number**
Directs (Px)	1988
Supports (Sx)	5418
Restates (Rx)	88
Complicates (Cx)	141
Refutes (Fx)	8
Pivots (Vx)	365
Transitions (Tx)	32
Wanders (Wx)	8
Total Structural Codes	**8048 (61 are double coded)**

Analysis

In beginning our analysis, we attempted to maintain the integrity of what each sentence did by placing it in relation to the other sentences in the paragraph. We then saw, in the resulting strings of structural codes for each paragraph, eight major types of what we call *coherence patterns*. These patterns we define as paragraphs that have similar semantic/argumentative strategies for linking together sentences in meaningful ways for readers. In this way, the eight patterns form "stems" that "grow" into the 291 unique structural code patterns that we found in the corpus.

Table 9.4. The Eight Coherence Patterns

Type 1: Sequential
Type 2: Nonsequential
Type 3: One Sentence
Type 4: Sequential Veering
Type 5: Nonsequential Veering
Type 6: Distributed
Type 7: Advanced
Type 8: Dependent

Our two goals when solidifying these eight categories were to first eliminate any "miscellaneous" category—the patterns, however they are named, should be able to offer some explanation for the structure of all sentences—and second, to keep the overall number of categories below ten to make our axial and selective coding processes more manageable and digestible.

In this section, we examine each of these eight perceived patterns in turn.

Type 1: Sequential—"Each sentence supports the previous in an unbroken chain."

31.75% of paragraphs, or 615 total, formed *sequential* coherence patterns where each new sentence built upon information introduced in the previous sentence, with a first "topic" sentence beginning the argumentative sequence. In the following example, each sentence is dependent on the previous sentence to maintain a cohesive flow:

> The third option consists of Old School revising the current budget to decide if switching to healthier alternatives to current snacks is viable. Firstly, Old School would need to calculate the total amount of money currently being used on all snacks for both locations. Next, the total cost of healthier snacks bought from a wholesale retailer would need to be calculated. Lastly, a comparison of these two totals would need to be evaluated to consider which option is the most feasible.

Type 1 sentences, when executed well, are difficult to get lost in while reading, due to the constant signposting. Their high semantic coherence meets Alexander Bain's standards for topic sentence usage and subordination.

Type 2: Nonsequential—"Scramble the sentences after the first and it still makes sense."

28.45% of paragraphs, or 551 total, began with a "topic" sentence like Type 1, but instead used all subsequent sentences to discuss the first sentence's idea, with no necessary sequential chain between the following sentences. Each subsequent sentence, therefore, is an independent follow-up to the topic sentence, and they function much like a bulleted list with a heading (and in practice, we coded such bulleted lists as Type 2 paragraphs).

The majority were only two sentences long, such as the following example, coded px.vi:

> Because intermittent fasting is not based on one specific diet per se, this plan was the most flexible with regard to selecting menu items. However, one foreseeable issue is ensuring that dining out would take place in the allotted 6-hour window of eating.

We classified these two-sentence paragraphs as Type 2 with other nonsequential support chains (which could go as long as ten sentences) as they seem to be the germinal stem from which the longer Type 2 examples grow.

As noted before, much of the remainder of Type 2 paragraphs took the form of lists, bulleted or numbered, as they are structurally almost identical to their prose siblings. In this example, the individual options are not in formal ranked order, so the paragraph can be coded px.s1.s1.s1 even with numbers instead of bullets:

> In Task 3 we narrowed down our options based on our necessary criteria as listed above. The following options were considered to best fit the necessary criteria:
>
> 1. Optos Daytona
>
> 2. ZEISS CLARUS 500
>
> 3. TOPCON NW8F Retinal Camera

Type 3: One Sentence—"Just one, and usually a transition."

18.38% of paragraphs, or 356, consisted of one sentence. They usually appeared right after headings or served a transitional role to the next section of a report, though they did not need the heading to be understood (an important distinction from the much rarer Type 8, discussed later). We did not observe Type 3 paragraphs used for more dramatic purposes, as we might expect in other writing genres like fiction, but rather they appeared more in papers dependent on nested headings to provide structure.

> In this section, I will present conclusions based on my research related to the five questions I sought to answer.
>
> On October 30, I decided to study which kind of laptop would be the best kind to use while enrolled in University.

Type 4: Sequential Veering—"It starts with a chain, but the chain breaks."

We mentioned before that there were 291 unique structural patterns in the corpus. The majority of these unique variants are in Types 4–7.

7.59% of all paragraphs, or 147, began a sequential "stem" in the first three sentences like Type 1, but then veered off into more complex variants. In the following example, coded px.s1.s2.v3.s4, a new idea appears in the fourth sentence that constitutes a PIVOTS from the initial sequential chain. This fourth-sentence PIVOTS allows the paragraph to close in a quite different, but tangential, place from where it begins.

> Jessica's Maid Service employs four individuals including me. Our cleaning service uses cleaning products daily including Bleach as a disinfectant. Our employees have explained how dry their hands get, and how allergic they get after using Bleach. I suggested we start using a new disinfectant that doesn't have harsh fumes and harmful chemicals. This is what started my search for healthy disinfectants.

Type 5: Nonsequential Veering—"It doesn't start with a chain, but it breaks anyway."

4.23% of paragraphs, or 82, began with a nonsequential structure like Type 2, but then, much like Type 4 diverges from Type 1, split into many variants, with the initial nonsequential "stem" preparing for a later PIVOTS or COMPLICATES. Most PIVOTS/COMPLICATES codes in the corpus are Type 5, with the rest in Type 7.

Finding such structures felt intuitive to us, in retrospect. Instructors "know" that students are more likely to attempt a shift of some kind by the third sentence of a paragraph, but it is more striking with data on hand. In the following example, coded px.s1.v1.s3, a nonsequential structure is interrupted by a new idea that also references and is dependent upon a "proposal mentioned in a previous paragraph, but not referenced in the first two sentences, giving this paragraph a drifting, decentered feel:

> Currently there are only about 100 textbooks currently in the University X reserve system, with some of them being copies. This is a large contrast to the number of courses offered by University X, which is over 1000 classes several different majors. To accomplish the proposal and (sp?) purchase of at least 1500 textbooks will be needed. A majority of them being for upper level courses, as most books currently on reserve are only for low level courses.

Type 6: Distributed—"It has a thesis, but not in any one sentence."

5.52% of paragraphs, or 107, distributed DIRECTS codes in different parts of the paragraph other than the first sentence, but at the same time did not contain PIVOTS, COMPLICATES, or REFUTES codes. Some used the first two sentences to orientate the paragraph, others formed "bookends" after an initial topic sentence with a closing sentence that completed the overall thought, and others deferred the point to the second or third sentence.

A "bookends" variant follows, where both the first and the last sentence have DIRECTS codes, as the paragraph concerns both the process of a decision and, ultimately, what the decision was. There is a rhetorical choice to hold the decision to the last sentence rather than reveal it in the first sentence or follow the first sentence with the decision in the second, among other options. These paragraphs, like Type 5, require more mental assembly and closer reading than Types 1–4, and the unresolved next two criteria grant momentum and anticipation.

> The process of this decision matrix on disinfectants that could replace the use of bleach depended on three criteria, accessibility, affordability and how healthy they are. Healthiness is the biggest concern to the employees in the cleaning service, so it got the highest weight. The rating depended on how safe the disinfectant was to people due to the number of harmful chemicals it has in its ingredients. Seventh Generation disinfectant spray got the highest rating in healthiness as it has minimal toxic chemicals in its ingredients.

Type 7: Advanced—"Follow the winding road closely."

2.48% of paragraphs, or 48, used either two or more PIVOTS, COMPLICATES, or REFUTES codes, or at least one of those three codes and multiple DIRECTS codes. We considered these the most "advanced" paragraphs in the corpus in that they demonstrate more willingness on the part of the author to challenge and test their own ideas, with the tradeoff being a risk of losing readability. Their low frequency in the corpus may suggest that most students either do not know how to use these structures, that they prefer the simpler (and typically shorter) types, or they are following models that do not contain them or split them into those simpler structures. The structural codes for this paragraph were px.s1.v2.c3.s1.s5.s6.v6.s8, using 1 COMPLICATES and 2 PIVOTS, which we've bolded:

> The mounting budgeting costs and debt associated to deferred maintenance is a growing trend that will affect many students and colleges in the coming decade. For the most part, campus buildings are required to have major renovations at 25 years, with further renovation, if not a complete replacement, before 50 years. **However, such renovations require budgeting concerning any maintenance updates issue, which increases debt for many college campuses, thus continuing the practice of deferred maintenance in certain prioritized areas of a campus. It estimated that as many as 300+ colleges face the issue of needed repairs to their aging buildings, which has since risen since the start of the 2008 recession.** Estimating any exact cost figures on deferred maintenance is hard to measure since inflations needs to be accounted for. Experts estimate that deferred maintenance afflicting college many campuses amounts to as much as $36-billion across the country, with at least $7-billion of that being considered "urgent" in priority repairs (Scott Carlson 2012). **To illustrate this problem in a real-setting context, Mr. Ender, the college president of Grand Rapids Community College, best describes the**

> **possible outcome and economic repercussion of neglecting repairs to buildings or, in the case of my report, designated student parking lots: "I am having a hard time limping along without fire-suppression systems in all of my buildings," he said. "I am having a hard time limping along in classrooms where you are so uncomfortable with the heat that it is hard to focus."** Because students look closely at buildings when they decide to enroll at a college, and because repair costs mount as time goes on, said the president, "limping along only puts us deeper in the hole." (Scott Carlson 2012).

The increased length of this example does not neatly correlate to the use of a more "complex" type: there are Type 1 and Type 2 paragraphs in the corpus with eight or more sentences, for example. However, for an illustrative metaphor, to build a winding road, the road needs to be long enough to accommodate the curves—in this case, the PIVOTS and COMPLICATES must respond to a previous sentence, which requires a minimum length for maneuvering.

The student in this case could have chosen to break their paragraph into several smaller chunks. However, we in all cases followed the actual paragraph breaks when coding; if the student decided, for whatever reason, to visually "end" a structure, we treated the new sentences as a new structure.

Type 8: Dependent—"Something is missing but it's still a paragraph."

1.60% of paragraphs, or 31, were extremely dependent on either a previous heading to be understood, or they exist only to smooth a transition to another paragraph—but they are not Type 3's single sentence. Of the 8 coherence patterns, they were the least "paragraph-y" to us despite their length, and play a heading-dependent function much like Type 3. In the following example, the "first option" is never clearly defined, as the heading (removed here to show the dependence) does that semantic work:

> The first option is based on one of the latest trends in the dieting world. There are many people who have shed major weight by using this regimen and have been able to maintain a healthy lifestyle by changing their food intake habits. This regimen consists of the drastic elimination of carbs and refined sugars and replacing them with foods high in fat and protein. Following the rigorous rules of the keto diet leads one's body into ketosis, further causing the body to burn fat instead of carbohydrates.

Headings and Images in Relation to Total Paragraphs

While we placed each of 1937 paragraphs as one of the eight types, there are 3184 "structures" in total if we also count headings and images. The following table, in addition to displaying the aggregate totals for Types 1–8, demonstrates some of the complicated relationship between these different structural types:

Table 9.5. Paragraph Types Across All Reports

Paragraph Types	**Number**	**% Paragraphs**	**% "Structures"**
Type 1: Sequential	615	31.75%	19.32%
Type 2: Nonsequential	551	28.45%	17.31%
Type 3: One Sentence	356	18.38%	11.18%
Type 4: Sequential Veering	147	7.59%	4.62%
Type 5: Nonsequential Veering	82	4.23%	2.58%
Type 6: Distributed	107	5.52%	3.36%
Type 7: Advanced	48	2.48%	1.51%
Type 8: Dependent	31	1.60%	0.97%
Total Paragraphs	**1937**	**100%**	**60.84%**
Headings, Levels 1–3	1114	N/A	34.99%
Images	133	N/A	4.18%
Paragraphs with Lists	190	9.81%	5.97%
Paragraphs w/o Lists	1748	90.24%	54.90%
Total Structures	**3184**	**N/A**	**100.00%**

Lists

Table 9.5 also considers the presence of lists, which we decided to treat as paragraphs, though with additional care. Lists took several distinct forms: bulleted, numbered, with or without a heading, and either separate from paragraphs or embedded within them. We judged them to perform the same structural argumentative work as paragraphs and sentences, but with a distinctively different visual approach. For tallying purposes, we noted their presence as a percentage, 9.81%, in the 1937 coded paragraphs; this includes separate and/or embedded examples. As demonstrated in the second example for Type 2, we strongly felt that they were still "paragraphs" for all practical purposes.

The following example shows how an embedded list functions. Preceding with a second-level heading (H2) the following paragraph begins in a straightforward Type 2 manner, but concludes with an embedded list that we treated as part of the larger paragraph. The codes were px.s1.s2.s3.s3.s3.s3.s3, with the third sentence having the positional code LHP and the last five LI. The LHP list structures were twice as frequent as the freestanding LH.

Task 5: Follow up on the project

This period of the project will study the progress of how the Smart Development Zoning Area A is performing. For the Smart Development zoning program to be considered a success the program must pass a certain criterion. The criteria are listed as followed:

1. In a year's time, does project accumulate the amount invested in the project?
2. What are the majority of residents and business owners in the Zoning Area A outlook on the developed community?
3. What was the amount of flood activity in Harris County during the project period of task 4?
4. What was the amount of flood activity in Precinct 4 during the project period of task 4?
5. What was the amount of flood activity in Zoning Area A during the project period of task 4?

Instructors and Paragraph Types

We were also interested in whether there would be a difference in the paragraph types used by students with different instructors. The following table breaks down the appearance of the eight types, as well headings and images, in papers by instructor.

The majority of paragraphs for all four instructors were of Types 1–3, and headings and images were between one-third and nearly one-half of the structure of the papers for Professors 1, 3, and 4. Professor 2's students, however, for whom we had the smallest amount of papers available, had a noticeably higher percentage of more complex types, with only 59.22% of paragraphs using Types 1–3, and using headings and images rarely, with 76.73% of structural elements being prose paragraphs.

Table 9.6. Instructor Comparison

Paragraph Type	Prof "1"	Prof "2"	Prof "3"	Prof "4"	Total
Type 1: Sequential	149 (29.27%)	62 (29.38%)	171 (35.77%)	233 (31.29%)	615
Type 2: Nonsequential	140 (27.50%)	48 (22.74%)	132 (27.76%)	231 (31.25%)	551
Type 3: One Sentence	93 (18.27%)	15 (7.11%)	80 (16.74%)	168 (22.73%)	356
Type 4: Sequential Veering	48 (9.43%)	24 (11.37%)	28 (5.86%)	47 (6.36%)	147

Paragraph Type	Prof "1"	Prof "2"	Prof "3"	Prof "4"	Total
Type 5: Nonsequential Veering	25 (4.91%)	10 (4.74%)	26 (5.44%)	21 (2.84%)	82
Type 6: Distributed	29 (5.69%)	27 (12.79%)	26 (5.44%)	25 (3.38%)	107
Type 7: Advanced	7 (1.38%)	22 (10.43%)	11 (2.30%)	8 (1.08%)	48
Type 8: Dependent	18 (3.53%)	3 (1.42%)	4 (0.84%)	6 (0.81%)	31
Total	**509**	**211**	**478**	**739**	**1937**
Headings	334	75	408	416	1114
Images	62	10	9	52	133
Total w/other	**782**	**275**	**890**	**1104**	**3184**
Ratio: Paragraphs to H&I	**65.09%**	**76.73%**	**53.71%**	**66.94%**	

Professor 3's students, for the opposite extreme, used Types 1–3 for 80.01% of paragraphs, and also only used paragraphs for 53.71% of the structure of their overall papers. We see an inverse relationship between Type 1–3 paragraph usage and heading/image usage across all four professors; the simpler the overall paragraphs, the more likely the student used headings in their papers, and vice versa.

Early in the structural coding process, we noticed that student papers from a given instructor seemed to follow similar structural patterns. For example, Professor 3's students almost uniformly followed a strict nesting structure in which they relied heavily on headings and subheadings to construct their arguments, with any paragraphs much shorter than the reports of students in other classes.

Level 1 Results

Level 2 Result 1

Level 3 Criterion 1

Level 3 Criterion 2

Level 3 Criterion 3

Level 2 Result 2

Level 3 Criterion 1

Level 3 Criterion 2

Level 3 Criterion 3

Figure 9.1. Structure and Headings and Subheadings in Student Papers from Professor 3

The structure of the headings and subheadings in Professor 3's student papers is not surprising. Chunking information is a long-referenced technique in technical communication (Henschel, 2010; Horn, 1993) and we teach it ourselves, as we find this structural pattern to be mostly successful in helping students organize their ideas. The headings and subheadings themselves work to create meaning; they often carry the main argument of heading/level with little explanatory text underneath.

However, the remarkable consistency in structure among student papers in Professor 3's corpus led us to consider the unusually high importance of models for students in the matter of paragraph structure. Professor 3's students followed their model so closely that we could recognize their papers without checking the positional code that listed the instructor. While other instructors' student papers did not hew to models as closely as Professor 3's students did, we were able to discern structural patterns across the corpus that correlated with instructor. Professor 2's students, for example, wrote comparatively free-form papers with longer, more complex sentences and paragraphs that correlate with the lack of an explicitly required structure in the assignment instructions (Professor 2's documentation for the assignment was the least detailed of the four, covering required sections but offering much less on how the internal structure of each section should look). However, this complexity must be considered against the fact that the longest paragraphs in the corpus, upwards of 16+ sentences, are in Professor 2's student papers, and their sheer length and verbosity tended to destroy coherence and readability after eight sentences. We suspect a model would have helped to hedge in such unrestricted and counterproductive growth. But such a balance is easier said than done, given that for most of the students in the corpus, models seem to have been more than something to imitate, and rather, something to reproduce. The danger of reproduction is particularly acute in genre writing such as reports. Even if the instructor stresses the rhetorical nature of genres, when students follow a model closely, they are not benefiting from the affordances and flexibility of a broad rhetorical style; instead, a given genre becomes only a template for students to plug into. Students will learn the template, but not how to vary from it when needed by more complex and demanding contexts that might require a departure from the template.

Preceding and Following Paragraphs, and Report Sections

While we examined the relationship between adjacent paragraphs using a mix of positional and structural codes, we did not find interesting results from such investigation due to the preponderance of Type 1–3 structures in the corpus. For example, there are 330 px.s1 paragraphs in the corpus, classified as Type 2, Nonsequential. These two-sentence paragraphs were preceded by the positional codes in Table 9.7.

Table 9.7. Positional Codes Preceding px.s1 Patterns

H	61
H2	99
H3	33
Image	12
LH	3
LH2	1
LHP	2
LI	3
S	116
Positional codes preceding px.s1 patterns	**330**

We can view such correlations in two ways. One is that any two-sentence px.s1 pattern is more than likely going to be preceded by a heading; the other is that headings are often followed by two-sentence px.s1 paragraphs. If we dig deeper, however, by looking into the 116 "S" sentences preceding px.s1 paragraphs (the S code singling a paragraph rather than a heading), the overall lack of Type 4–8 paragraphs in the corpus does not leave us with much to conclude other than, again, the overall dominance of Types 1–3.

However, we did observe something interesting concerning the more infrequent paragraphs with PIVOTS and COMPLICATES codes; namely, it was much more likely that they would be followed by a S code, or in other words, another prose paragraph, whereas the other types were far more likely to be followed by a H, H2, or H3. Again, the relationship between headings and simpler coherence patterns seems to hold up, and perhaps, writing a more complex paragraph leads (in the habits of such student writers) to writing another complex paragraph instead of quickly transitioning to another heading.

We also attempted to find relationships between the formal sections of each report and the eight paragraph types, but we could not come to firm conclusions due to the students using a wide array of section names, with inconsistent use and length even when the papers were written for the same instructor. We would note however, that the concluding sections of reports, such as those labelled "recommendations," "conclusions," or "analysis" were more likely to contain Type 4–8 paragraphs, contain longer paragraphs, and more paragraphs overall than previous sections.

Takeaways

We would divide our closing thoughts into descriptive and prescriptive takeaways:

Descriptive

- The undergraduate students in the corpus used relatively simple paragraph structures to build over three-quarters of the prose of their reports—Type

1, 2, and 3 patterns constituted together 78.58% of the 1937 coded paragraphs. These ubiquitous structures correlate with the presence of more headings and images.

- The models and explicit structural instruction provided by each of the four instructors also correlate strongly with the structures that we found in their respective students' reports; students therefore seem to rely heavily on the models they have been provided. We wonder if student overreliance on simplistic forms hinders their ability to develop more rhetorically sophisticated structures as seen in Types 4–8.
- This study provides empirical evidence of what instructors of technical communication tend to know intuitively about report writing and paragraph construction and helps move our collective knowledge of writing instruction a little further away from the realm of lore.

Prescriptive

- Technical communication instructors should be intentional and careful about what structural models they choose to share when teaching the report genre. Our analysis of the corpus suggests that students will follow what they are given (or not given), even to a fault. We suggest presenting different strategies for structuring paragraphs, especially in relation to headings and lists in relation to the whole report, rather than a single authoritative model. In addition to teaching technical communication genres as rhetorical, instructors could provide multiple generic models of reports. For example, an instructor could provide students with three models that demonstrate three different ways of writing the results section of a report. Students could mix the features of several multiple models; either way, they could justify their rhetorical choices in a reflective piece and not be locked into a single path. After careful study of this corpus in conjunction with our own experience, we judge functional flexibility in structure is more important than adherence to any one model or method, especially to undergraduates that will be entering a wide variety of fields with rhetorical contexts and audiences that neither the instructor nor the students can predict.
- Providing multiple models and a separate reflective piece does demand more work and resources from students and instructors than the one-model approach we saw from the four instructors in our corpus, but we would temper that concern with another sobering observation; the reports in the corpus were, by and large, not strong reports. The authors of this study have over 40 years of teaching report writing between us, and we hold that nearly all the 74 reports we coded would have benefited from more complex and nuanced paragraph structures, especially the PIVOTS and COMPLICATES maneuvers. This is not to say that the percentage

of simpler types and the rarer types need to reverse places, but that even the inclusion of a few more of these maneuvers in a report was noticeable and positive, especially in the closing sections. The traditional, if out of style, recommendation for encouraging the composition of more complex sentences is the pedagogy of sentence combining exercises (Connors, 2000; Wolfe et al., 2011); we would note that manipulation of paragraph patterns through the presentation of multiple models could be seen as the same "exercise" strategy, but writ larger at the paragraph level. A closer examination of models is beyond the scope of this immediate paper.

- Practitioners can use these paragraph categories to analyze and critique their own writing, as well as the writing of others. We suggest reflecting on the differences between more heading-dependent and more paragraph-dependent argumentative structures, the presence (or lack of) PIVOTS and COMPLICATES maneuvers, and what constitutes ideal paragraph length, which may shift depending on section and context (longer, perhaps, in analysis and conclusion sections to accommodate more complex argumentation). We would not prescribe any specific ideal percentages/amounts, given rhetorical documents are driven by specific context; rather, the value of the analysis lies in an increased consciousness of textual structure, enabled by new vocabulary. Future research might include what kind of report paragraphs and related structures are actually being written in professional environments, and how those structures compare to this study.

Closing Thoughts

Historically speaking, this study recalls earlier style-centric studies of the 1960–80s, when usage remained a major theoretical concern and focus of the writing disciplines. Isolated treatments of paragraph structure tend to be placed within the small but dedicated subdiscipline of "style." As Ryan Boettger and Erin Friess (2020) note in their recent meta-analysis of technical communication journals, editing and style were once subjects at the forefront of the discipline, but they now represent the least populated corner in terms of published journal articles (pp. 18–19; refer also to Carradini, 2020). We do not imagine this study, however, as a corrective to such a trend. Rather, we would note that that the central issue of how to teach report writing and paragraph writing has not gone away, and regularly returning to this central matter to see "what is going on" in student writing with empirical, theoretical, and practical perspectives remains a worthwhile endeavor. Further, we would also like to promote the teaching of more complex paragraph structure. This px.s1.s2px.f3.c4.v5.px paragraph is an example of how paragraphs do not have to be simple to be effective and readable.

As we readied this piece for publication, concerns about the abilities of generative AI to mimic human sentence and paragraph structure became prevalent in the media and the academy, and we considered how this study might address such concerns. We see strong parallels between the typical paragraph structures produced by ChatGPT and its chatbot competitors on one hand, and the most popular of the variant structures in our corpus on the other. When we query ChatGPT with prompts, we see its reliance on Type 1 and Type 2 paragraph structures to maintain strong paragraph cohesion, and its inability to produce more complex, unpredictable, or nuanced argumentative structures. While the bots can muster a COMPLICATES or PIVOTS maneuver, their "however" turn typically comes off as predictable and formulaic as a first-year Rogerian essay. With no evaluation or thought behind the turn, such attempts remain awkward and false. As Joseph Weizenbaum (1976) and many others have cautioned, digital computers do not have access to *qualia*, and therefore cannot evaluate subjective experience as humans can; their argumentative capabilities are therefore limited to a veneer of linguistic coherence that can only be emulated by pulling fragments from large numbers of human-written sample texts via LLM (large language model) methods.

Unless the student authors of these papers had photographic memory, they did not compose by such a method. Their attempts at evaluation and exposition may be clumsy, but they are human. We note the irony of suggesting multiple models for students even as chatbots sample millions of texts, but we also note that the many paragraphs in this corpus of often painfully awkward reports all have potential to grow from their "stems" into more robust and better rooted weeds.

Rather than see such technology as a pedagogical or existential threat, we see AI developments as an indicator that the field is once again brushing up against the deeper argumentative structure of student writing. Further, we suspect that the current (and we cannot stress "current" enough) inability of chatbot writing to break free of these simpler structural patterns in a rhetorically functional and coherent manner is not only one of the most straightforward ways to detect chatbot-composed language, but one of the easier ways to critique and improve student paragraph structure. However, if the LLM models on which generative AIs are trained contain primarily Type 1–3 sentences, we should not be surprised if they replicate them, especially if readers accept them. And if those models feed upon their own sentences, this trend will continue, much like it will for students.

The ability to break free of simpler structures and improvise more complex ones is one of the clearest indicators of strong critical thinking and composition in human-written paragraphs. Of the codes we generated, just the inclusion of a single PIVOTS or COMPLICATES is the easiest way for students to break out of Type 1–3 structures and create more unique variants. Each of the authors of this paper (all humans, to be clear) repeatedly mentioned during the collaborative work of the study that within the corpus, the longer, more structurally complex sentences that used more of the available "maneuvers" tended to contain the strongest writing by any measure, stylistic or otherwise. Every time a student relied on a simpler structure, they missed the opportunity to use a more complex one, even if unsuccessfully—and thus to build their skills.

The act of selection (Perelman & Olbrechts-Tyteca, 1969) is central to the enterprise of rhetoric, and as paragraph structure allows fine-tuning of that selection, careful attention to paragraph structure is warranted in writing pedagogy. As this study shows, even the generic recommendation report genre contains numerous opportunities for rhetorical variation that are not always taken. Facility with more complex paragraph structures, however, can be encouraged with the skillful use of multiple templates and models by instructors, in conjunction with descriptive research into how they actually write. The eight structural sentence types can be used as either tools for further analysis or for pedagogy, and accordingly, we offer here a unique, measurable, alternative way to listen to how students write by paying close attention to the internal argumentative structure of their paragraphs, and to help them listen to their own composing process.

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10. More Than Words: A Text Mining Approach to the Analysis of Topics and Skills in Technical Writing Job Ads

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Abstract: Technical writing work can vary significantly in its content, skills, and goals. This study examines patterns in the language of recent technical writing job advertisements as a way of assisting efforts of job seekers and educators related to professional development and curricula. Job advertisements were collected from Indeed each month for a year across the ten most populated cities in the US. We created a corpus of 4,597 unique advertisements using the search terms *Technical Writing* and *Technical Writer* posted during this time frame. We analyzed this corpus using distant reading and text as data methodologies. We present the most frequently used words used in technical writing job ads, and we examine several topics of interest to get a sense of how frequently (and infrequently) particular words are used. We also identify several topics representing the industries and roles that technical writers work in. The patterns in the corpus have several implications for professional development, higher education, and job seekers. This study provides an entry point into examining the expectations and perceptions of work in the field of technical writing, and it highlights several opportunities for reflecting on and studying the practices, priorities, and opportunities in technical writing.

Keywords: Job Ads, Text mining, Topic Modeling, Professional Development, Technical Writing

For us, as practitioners and educators in technical and professional communication (TPC), articulating what we do has significant implications. Definitions, as turns out, matter. Because the work of a communicator is varied and context-specific, the boundaries of our work are far from definite. Concrete deliverables might appear deceptively simple when we do our jobs well, but the work and value of technical communication goes beyond the physical outputs. With every project, and in each context, the subject, form, and value of our work may look different. The situational differences between roles and projects can make it difficult to judge how the professional communicator fits in with project dynamics.

The problem is nothing new. Over three decades ago, Jo Allen (1990) described the attempts and failures of the Society for Technical Communication

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(STC) to define technical writing. Allen's argument came after an incident in which a cookbook was disqualified from a technical-publications competition because the judges determined it did not meet their definition of *technical writing*. Allen also pointed out that the year before, the STC board had abandoned their attempt at developing an official definition of *technical writing* after members could not agree on a definition. In the end, Allen (1990) cautioned, "we should be careful, in our earnest desire to create a definition, not to exclude or disenfranchise writing that falls outside our strict categories" (p. 75). For Allen, the biggest problem is the way definitions draw firm lines that determine what is and isn't technical writing, and the firm boundaries lead to problems. Allen suggested that "we should reconsider works…that fall so naturally in line with almost all the criteria we claim for technical writing before we exclude these works for violating a single criterion" (p. 75). Allen's point is that definitions are a statement about what is valued in our field, and it can lead us to ignore or overlook otherwise important work.

In the years since Allen's argument, what it means to be a writer and a communicator has gone through significant changes. Perhaps unsurprisingly, scholars and practitioners find it challenging at times to describe the focus and value of the field (Batova et al., 2016; Henning & Bemer, 2016; Kimball, 2016; Lauer & Brumberger, 2016; Melonçon & Schreiber, 2022; Rice-Bailey, 2016; Shalamova et al., 2019; Swarts 2012). Each attempt by scholars and practitioners to articulate a vision of the field has its value, often providing readers the opportunity to consider new ways to apply their skills, opportunities to ask new questions, and arguments for the value of writing and communication work.

Keeping pace with the historical context, recent progress, and emerging trends of our field presents a formidable task. Perspective accumulated through years, or even decades, of experience in TPC can provide valuable insights, but rapid growth and change in the field necessitates continuous learning and adaptation. The challenge lies not only in monitoring new developments but also in integrating them beyond our areas of specialization within the vast scope of TPC — a feat often unrealistic. Derek Mueller (2017) has referred to the challenge of keeping pace with a field as the "reading problem," explaining, "this ongoing condition—the field's perpetually being written—means that more disciplinary material is generated than any one person reading by conventional strategies alone could reasonably handle" (p. 21). Of course, most members of our field specialize in a few areas, developing their own sense of what it means to be a technical communicator. In a sense, each of us will develop our own working understanding of what technical communicators have to offer.

Still, we often ask questions like: What kinds of skills, tools, and technologies are most desired? How do companies define the job and responsibilities of communicators in a job posting? How can educators train students to meet the expectations of an ever-changing job market? These types of questions have motivated several studies over the past few decades of TPC scholarship (Coffelt et al., 2022; Lanier, 2009; Rainey et al., 2005; Rosselot-Merritt, 2020; Rude, 2009; Shalamova et al., 2019; Spyridakis, 2015; Stanton, 2017). These studies strive to use observations about the prevalence and importance of theories, competencies, skills, processes, tools, genres, and more to orient our attention towards ideas that are the most relevant to various goals. Studies that attempt to determine what is most common, most needed, and most valuable are useful because they examine and contextualize TPC work.

Ultimately, TPC is a dynamic and engaging field which led Eva Brumberger and Claire Lauer (2020) to observe that "technical and professional communicators must now acquire broader skill sets than in the past" (p. 1) an observation that motivated their work developing data-driven personas of TPC practitioner roles. The broad and evolving nature of TPC has also led to questions regarding its value and legitimacy.

The ways we explain our field to managers, colleagues, clients, students, and each other can have significant implications. Jeremy Rosselot-Merritt explained that "perceptions of TPC among non-TPC professionals reveal accurate conceptions of the field on a basic level; however, those conceptions lack the depth needed for an accurate understanding in a broader sense" (2020, p. 57). Rosselot-Merritt goes on to suggest that poor understanding of the value that TPC work brings is an existential problem based on two key realities: TPC is dependent on collaboration with other disciplines and decisions about technical communicator's roles and responsibilities are often made by stakeholders without a TPC background.

Like other scholars, our desire to orient ourselves to what matters most in our field has led us to an empirical study of job advertisements (ads) that would produce insights into some fundamental questions. TPC is a broad field and each facet is worth investigating, but in practice 'technical communicator' is a broad term. Very few job ads use the general term, offering more specific titles.

Why Technical Writing?

While the broader language of *technical and professional communication* or *technical communicator* are our preferred labels, the job titles and specializations that qualify as TPC work vary broadly. For example, Brumberger and Lauer (2020) used 55 job titles to collect job ads after reviewing the Society for Technical Communication (STC) job board and other sources, and they go on to remark after conducting interviews that job titles can be "fluid" and "arbitrary" (p. 7). Instead of attempting to study all TPC roles simultaneously based on the job title, we decided to collect job ads based on search results of a job board. We believe this helps ensure the collection represents the language job seekers would encounter when seeking employment as a technical writer.

For this study, we narrowed our focus to the way technical writing is represented in job ads. During a 12-month period, we developed a corpus of 4,597 unique job ads using the search terms *technical writer* and *technical writing*. As a genre that describes the work of our field, job ads themselves don't completely reflect what technical writers do, but rather what hiring managers *think* they can do. Our corpus reflects the way specific industries value technical writing, and it can potentially highlight the disconnects between what we actually do, what we think we do, and how we're being described.

We choose to analyze job ads because they, in part, directly define what it means to be a technical communicator. Individual job ads are limited, but the descriptions offered in them represent real attempts at explaining the necessary skills, experience, and responsibilities that are expected. This reveals how hiring managers (or sometimes, Human Resources) see technical writing, at least as it relates to their needs. Job ads also allow us to see TPC from the vantage point of a practitioner looking for work because we are analyzing the language they will encounter that most meaningfully explains what technical writers do.

A Text Mining Approach

In this article, we analyze the language employers use in communication job ads to identify useful patterns. We use text mining and analysis methods that are common in computer science, machine learning, and natural language processing. Text mining refers to computer-aided methods that analyze large collections of text. More specifically, we treat text as data following approaches described by Justin Grimmer et al. (2022). Grimmer et al. explained the reason, writing, "forcing researchers to use data to test theories that were developed before the data arrived also has substantial weakness. Scholars in the social sciences have acknowledged the importance of more inductive forms of analysis in qualitative research including full cycle research design, grounded theory, and nested analysis" (2022, p. 14). The goals of text mining are to identify patterns of facts through systematized observations, and the careful analysis of the patterns will lead to interpretations that can be further tested.

These methods resonate with the distant reading techniques introduced by Franco Moretti (2013) as an alternative to close reading and further elaborated by Mueller (2017) for investigating disciplines. Distant reading prioritizes the analysis of patterns across a body of literature instead of focusing on an individual passage, allowing for conversations about the features and relationships across a network of texts. Distant reading encourages a relationship with text that is critical and analytical, but it recognizes that viewing text in context of related materials can provide useful context.

A text mining approach is valuable when researchers have a broad interest in an area of inquiry but do not want to apply pre-determined assumptions. The methods we are working from are exploratory and iterative in nature, using abductive reasoning which is a logical approach that "involves an inference in which the conclusion is a hypothesis that can be tested with a new or modified research design" (Ignatow & Mihalcea, 2018, p. 51). While many data-driven studies often start with specific research questions, text mining research often avoids predetermined assumptions about what appears in the collection. Researchers work, instead, to carefully report the data, observing patterns of interest, attempting to explain and formulate new questions. The findings and interpretation often result in new, testable hypotheses that are grounded in the data. Our goal was to uncover patterns and features within technical writing descriptions that represent the field systematically and in a way that can be reproduced and expanded on. The identified patterns and insights reflect the needs and expectations of managers and organizations hiring technical writers.

To help situate this research, we first discuss the complications of explaining the work of technical writers. The history of scholars discussing TPC's boundaries, key topics, and questions illustrates why distant reading and text as data methods can provide valuable perspective. We take a look at this history to provide context and to suggest that scholarship that maps the field in TPC helps the field reflect and grow. We argue that text mining compliments these efforts. Then, we outline our method and present comprehensive data sets from technical writing job ads. We identify several patterns in the data that add to previous scholars' efforts to review the field. Through sharing our findings and discussing various interpretations, we suggest several perspectives and questions that merit further exploration.

Literature Review

Demonstrating the value, variability, and complexity of TPC work in a way that is both illustrative and productive is no simple task. In a faculty meeting, a senior administrator recently remarked that technical communicators are 'the ones who write instructions for how to use the toaster.' This accurate, but diminutive, explanation illustrates the problem of explaining TPC. Similarly, a former graduate student recently remarked, "I thought technical writing was just making things clearer and easier to understand, but now that I'm actually doing the work, I see that it's so much more complex."

At times we must contend with popular, reductive, descriptions of the work we do, which as Rosselot-Merritt demonstrated, may "reveal accurate conceptions of the field on a basic level…' (2020, p. 57). A layman understanding of technical communication is quick to grasp, but it hides the difficulty, diversity, and impact of our field. Easy definitions like "writing simple instructions" or "translating complicated topics" may be accurate, but they can also significantly reduce the sense of complexity and value that our work involves, a problem that is not unique to TPC.

We have often used the definition of *technical communication* offered by STC, which includes three categories: 1) "Communicating about technical or specialized topics," 2) "Communicating by using technology," and 3) "Providing instructions about how to do something" (n.d.). While this definition is both more accurate and adds clarity, the variety of work that is covered by these areas is substantial and often dependent on industry-specific norms. Within each of the three categories, we could quickly add a variety of roles and skill sets that are distinct while clearly falling within the field of TPC.

Scholars within TPC often publish work with the primary goal of making sense of the field, publishing about the field's history, methods, and research questions. Scholarship about the history and current state of TPC is filled with discussions about what subjects are most important, salient, or suitable for the profession (Brumberger & Lauer, 2020; Clegg et al., 2021; Coffelt et al., 2022; Melonçon & St.Amant, 2019; Robinson et al., 2019; Roundtree, 2018b; Spyridakis, 2015; Tham et al., 2022; Zheng et al., 2016). Questions about the status of the field are not new, and many past articles lay out the topics and perspectives that the authors view as growing in significance and essential to the future. TPC scholars have built entire careers by describing and redefining the field. Ongoing scholarly self-reflections have played an important role in developing a clear understanding of the field and the value of our work.

A Dynamic Landscape

TPC is a continuously evolving domain, shaped by diverse professional expectations and industry trends. A mature field is not a monolith, which is why scholars must engage with this type of disciplinary maintenance. The complexity of a field can be seen as a sign of its strength and maturity, and as a complex and growing field, TPC is a perfect example. TPC is a complex field, and it often faces rapid change due to the evolution of tools, technologies, and industry practices. Jason Tham et al. (2022) recently explored the implications of integrating design thinking, content strategy, and artificial intelligence into TPC programs, insightfully pointing to the need to adapt and suggesting several strategies for doing so.

In the face of such a field, the argument put forward by Allen (1990) seems as relevant today as it did three decades ago. A strict definition of technical writing can arbitrarily exclude important work. Of course, definitions are needed at times, but we also need ways to investigate the broader workings of our field.

Still, establishing the focus, boundaries, and directions of TPC is a frequent goal of scholars, and there are several methods that have been developed. The implications of the definitions and descriptions can be significant. Two decades ago, Barbara Giammona (2004) conducted a survey and suggested that the future of technical communicators would shift focus toward information management and the change would require that the field adapt to technological and societal changes. Miles A. Kimball's (2017) analysis of the field leads him to argue for academic programs in technical communication to broaden their appeal by adjusting the scope and definition beyond a field of study and a profession "to include the vast, unrecognized bulk of technical communication performed every day" (p. 346).

In the effort to define what we do, Giammona and Kimball both offer engaging analyses and arguments about the potential influences and directions that could shape the fields related to technical communication at the time, and they both offer suggestions based on their observations. The predictions of Giammona and Kimball are engaging and valuable, but their efforts are not unique in the field and speculating about the future of the field is an imprecise art. David Wright et al. (2011) showed the robust history of predicting the future within technical communication with a detailed annotated bibliography covering six decades, and making the observation that "Many predictions do seem to be motivated by fear" (p. 448). While many scholars discuss the many changing facets of the field to consider its future, other scholars do so to create useful frameworks that invite us to notice the many corners and interconnected elements of our field.

Mapping the Field

Attempts to define the field or predict its future are essential efforts for determining how scholars, students, and practitioners should apply themselves. Discussions about what matters in TPC help inform our decisions when we design courses and programs, decide on academic paths, seek professional development opportunities, plan future career goals, select research topics, or reflect on our own skill sets as we draft a resume. As researchers approach the field from different perspectives, they help show the many sided, thriving complexity of technical and professional communication. Each study adds a new vision, and in so doing we may find at times that there are significant differences. For example, there is a disconnect between TPC articles written by practitioners and researchers in focus and motivation with practitioner articles focusing on process and profession and academic researchers more often focusing on writing products and educational matters (Boettger & Friess, 2016).

Studies that examine features of a field are valuable, especially during periods of change, because they can help clarify and strengthen connections in the field. Mueller (2017) has called such studies forms of "discipliniography," which he defines as "a genre that writes the field and is written by scholars in the field, and as such is a genre that is responsive to the growth of the field and its changing, contested state(s)" (p. 13). This type of scholarship helps to mediate discussions within the field, and it facilitates the process of familiarizing newcomers and outsiders by surfacing patterns and histories that would take years to learn about through first-hand study.

Carolyn D. Rude (2009) is an example of a study that has done this type of disciplinary work by documenting the research questions in our field — what to study (disciplinarity), how to teach (pedagogy), what we do (practice), and how to engage in rhetorical change work (social action). Rude referred to her work as 'mapping,' which is an apt metaphor for identifying a field's features and relationships. Rude's approach to explaining the field focused on research questions, and the result is a useful entry point into a complex field of academic study and industry practice. Her map helps newcomers to the field understand the conceptual landscape, and it helps established members reflect and discuss the features and connections.

Several studies have documented the perspectives and experiences of practitioners in technical writing through surveys (Rainey et al., 2005; Shalamova et al., 2019). The findings of surveys, on their own, provide valuable insights; however, triangulating the findings from surveys with analyses of technical writing job ads generates a richer sense of the field that is grounded in the most current data.

Another approach to clarifying the focal points and systematizing the values of the field is to identify core concepts and keywords. Several books have been published in recent decades dedicated to explaining the values of TPC and our related fields through a close examination of our keywords (Adler-Kassner & Wardle, 2015; Heilker & Vandenberg, 2015; Tham, 2022; Yu & Buehl 2023). These types of collections that draw on the deep expertise and experience of established members of the field can be authoritative and useful, and they help the field examine its own complexity.

In the introduction to a recent collection, Han Yu & Jonathan Buehl write, "Keyword essays attempt to open up the meanings of words, to emphasize that meanings are always in flux, and to celebrate the different (but also overlapping) meanings of words as they are used in varied social, cultural, and disciplinary circles" (2023, p. 9). They go on to invite scholars to use the keyword essays in their collection to help examine the "evolving, divergent, and contested meanings" (p. 23). The process of identifying important terms and examining the full, complex usage of the terms in our field reflects that type of disciplinary maintenance described by Mueller, albeit through other means. Yu and Buehl's (2023) collection offers the field an insightful glimpse into the complexity of many topics in our field, and what makes their collection particularly valuable is how the terms were selected. They explain that they used a data-driven process that began with an analysis of the field's academic publications (p. 11). Scholarship that engages in the careful identification of key features provide valuable entry points. Tracking the field's boundaries, concepts, and language is essential for working through questions like those regarding TPC's evolving scope, core concepts and terms, interdisciplinary nature, and ethical commitments through social and technological changes. These questions are not only of interest, but they should regularly be reexamined so we can confidently make sense of the field itself, what we offer as members of a shared discipline, and what avenues of professionalization are needed.

Researchers will often review scholarly and practitioner publications to create their own conceptual maps to highlight the various domains of the field, just as Yu and Buehl (2023) did to identify keywords for their collection. For example, Lisa Melonçon and Kirk St. Amant (2019) and Chris Lam and Ryan Boettger (2017) analyzed the research methods in top TPC journals. Rude (2009) investigated the research questions in technical communication by analyzing books published in our field, an approach that is similar to Kimball's (2013) approach to gathering information about design principles. Books or articles are scholarly genres that represent the interests, questions, topics, perspectives, and values of our field, but scholarly perspectives may not provide a complete picture of how industries are (re)shaping the field.

Careful analysis of our most representative texts, such as job ads and associated documents, is an avenue that can help us develop a grounded understanding of the many facets of our field. Several scholars in TPC have involved technical writing job ads as data for this purpose (Brumberger & Lauer, 2015; Lanier, 2009; Stanton, 2017). While job ads themselves are imperfect, they yield insights into current and future expectations for technical writing positions. More recently, Brumberger and Lauer (2020) were able to identify key competencies, personal characteristics, and common information products in their grounded theory research. Because job ads are a meta-genre (Giltrow, 2001) of technical communication that are often composed by non-technical writers within human resources, their patterns—both how they define technical writing skills and who they claim to be seeking to fill technical writing roles—a large (and ever-expanding) corpus of technical writing job ads can help us begin to move from definitional work to a more in-depth understanding of the everyday knowledge work of technical writers across industries.

For our purposes, we define meta-genre as situated, self-referential language that characterizes who technical writers are and what they do. Job ads are a meta-genre of a primary set of TPC genres: resumes, cover letters, applicant instructions, and even LinkedIn profiles. They contain information commonly found in these primary TPC genres, such as lists of required skill sets, descriptions of experience, or desired certifications and credentials. They are, as Janet Giltrow (2001) describes them, "wordings and activities, demonstrated precedents or sequestered expectations" that surround a genre and indicate how readers and writers should appropriately take it up" (p. 195). As such, a corpus of job ads from a variety of locations and industries collected over a period of time can provide the TPC field with a better understanding of "how texts and related communication practices mediate knowledge, values, and action in a variety of social and professional contexts" (Rude, 2009, p. 176).

Available, Scalable, and Repeatable

Other researchers have studied patterns in the field using job ads, but typically at a smaller scale. Text mining lets us zoom out and view things at a different scale. We approach this study with the understanding that text-mining allows for a more comprehensive analysis of the field than is typical in other methods. By treating advertisements as machine-readable data that can be aggregated, we can observe language patterns that are difficult to identify by close reading. Automated frequency counts, collocation searches, topic modeling, and related methods for computationally analyzing collections of text create statistical representations of the text that help us understand the disciplinary landscape at a wider scale. Computer-aided textual analysis is a useful way to conduct a distant-reading study due to the availability of text, the scalability of the analysis, and the repeatability of the methods. A thoughtful and consistent analysis provides the opportunity to zoom in or zoom out to understand patterns in context and from afar.

In each job ad study we reviewed, researchers relied primarily on human readers to identify the features for analysis. While the methods and findings of previous studies on job ads are effective and valuable, the choice of textual features are predetermined or determined by human readers as they review the ads, which means the identification of patterns in the text is driven by the research team. The study that follows this review, in contrast, employs a different approach, viewing the language that describes technical writing in aggregate before human analysis. The full text in each ad across the entire collection is counted and considered for potential patterns by the computer during the analysis. The computer does not begin with preconceptions about which language is most important, so when the human reader reviews the patterns, they are faced with a different sense of what is important.

Large-scale analyses of job ads can provide grounded descriptions about the current state of the field for stakeholders to engage more confidently and comfortably with the most relevant and current concerns of the field. For example, Rhonda Stanton (2017) has argued that understanding what employers want will help university faculty and administrators (p. 224), a point that had been made in an earlier study (Rainey et al., 2005, p. 335). We ourselves have had many discussions with colleagues speculating about what employers are seeking from applicants in technical writing and the need for reliable data about various paths that are available. Studying job ads and employment trends that move quickly can help us trace new subfields and specialized skill sets as they gain importance (Shalamova et al., 2019).

To establish a more holistic picture, to strive for a sense of the field with all of its complexity, we can use computational methods of textual analysis based on consistent features across the texts. Using computational approaches to analyzing text offers a reflective analysis of TPC, and there are several ways this type of work has been described including text mining (Fan et al., 2006; Roundtree, 2018a), machine learning (Lindstedt, 2019; Murakami et al., 2017), and text as data (Grimmer et al. 2022). Text mining may include a wider array of activities that include acquiring and parsing text as well as various forms of analysis, including machine learning.

Machine learning employs algorithms to improve upon tasks by learning from data and can facilitate the analysis of extensive textual data in ways that human reading and interpretation alone cannot accomplish. These methods have received limited attention in the field of TPC. After many months of attempting to code our data set with more conventional methods of text and rhetorical analysis, we began to see the need for another approach. There are several methods in natural language processing and machine learning that are appropriate for making sense of large collections of texts, including text clustering, text classification, information retrieval, summarization, opinion mining, and sentiment analysis (Aggarwal, 2018). Grimmer et al. (2022) use the term 'text as data' to capture many of these methods, and they provide several useful guidelines for applying machine learning, most notably they argue that text methods are useful because they support discovery and can lead to new insights and questions. They also clarify that "Text analysis does not replace humans–it augments them" (p. 24).

Changing the analytic scope from a hand-read sample to a comprehensive corpus has several important implications for research. Close-reading supports deep critique, but cannot claim representativeness. A wider, more comprehensive scope builds what Mueller calls *network sense*, which "mitigates the negative consequences of excessive specialization" (2017, p. 164). Distant reading and corpus methods operationalizes that network sense by focusing on surface-level, countable features, what Mueller calls *thin description*. Reducing and simplifying texts can take many forms, as Mueller writes, "everyday examples where distant reading and thin description do their thin-distant work…table of contents, indexes and the notes on a book jacket" (2017, p. 6). In short, thin description and distant reading are the tools that Mueller identifies for adjusting our scope of inquiry. Thin description makes it possible to engage in distant reading by treating content as data that can be tracked across thousands of texts, after which researchers can then analyze and discuss the significance of those patterns based on the goals and theories of the field.

In our study, we work to better understand technical writing using job ads, a genre of communication explicitly designed to describe the work expected and the skills involved. In particular, we have examined language patterns and the presence of communication forms and tools that fall outside of traditional notions of writing. By identifying common features and their relationships, the findings of our study function as a conceptual map of the field, providing data about the topics and their relationships in context. While job advertisements cannot reveal everything about the work of technical writers, the language in the advertisements can act as an indicator of what working professionals face as they navigate the profession. Understanding technical writing from multiple perspectives is important for getting an overall sense of our complex field.

Methods

The project has gone through several phases, and the texts have been analyzed in multiple ways as described below. The findings are based on 4,597 job advertisements available on Indeed, a popular job board, that result from the search terms *technical writer* or *technical writing*. Throughout the study, we treat text as data (Grimmer et al., 2022), with the understanding that it is through certain texts that we define, describe, and create the field.

Data Collection and Data Cleaning

The first phase of the study was developing a principled corpus of texts. A corpus is principled if the collection and inclusion of items in a corpus follow specific and predefined rules. The process involved collecting, organizing, and cleaning the texts. To ensure repeatability and to clearly explain what the data represents, we carefully managed the collection process and parameters. During the first week of the month, we identified and collected job ads by searching Indeed using the target search phrases. Collecting advertisements took place over a 12-month period, November 2021-October 2022. We searched for *technical writer* and *technical writing*, which yielded job postings from a wide variety of organizations and with a wide variety of job titles. We repeated the search using the same search terms for the 10 most populous cities in the United States according to the U.S. Census: New York, Los Angeles, Chicago, Houston, Phoenix, Philadelphia, San Antonio, San Diego, Dallas, and San Jose.

Understanding the Corpus

The tables in this section describe the corpus makeup: the distribution of the ads across months (Table 10.1), the number of word tokens and word types (Table 10.2), and the job titles found in the collection (Table 10.3 and Table 10.4).

Table 10.1. Ads Collected and Ads Identified as Unique Within Each Collection Cycle

Month	**Ads Collected**	**Unique Ads**
Nov -2021	1,187	670
Dec-2021	1,195	632
Jan-2022	1,307	657
Feb-2022	1,273	609
Mar-2022	1,212	650
Apr-2022	1,202	637
May-2022	654	459
June-2022	1,142	642
July-2022	967	530
Aug-2022	1,140	606
Sept-2022	534	370
Oct-2022	1,387	577
Total	**13,200**	**7,039**

Table 10.2. Final Corpus Construction by Texts, Word Tokens, and Word Types

Collection Period	Total Unique Ads	Word Tokens	Word Types
Nov 2021–Oct 2022	4,597	2,449,139	20,399

** The final number reflects the corpus after exact duplicates were removed across the whole collection period.*

Table 10.3. Job Titles Containing Target Features

Title Characteristics	Total
"tech*" and "writ*"	3,224
"sr." or "senior" or "manag*" or "supervis*"	750
Contains "edit*"	303

Table 10.4. Job Titles that Occur 10 or More Times in the Corpus

Title	Count
Technical Writer	1,197
Senior Technical Writer	168
Proposal Writer	123
UX Writer	56
Technical Editor	41
Technical Writer II	35
Technical Writer/Editor	31
Sr. Technical Writer	31
Technical Content Writer	26
Technical and Engineering Writer	24
Senior UX Writer	24
Specifications Writer	22
Technical Writer I	20
Tech Writer	19
Content Writer	19
Technical Writer III	16
Technical Report Writer	15
Specification Writer	15
Document Control Specialist	15
Grant Writer	14
Associate Technical Writer	13
Technical Writer (Contract)	12
Technical Proposal Writer	12

Title	Count
Technical Proposal Manager	12
Technical Writing Manager	11
Proposal Manager	11
IT Technical Writer	11
Impact Report Writer	11
Writer	10
Technical Volume Writer	10
Sr Technical Writer	10

During the collection process, each job ad was saved as an individual file that included the job title, company, location, and the description of the position. Tags were used to designate each content type so that computer-aided searches could more easily recognize these pieces of information with each position. The development of a data set, or a corpus, involves careful planning to ensure that the computer can reliably assist in the analysis, but also to ensure that the contents are consistent and principled. The choice of the composition of a corpus can have significant impacts on how it is interpreted.

The process of preparing the files for analysis involves multiple steps of organizing and cleaning. After the initial collection process, the job advertisements are then organized and stored based on month and search term. While there are many ways the corpus could be structured and analyzed, for this study we consolidated job ads for the entire collection period into a single corpus for analysis. In future studies, a comparison of the advertisements could be made based on location, month, or search term.

Using a program named SearchMyFiles, we removed duplicated postings from the collection. The program compares files to remove identical information. Companies often reuse substantial portions of their postings, so many advertisements share large portions of text. However, small differences in language are considered a different position for the sake of this study. Date and location were disregarded when identifying duplicate ads, so ads that remained across collection periods or ads that were reposted regularly were identified and exact duplicates were removed. The removal of duplicates was completed using automated methods for exact matches only, so some redundant postings with only small differences are included in the final corpus. Differences, no matter how small, were assumed to be an intentional distinction between different positions or updates intended to improve the advertisement in some other way.

Additional cleaning was needed for the frequency analysis, which is described below, to move past words with little relevance to the study. To ensure the analysis would generate the most useful data, a list of words was generated for AntConc, specialized software for analyzing text, to ignore when generating frequencies.

The list included words with primarily grammatical function and words that are generalizable to job advertisements. The grammatical words include pronouns, prepositions, articles, conjunctions, helping verbs, demonstratives, and some vague adverbs. Additional words were filtered because they appear frequently in job advertisements because they refer to the position, applying, or legal disclaimers but do not provide insight into the position (e.g. words related to locations, pay or benefits, and legal protections). Examples of these types of words include *job*, *apply*, *applicant*, *work*, *race*, *sex*, *gender*, etc. Words were only ignored when creating frequency lists, not during the topic modeling.

Results

In the sections that follow, we explain the method for each phase of analysis and present the findings. We begin by sharing information about the job titles to provide additional context for the corpus and to provide insight into the roles that job seekers would likely encounter when conducting a generic search for technical writing jobs. We then provide an overview of frequently occurring language organized into general frequency and then frequency by selected topics. Finally, we explain how we applied topic modeling to further investigate the corpus.

Job Titles

Examining the job titles in the corpus helps to clarify the range of work represented in the collection. Table 10.4 shows that just 70% of the job titles represented in the corpus match for both *tech** and *writ**. These titles include many variations, though, with 1,035 unique job titles. 31 out of 1,698 job titles in the corpus appear 10 or more times. 1,149 job titles in the corpus appear in only a single job ad. It is worth noting that even though *technical communicator* is often the preferred term by practitioners and scholars, *communicator* only appears twice in job titles we collected.

The review of job titles also shows that the corpus includes a small number of positions explicitly identified as senior and editor roles. Technical writer levels are distinguished by a variety of labels and levels. The collection includes technical writer levels 1–5, often represented with roman numerals. Titles also include distinctions such as *senior*, *sr*, *junior*, *manager*, *lead*, *principal*, and *associate*.

Exploring Frequent Language

As an initial point of analysis, a general frequency analysis helps provide additional context for the makeup of the corpus of job ads. The frequency list (Table 10.5) shows the most frequently occurring words, along with their total frequencies (number of occurrences) and ranges (number of job ads containing the word at least once). Additional frequency lists were generated using premade lists of terms associated with several topics of interest in technical writing classes. Table 10.6 shows both the frequency and range for selected word types. The frequency lists help add context for the analysis, and creates the opportunity for some initial observations.

Table 10.5. Words that Appear in 50% or More of the Ads, Ordered by Range

Type	Freq	Range	Type	Freq	Range
technical	21569	4240	development	6161	2725
writing	11090	3903	management	5986	2685
skills	9775	3703	communication	3845	2621
team	9847	3367	knowledge	5157	2612
writer	6274	3288	opportunity	4204	2602
ability	9098	3275	support	5144	2542
degree	3966	3050	new	4790	2520
information	7029	3008	environment	4427	2507
time	5464	2877	company	5182	2455
content	11349	2859	related	4039	2422
documentation	11083	2824	business	5567	2409
required	6779	2822	strong	4057	2340
requirements	5587	2814	written	3210	2328
responsibilities	3557	2764	preferred	4084	2302

Table 10.6. Frequency of Words Indicative of Modes of Communication and Communication Technologies

Category	Term (freq, range)
Writing, Designing, and Making	writing (11090,3903), writer (6274,3288), design (3624,1722), written (3210,2328), write (2775,1866), make (2154,1474), writers (1529,926), making (796,680), designers (762,537), writes (438,344), makes (371,322), designed (308,266), designing (222,202), designs (220,205), designer (109,86), makers (72,71), designated (71,68), maker (31,27)
Oral Communication	meet (1822, 1362), meetings (871, 669), presentations (775, 614), interpersonal (774, 712), presentation (546, 450), meeting (513, 399), present (506, 451), meets (477, 414), speak (159, 142), presenting (126, 124), speaking (108, 92), presented (84, 63), presents (38, 38), speaks (28, 28), speakers (14, 11), presenter (11, 11), presently (11, 11), meetups (11, 10), speaker (8, 8), presentational (4, 4), presenters (4, 2), presentable (2, 2), presentations (1, 1), presentation (1, 1)

Category	Term (freq, range)
Visual Communication	visual (435, 379), visuals (103, 99), display (90, 87), slides (61, 60), visualization (57, 50), visually (40, 37), slide (32, 27), visualizations (30, 30), displays (30, 27), visualize (14, 14), displaying (8, 8), slideshow (4, 4), displayed (4, 4)
Multimedia	video (718,490), interface (525,417), videos (338,274), multimedia (166,142), interfaces (163,145), podcasts (37,34), interfacing (34,32), podcast (30,10)
Authoring and Design Tools	microsoft (2067,1592), adobe (1285,883), google (630,280), acrobat (540,415), confluence (417,336), visio (363,332), illustrator (368,312), jira (346,310), photoshop (329,298), indesign (305,257), framemaker (302,249), madcap (232,182), robohelp (69,65), figma (51,44), lucidchart (18,18), xd (7,6)
Coding and Programming	code (662, 476), html (525, 451), xml (495, 389), dita (296, 214), markdown (199, 185), git (198, 184), css (206, 182), javascript (130, 118)
CMSes	aws (198,68), wiki (67,57), squarespace (62,6), wordpress (50,44), drupal (9,9), joomla (1,1), wix (1,1), blogger (1,1)
Social Media	linkedin (161,150), facebook (153,126), twitter (125,118), instagram (49,45), youtube (44,41), tiktok (79,14), snapchat (10,8), whatsapp (1,1)

Topic Model

Topic modeling is an iterative process of identifying groups of words that commonly occur together in documents. There are a few methods for identifying topics and themes within a body of text, and topic modeling is one of the most well-established uses of machine learning when working with language. Latent Dirichlet Allocation (LDA) is one of the processes for identifying topics (Grimmer et al., 2022; Lindstedt, 2019). For this study, an LDA model was created using Gensim, a python library for topic modeling.

The outputs of an LDA model are groups of words that frequently appear together in the same texts throughout the corpus (see Table 10.7). It's important to note that the LDA model outputs topics as numbered groups. The actual naming of these topics is done post hoc by the researcher based on the words in each group and their perceived thematic relevance. These groups of words are called topics, and researchers rely on an iterative process to identify a useful model, which includes labeling the numbered topics in a way that is meaningful for their analysis.

Researchers must ultimately determine, based on a review of the word groupings and the texts that contain them, how many topics to include in the model and what each 'topic' is about. An analysis of the topics and their presence in various texts can then be used to characterize the overall themes that are discussed in the texts. As a process for finding hidden patterns in text, LDA is an effective tool for finding hidden (latent) patterns, and by analyzing these patterns researchers can discover relationships that may not be immediately clear through other means.

To analyze the topics further, we created visualizations. We used the pyLDAvis, a Python package that implements the visualization described by Carson Sievert and Kenneth Shirley (2014). This type of visualization, shown in Figures 10.1, 10.2, and 10.3, is a tool that helps researchers interpret a topic model.

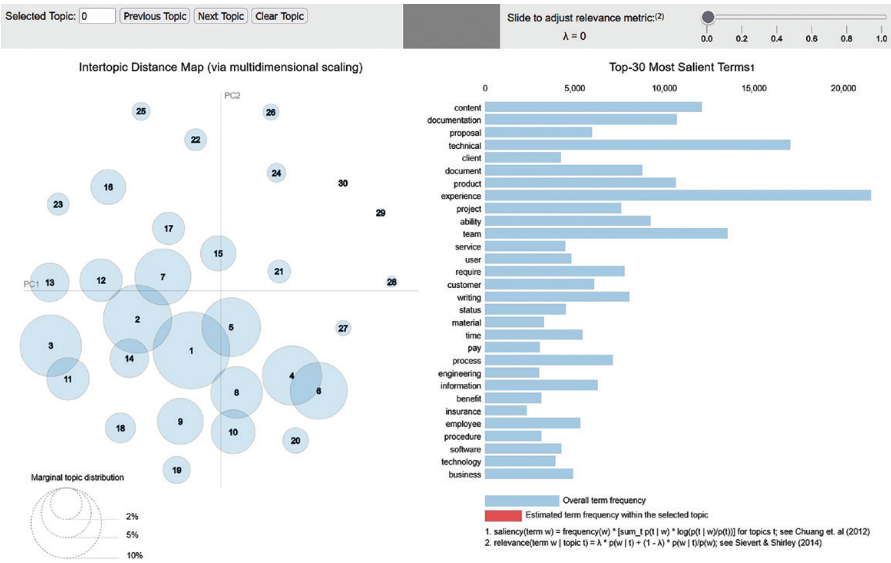

Figure 10.1. Interactive visual of the topic model generated using Gensim and pyLDAvis. The visualization helps with the interpretation of topics.

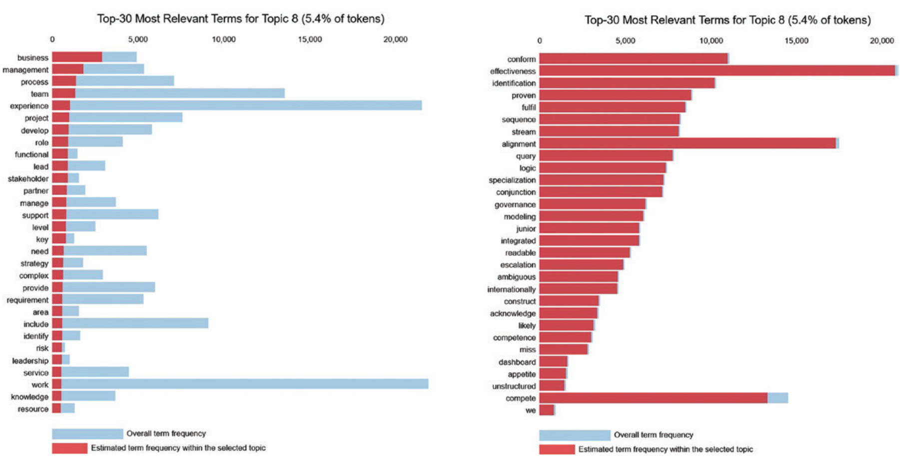

Figure 10.2. A visual comparison of the words in Topic 8, Analysis and Risk. The most probable words are shown on the left, and the words with the highest lift (indicating less likely to appear in other topics) is on the right.

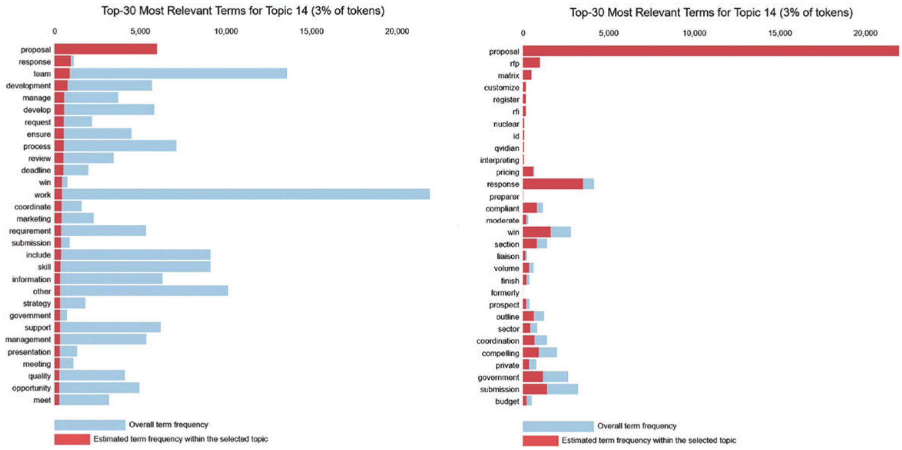

Figure 10.3. A visual comparison of the words in Topic 14, Proposals. The most probable words are shown on the left, and the words with the highest lift (indicating less likely to appear in other topics) is on the right.

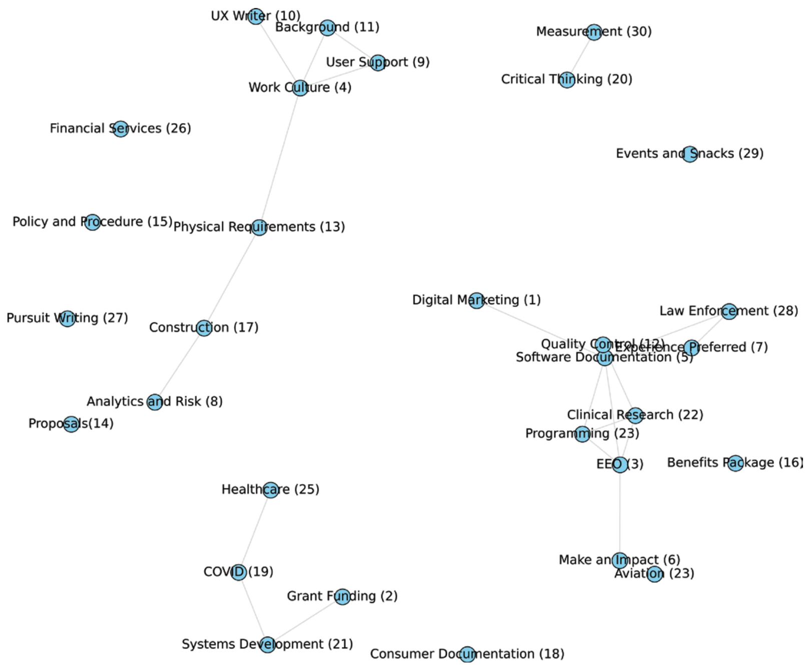

Figure 10.4. Network diagram of strongest topic correlations. Lines connect nodes with a tie strength > .1, indicating a potential relationship between the topics. Correlations were calculated between each topic based on the topic-document matrix using Pearson correlation. Numbers in parentheses reflect the topic number in the topic model.

Figure 10.4 shows the correlation between the topics (Lindstedt, 2019). According to Sievert and Shirley (2014), the interactive visualization "enables deep inspection of topic-term relationships in an LDA model, while simultaneously providing a global view of the topics" (p. 69). The key functionality in the LDA visualization is the relevance slider which allows users to adjust the way 'relevance' is calculated by balancing two measurements: its *probability* and its *lift*, and the top terms by both are presented in Table 10.7. The probability of a word occurring in a topic is higher for more common words, while the lift score of each word is determined by calculating a ratio of the probability within a topic to its probability across the corpus. Understanding topics becomes easier when looking at both frequently occurring words in a topic and words that are less frequent but unique to the topic. The lift score often reveals words that occur infrequently overall, but are much more common with a particular topic.

Table 10.7. Word Lists Representing Each Topic Generated in the LDA Topic Model*

	1 - Digital Marketing		**2 - Grant Funding**	
	Probable	**High Lift**	**Probable**	**High Lift**
1.	content	image	include	student
2.	skill	audio	program	grant
3.	ability	seo	experience	administrative
4.	write	original	provide	funding
5.	experience	white	other	validation
6.	writing	threat	position	letter
7.	work	proofreading	support	behavior
8.	strong	succinct	report	dependent
9.	communication	minority	work	brochure
10.	technical	constructive	require	classification
	3 - EEO		**4 - Work Culture**	
	Probable	**High Lift**	**Probable**	**High Lift**
1.	status	creed	team	even
2.	gender	discrimination	work	cell
3.	disability	genetic	look	much
4.	protect	prohibit	role	choose
5.	work	harassment	experience	air
6.	national	permit	new	raise
7.	race	grade	base	eager
8.	origin	tough	benefit	excited
9.	orientation	political	company	happy
10.	sexual	affiliation	learn	entertainment

	5 - Software Documentation		6 - Make an Impact	
	Probable	**High Lift**	**Probable**	**High Lift**
1.	documentation	api	work	difference
2.	product	programmer	people	embrace
3.	technical	fix	world	too
4.	software	scratch	make	boundary
5.	experience	cyber	help	dream
6.	user	screenshot	life	belong
7.	team	alone	well	authentic
8.	create	facing	opportunity	redefine
9.	work	distinguish	diverse	forefront
10.	use	instrumental	way	ahead
	7 - Experience Preferred		**8 - Analytics and Risk**	
	Probable	**High Lift**	**Probable**	**High Lift**
1.	experience	commute	business	conform
2.	technical	relocate	management	effectiveness
3.	work	mechanical	process	identification
4.	year	reliably	team	proven
5.	location	desktop	experience	fulfill
6.	time	podcast	project	sequence
7.	require	shift	develop	stream
8.	hour	registration	role	alignment
9.	writing	historical	functional	query
10.	document	raw	lead	logic
	9 - User Support		**10 - UX Writer**	
	Probable	**High Lift**	**Probable**	**High Lift**
1.	customer	edge	content	unlock
2.	technology	campus	product	localization
3.	technical	cut	experience	failure
4.	solution	authoring	user	strategist
5.	experience	computing	customer	encouraging
6.	service	listening	work	landing
7.	cloud	proprietary	design	evolution
8.	provide	tier	create	obsession
9.	datum	gas	strategy	iterate
10.	company	unparalleled	team	uncover

	11 - Background		12 - Quality Control	
	Probable	**High Lift**	**Probable**	**High Lift**
1.	applicant	criminal	document	monitoring
2.	employment	affirmative	system	deviation
3.	accommodation	hiring	ensure	inspection
4.	opportunity	recruitment	procedure	batch
5.	application	charge	control	instructor
6.	position	recruiting	requirement	root
7.	disability	conviction	review	conclusion
8.	process	placement	change	classroom
9.	provide	disclose	record	capa
10.	consider	disabled	compliance	corrective
	13 - Physical Requirements		**14 - Proposals**	
	Probable	**High Lift**	**Probable**	**High Lift**
1.	perform	representative	proposal	proposal
2.	require	site	win	rfp
3.	duty	laboratory	requirement	matrix
4.	job	occasionally	submission	customize
5.	ability	lift	include	register
6.	employee	walk	skill	rfi
7.	other	pound	information	nuclear
8.	assign	contain	other	id
9.	function	object	strategy	qvidian
10.	essential	incumbent	government	interpreting
	15 - Policy and Procedure		**16 - Benefits Package**	
	Probable	**High Lift**	**Probable**	**High Lift**
1.	document	continuity	insurance	dental
2.	procedure	confidentiality	pay	savings
3.	documentation	mortgage	benefit	spending
4.	process	suit	time	checklist
5.	technical	moderately	dental	retirement
6.	policy	css	company	discount
7.	information	lending	employee	immediately
8.	standard	intranet	plan	sick
9.	maintain	simplifie	offer	tuition
10.	template	bond	match	technician

	17 - Construction		18 - Consumer Documentation	
	Probable	**High Lift**	**Probable**	**High Lift**
1.	project	construction	content	teaching
2.	design	selection	training	maximum
3.	engineering	sustainable	create	centralized
4.	technical	architectural	material	informative
5.	specification	abreast	information	groundbreaking
6.	construction	committee	write	complement
7.	firm	profession	need	outdoor
8.	coordinate	forum	understand	distill
9.	provide	notch	audience	financially
10	development	attach	instructional	confluence
	19 - COVID		**20 - Critical Thinking**	
	Probable	**High Lift**	**Probable**	**High Lift**
1.	covid	faculty	ability	judgment
2.	vaccination	vaccine	knowledge	comment
3.	vaccinate	light	information	lesson
4.	faculty	card	problem	diploma
5.	fully	mathematic	understand	exchange
6.	health	attribute	require	certificate
7.	include	emergency	concept	concurrently
8.	safety	chemistry	method	fashion
9.	requirement	mask	basic	delegate
10	vaccine	pandemic	technique	cognizant
	21 - Systems Development		**22 - Clinical Research**	
	Probable	**High Lift**	**Probable**	**High Lift**
1.	experience	assembly	medical	clinical
2.	engineering	lab	clinical	scientific
3.	product	carrier	scientific	phd
4.	development	ease	regulatory	manuscript
5.	technical	smartphone	science	dose
6.	demonstrate	actalent	device	systematic
7.	support	established	document	statistical
8.	drive	aviation	submission	collaborator
9.	process	transparent	datum	communicating
10	good	discrepancy	review	endeavor

	23 - Programming		24 - Aviation	
	Probable	**High Lift**	**Probable**	**High Lift**
1.	programming	programming	production	operator
2.	application	multimedia	material	http
3.	technical	electrical	engineering	sketch
4.	developer	networking	drawing	flight
5.	language	server	specification	slide
6.	system	troubleshoot	technical	aircraft
7.	engineering	licensing	equipment	bulletin
8.	xml	scam	chart	schematic
9.	technology	setup	interview	revolutionary
10	multimedia	demonstration	illustration	usd
	25 - Healthcare		**26 - Financial Services**	
	Probable	**High Lift**	**Probable**	**High Lift**
1.	healthcare	healthcare	client	employ
2.	patient	patient	service	capital
3.	university	university	financial	catalog
4.	medicine	medicine	firm	side
5.	school	school	employ	expense
6.	departmental	packaging	capital	upcoming
7.	college	ideally	investment	legacy
8.	education	accredited	credit	client
9.	care	artwork	market	corporation
10.	show	initial	catalog	investment
	27 - Pursuit Writing		**28 - Law Enforcement**	
	Probable	**High Lift**	**Probable**	**High Lift**
1.	bid	bid	productivity	productivity
2.	executive	extract	citizen	citizen
3.	pursuit	pose	mark	mark
4.	persuasive	humanity	sensitive	externally
5.	messaging	grammatically	client	rank
6.	extract	tune	externally	recognition
7.	pose	jargon	rank	touch
8.	team	journalistic	recognition	residence
9.	humanity	liberal	touch	autonomy
10.	business	crisp	internally	justice

	29 - Events and Snacks		30 - Measurement	
	Probable	**High Lift**	**Probable**	**High Lift**
1.	event	frequent	store	store
2.	frequent	sport	sometimes	sometimes
3.	investor	lunch	retail	measurement
4.	space	snack	measurement	stereotype
5.	sport	publicly	stereotype	fantastic
6.	lunch	ramp	fantastic	retail
7.	snack	off	abroad	abroad
8.	regulate	breakfast	cellphone	cellphone
9.	publicly	premier	filesystem	filesystem
10.	ramp	kitchen	git	git

** Each topic includes two word lists. The most probable words (most frequently occurring) for the topic and words with a high lift (which is calculated as a ratio with the whole corpus indicating these words are more exclusive to the topic).*

Discussion

While there are several limitations that are worth acknowledging with this study, we believe that the topic and study design ensure that the limitations point to the potential for additional research to map the field through job advertisements and related texts. The methods are extendable by design, and the available content for investigation pose both challenges and opportunities. In the discussion that follows, we begin to lay out our interpretation of the results, but time and the constraints of this article make it impossible to fully investigate all of the patterns that emerge from a large corpus. It is worth noting that the corpus itself likely favors entry-level positions for several reasons. First, as a ratio, there are fewer senior-level or managerial positions, so the corpus represents more entry or mid-level positions. Additionally, senior positions may not be advertised as frequently as companies seek candidates through other strategies such as internal promotion or targeted recruiting. We have identified one avenue for investigating senior positions through advertisements, though, by isolating positions based on the job title. However, the analysis here primarily focuses on the corpus as a whole.

Using text mining as a distant reading technique requires judgment and interpretation. While the findings from this study are driven by the data and the process could be repeated, the choices made during the analysis (which topics to investigate when generating frequency lists, the parameters for the LDA model, which topics to analyze from the topic model) are driven by researcher judgment. Topic modeling is a form of unsupervised machine learning. Small adjustments in the parameters can lead to variations in the topics. Determining an appropriate number of topics can be a challenge, and in this study the final model was selected after several iterations and review topic distribution using pyLDAvis. The topic model discussed in this study is one model among many, so this should not be understood as a definitive list.

Additionally, while the corpus analyzed in this study was systematically constructed, the data cannot fully represent the field of technical writing for several reasons. First, the collection strategy focuses on high-population locations in the US, and further investigation should be done in rural and international locations. Additionally, the search terms of *technical writer* and *technical writing* limit what is included. Technical writers have many responsibilities and job titles that were not the focus of the collection process, and it is our hope that a more complete picture can be developed with follow-up studies. Finally, job advertisements are imperfect representations of the jobs they describe as they are at times incomplete or overwritten to include more than necessary.

As an imperfect reflection of what it means to be a technical writer, though, the patterns and language within the job advertisements may have several implications. In this section, we discuss some of the patterns that we find most notable based on the data presented above. We offer these observations, hypotheses, and questions as an invitation for further inquiry about how the meta-genre of job ads shapes the field.

Industry Implications

Domain-specific topics present opportunities for understanding when and where technical writers can make an impact. These topics reflect industry-based domain knowledge and specialized skills that may be most beneficial when seeking career opportunities. The topic model, presented in Table 10.7, highlights many specialized industries and roles for technical writers. Working in each domain could require additional expertise beyond the scope of the core technical writing and communication skills. Topic 17, construction, may include several industries related to design, engineering, and architecture.

The knowledge and interests needed for working in a construction-focused role will differ from those needed to write in a user support (Topic 9) or clinical research position (Topic 22). For example, analytics and risk, Topic 8, includes several positions that focus on business, data, and risk. To work in this capacity, the ads ask technical writers to be comfortable with "modeling process flows, data relationship flows and event sequencing" and "Advanced business and data analysis, business process and application knowledge." The ads also discuss a type of technical document that we have not encountered in our own training or in our teaching materials called "model documentation," a formal and essential type of documentation for communicating risk. Several of the positions appear to require a combination of business knowledge, data analytics, and communication skills that make for an exciting and unique combination of skills. Certain aspects of the work within each of these fields will be unique. The goals, genres, domain knowledge, and ancillary skills needed will vary for technical writers documenting software or drafting policies for corporations. If we consider job descriptions as collections of "wordings and activities, demonstrated precedents or sequestered expectations" about how technical writers should work (Giltrow, 2002, p.195), we can better understand how our discipline is being shaped by these external, but related documents. Future studies could map these domains more precisely.

Many of the topics–including digital marketing, grant writing, software documentation, analytics and risk, user support, UX writer, quality control, policy and procedure, construction, consumer documentation, clinical research, aviation, healthcare, and financial services–provide some insight into different professional avenues that technical writers could pursue. These topics also appear to identify the industries and roles that have been recently hiring technical writers, and investigations into the similarities and unique skills that are required between these topics could be valuable. Like our study, some of the most insightful studies about communication skills in the workplace (Coffelt et al., 2022; Shalamova et al., 2019) provide insights about communication skills by looking across industries and roles. Further analysis that compares the required skills and career options for technical writers in each industry could provide additional insights. An analysis that provides a detailed comparison of the experiences, skills, and expectations for technical writers in several industries could add additional valuable insights for educators, researchers, practitioners, and hiring managers.

Digital Media and Writing Technologies

A comparison of the topic model and frequency data for language related to technology illustrates one of the challenges of our field. Many writing technologies and their related skills appear in the data underscoring the value or necessity of writing technologies. In the topic model in Table 10.7, Topic 1 shows language associated with digital media and the web, and Topic 23 contains language related to programming and code. The topic model indicates that there are patterns in which digital media and programming are discussed in the job ads. We reviewed the frequency data for the whole corpus, and the data shows that specific tools are rarely mentioned in the job ads. Table 10.6 reveals that in the entire corpus of job ads, there are many tools and technologies discussed, but specific technologies (which we categorized as authoring tools, programming languages, content management systems, or social media platforms) are each only rarely mentioned. These observable patterns have several potential implications and raise some important questions about the practical relationship between technical writing and the technologies of writing. For example, do the practices of technical writers govern the technologies used for documentation, or are new technologies further expanding the definition of *technical writing*? Is the practice of technical writing too closely linked to the work of translation within specific industries? Are the tools for technical writers evolving so quickly that it's difficult to define technical communication in succinct terms?

Broad familiarity with tools appears most useful.

Generic mentions of authoring and design tools include Microsoft (35%), Adobe (19%) and Google (6.1%) which may function as a need for broad familiarity with common writing applications. The most frequent specific applications identified include infrequent mentions of tools for collaboration, visual design, structured authoring, and prototyping. Further research and analysis could be conducted to understand the perspectives of hiring managers and applicants about the transferability of skills between similar tool types to better understand these findings. For example, do employers see comfort with Microsoft Office or Google Workspace as interchangeable? Is familiarity with JIRA enough for teams that use Confluence? Are Adobe XD skills sufficiently valuable to join workflows that rely on Figma? Understanding the assumptions of both employers and job seekers on these questions would be valuable.

Minimal coding is requested.

Words related to coding, programming, and structured authoring appear infrequently. The most frequent type of coding involves markup languages with HTML appearing in 451 (9.8%), XML in 389 (8.5%), DITA in 214 (4.7%), and Markdown in 185 (4%). We take these observations to indicate that a strong awareness of and comfort writing in coding environments is often important, but the ability to code or program is rarely requested. Further research should be done to investigate the roles and industries in which coding is most and least valued. Additional research could also be conducted to determine the ways career paths evolve in terms of opportunities and promotions based on various combinations of skill sets.

Content systems are rarely mentioned.

Content management and social media are both significant cornerstones of TPC curricula and are frequently discussed in our scholarship (Andersen, 2014; Bowdon, 2014; Bridgeford, 2020; Clark, 2008; Roundtree, 2018b; Shen et al., 2022; Wang & Gu, 2016). Given the significance of both, we anticipated technical writing job ads to discuss Content Management Systems (CMSes) and Social Media Platforms; however, in our study, both are rarely mentioned as shown in Table 10.6. There appears to be a gap between the significance these systems have in the work of communicators and their inclusion in job ads. One explanation could be that writers in these positions will be more focused on producing content that can be shared in digital spaces than on managing the digital spaces. It is likely that more senior roles will need to focus on managing and distributing content, which entails a higher level of responsibility and specialization.

Other potential reasons for these findings should be considered and investigated as well. It is plausible that businesses don't want to share information about which tools they use. As a component of business operations, protecting this information may be viewed as necessary to maintain a competitive advantage. Alternatively, job advertisements are an initial call that requires candidates to self-select into applying, and naming the technologies may dissuade appealing candidates. Hiring managers may be more comfortable training or retraining good candidates on the necessary technologies.

In regards to technological skills and writing tools, this study aligns with previous studies that have suggested that a broad aptitude for using writing technologies is needed by technical writers, but that deep knowledge of any specific tools set may not be needed. Scholars have established that for technical writers, a broad comfort with technology and an ability to work with content across systems is necessary, while hiring managers likely expect new hires to quickly adapt. The expectation at the point of hiring appears to be that technical writers can adapt and adopt the necessary technologies. Avoiding the names of specific technologies that a writer will engage with in the job advertisement could be a strategic choice by managers and HR departments.

The data in this study support the arguments of Marjorie Rush Hovde and Corinne C. Renguette (2017) that technological literacy should aim to teach students how to learn new tools quickly and evaluate their suitability for specific tasks. Similarly, Nadya Shalamova et al. (2019) found that technical communicators benefit from a general ability to work with technology, to adapt and stay current. The findings also align with the conclusions of Ann Hill Duin and Jason Tham (2018) who have asserted that, for technical communicators, code literacy should be treated "as a holistic competency [that] includes the ability to distinguish between code-as-language, code-as-tool, and code-as-structure" (p. 55). Many technical writers may find themselves in positions where it is valuable or necessary to work with code, but the ability to write code on its own is unlikely to be sufficient.

Proposal and Grant Writing

The separation of grant writing (Topic 2) from proposal writing (Topic 14) points to a clear divide between non-profit and for-profit positions. Topic 2 includes positions for organizations and programs that depend on grants and donors. These positions include charities and advocacy groups that rely heavily on proposals and reports associated with obtaining and sustaining funding for their work. Topic 14 is about proposals in a traditional sense, with ads focused on direct responses to RFPs. The emergence of distinct topics around the seemingly similar roles of grant and proposal writing shows that these roles are considered, at least in the marketplace, to be distinct in significant ways. Our initial analysis suggests that the positions that fit grant writing and proposal writing show clearly distinct workplace cultures and knowledge domains.

Pursuit Writing and Pursuit Strategist

A related, but unexpected, category emerged in the topic model. Topic 27 points to the emergence of a role not previously known to our team called 'pursuit writer' that is a strategic writing position focused on developing business opportunities or pursuing funding. A search in our academic databases did not reveal scholarly discussions of pursuit writing or pursuit strategy; however, there are several companies using these labels for key positions. Initially, this role sounds similar in nature to the work of proposal and grant writers, but there are some important distinctions. Language in job ads under Topic 27 often focused on audience analysis, or gaining insight into the client's needs in order to write a compelling proposal. One job ad in this group specifically focused on dissecting discussions, capturing information accurately, and reducing jargon for increased clarity. Better understanding the function of a pursuit writer or pursuit strategist would likely reveal valuable insights about the ways businesses develop a competitive edge when seeking relationships and funding.

Marketing to Potential Applicants

While it is undoubtedly the case that job advertisements are often written to entice applicants, the unique facets of this strategy in technical communication have several potential implications worth further investigation. Topic 4, workplace culture, revealed several strategies in the advertisements to attract applicants and introduce the type of work environment. Ads associated with Topic 4 often include language related to passion and inspiration with phrases like "leads by example and is passionate" and "write about your passions while educating other developers." Teamwork and collaboration are viewed as highly valued and positive in some of these ads with statements like "Our Customer Success team is one of the most tight-knit groups at the company" and "You will work with some of the smartest and most interesting people in the industry." Others talk about a culture of growth: "join a large team and get the chance to grow and learn from the experienced and passionate in-house team." Many of the advertisements emphasize how exciting and appealing the position is with claims like "Get paid well to write about your passions while educating other developers with your own voice." The emphasis on the relationship between personal investment, passion, collaboration, and an exciting work environment creates a positive tone and a sense of excitement. However, further investigation is needed to understand how 'culture marketing' and 'definable job tasks' are parsed out within the meta-genre of job ads.

The use of these appeals could be a strategy to motivate applicants, or it could be a strategy to find applicants with valuable character traits for certain positions. Workplace culture correlates with UX writer and with user support (see Figure 10.4), which indicates that the language about creating a positive workplace relates to creating a positive experience for customers. The kind of enthusiasm that is presented in the ads aligns well with the kind of investment and excitement that companies want to see from customers. The positivity and impact-oriented language could be seen as underscoring the role of technical writers as user advocates (Jones, 2016; Cleary & Flammia, 2012). Additionally, some employers may expect that technical writers that are motivated by dynamic, fast-paced, collaborative workspaces are more likely to be self-motivated and more prepared to gather needed information and feedback from their teams. In this way, the topic may point to the technical writer's role as a 'relationship-builder,' as found previously by Tammy Rice-Bailey (2016). Further research should be done to understand the use of workplace culture in job advertisements.

Backgrounds and Physical Requirements

The LDA analysis identified several topics based on the 'boilerplate' content that we would have initially overlooked, for example, Topic 3 (EEO), Topic 7 (Experience Preferred), Topic 11 (Background), Topic 13 (Physical Requirements), and Topic 16 (Benefits package). Our initial assumptions about some content in the advertisements was that the information is corporate/human resources language that has little to do with the positions being described. However, when reviewing positions that had contained some of these generic topics, some interesting questions emerged about the value of certain backgrounds for technical writers and the physical requirements that employers list for applicants, which we discuss below.

Encouraging Veterans and People with Criminal Backgrounds

Topic 3 and Topic 11 are closely related, sharing several words with some important differences. Topic 3 appears to be a general topic representing equal employment opportunity statements. By contrast, several of the ads matching Topic 11 include statements about supporting people with disabilities and disabled veterans, but they also include language about employee background checks. In reviewing these ads, an advertisement included a statement that 'we value diverse experiences, including prior contact with the criminal legal system, and applicants with criminal histories are encouraged to apply."This statement follows the EEO section, and could be easy to overlook, but it points to an interesting question about criminal backgrounds and technical writing. A search for the word 'criminal' found 291 tokens over 235 job ads, and a search for the phrase 'background check' found 204 occurrences in 166 ads. The short review found that most instances of criminal activity appeared to encourage applicants to apply regardless of their criminal background, and many of these positions were in technology companies. Further investigation about the expectations for background checks could provide insights into the boundaries between the expectations of human resources and required qualifications for technical writing roles.

Unexpected Physical Requirements

Additionally, Topic 13, which is about physical requirements, may seem out of place, but several of the advertisements with this section are for companies that involve manufacturing and may include requirements to engage with subject matter experts and to work with products in ways that matter to the position. For example, one advertisement says, "the employee is regularly required to use hands to finger, handle, or feel and reach with hands and arms…the employee must regularly lift and / or move up to 10 pounds and occasionally lift and/or move up to 25 pounds… while performing the duties of this Job, the employee is occasionally exposed to fumes or airborne particles." Another ad explains, "the employee is regularly required to sit; use hands/fingers to handle, or feel and talk or hear…specific vision abilities required by this job include close vision and ability to adjust focus. The employee must have sufficient mobility to enable travel to industrial sites, offices, and facilities." A third describes the physical requirements as, "the employee is required to talk, hear, and see. The employee frequently is required to stand, walk, sit, use hands to finger, handle or feel objects, tools, or controls; and reach with hands and arms to read dials, graphs, and procedures." Some of the physical abilities may be associated with operating a computer in an office setting, and the physical requirements described may have the effect of discouraging applications from well qualified candidates. This language may point to a poor understanding of how effective communication can be accomplished with a range of assistive technologies. However, there are also indications that the physical requirements extend further and some of the environmental factors of a manufacturing environment and the types of cross-functional work expected necessitate these expectations.

Conclusion

Texts are a product of technical writing, but texts also define what technical writing is. The genres that describe our work provide the features that can be used to map the most salient features and expectations. As a meta-genre for the field of technical writing, job ads present an opportunity to consider how the language, although often written by non-technical communicators (e.g., human resources departments and hiring managers), shapes roles, defines responsibilities, and establishes expectations. The process of mapping the texts that describe technical writing creates a data-driven opportunity for investigation that has several implications.

Definitional: Mapping the gaps and boundaries can help create moments of reflection and negotiation. If there's a disconnect between what the field is saying technical communication is versus what hiring managers think a technical communicator is, we need to identify the differences and learn to cross disciplinary and cultural boundaries.

Theoretical: Job advertisements often include fragmented descriptions that are a copy of a copy of a copy, yet they play an essential function. The recurring language that is used to solicit work tells us how others understand technical communication, and these descriptions give a glimpse of what the marketplace expects technical writers to know, to be, and to do.

Methodological: Methods developed as machine learning and natural language processing have numerous potential uses in TPC scholarship. Conceptualizing text as data, specifically topic models, provides a path for how we might begin to shift the ethos of the field toward a more quantifiable, mixed method understanding of ourselves. When we treat text as data, we open new analytical tools. We gain the ability to understand the field, including new descriptions of the field that have the potential for better representation than other means provide.

Pedagogy and professionalization: While classroom practices must balance several demands, employability is one dimension of what this type of analysis strives for. To meet the needs of our students, our courses and programs must provide opportunities to develop knowledge and skills that prepare them to meet the challenges ahead of them. Providing job seekers themselves with topic models can create opportunities to strategize skill development and examine career options.

Ultimately, an analysis of job ads results in one perspective on the field and there are some things this data set can't show. However, technical communication scholars and practitioners can both benefit by examining the patterns that are revealed in an ongoing effort to understand the topics, skills, and boundaries that mark our field. Keeping an eye on the defining features of our field seems especially important as we continue to adjust from a wave of remote work, as new language technologies are disrupting the work of content production, and as higher education continues to face funding and enrollment challenges. No matter what position we play in the field, we need strategies to situate our work, to describe how we make an impact, and to communicate our value in both industry and academia.

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11. "Not Favors, but Fair Play": Black Technical Communicators in Mid-Twentieth-Century America

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Abstract: This study problematizes dominant historical narratives of the technical communication profession—narratives that have traditionally focused on organizations like STC and IEEE PCS—by foregrounding the overlooked presence and contributions of Black technical communicators from the 1940s through the 1960s. Drawing on archival and genealogical research, the author identifies Black technical writers, editors, and illustrators who worked in U.S. government and industry during the profession's formative decades. Employing the antenarrative method of *microstoria*, the study emphasizes the individual stories of practitioners who have been largely invisible in the field's recorded history. The project offers the first attempt to compile a registry of mid-20th-century Black technical communicators, presenting reconstructed historical and biographical details that shed light on their professional lives and experiences. In doing so, it not only documents individual contributions but also provides a foundation for broader scholarly engagement with the roles these communicators played in shaping the profession. Ultimately, the study argues that recognizing and integrating their legacy into the history of technical communication would strengthen both the discipline and the profession by offering a more inclusive and accurate account of its development.

Keywords: history of technical communication, African Americans, employment opportunities, antinarrative, civil service examinations

One area of Black Technical and Professional Communication that has not received scholarly attention is the presence and contributions of Black technical communicators in the middle of the 20th century—roughly from 1935 to 1965.[1] During this period, a self-aware profession of technical communication emerged from a group of related occupations devoted to the communication of technical information, and the number of people working in the government and private sectors with job titles such as "technical writer," "technical editor," and "technical illustrator" proliferated. Many Black technical communicators were hired by the government and private

1. For an anticipation of the present study, see Malone (2023), p. 139. For a definition of Black TPC, see McKoy et al. (2020), along with representative scholarship on Black TPC found in that issue

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companies as technical communicators during this period, although they must have comprised only a small percentage of all technical communicators.

If someone were to look only at photographs in the publications of the earliest professional organizations in technical communication from 1954 to 1965, they would see very few Black technical communicators—far fewer than even female technical communicators, who experienced their own kind of invisibility, in addition to being underrepresented, during the early professional era. These organizations, which would later form the Society for Technical Communication (STC) and the IEEE Professional Communication Society (PCS), left a photographic record that suggests Black technical communicators were scarcer than they actually were. From the conference proceedings, chapter newsletters, journals, and membership lists of these organizations, it is difficult to derive a clear sense of the presence and contributions of Black people to the emerging profession of technical communication. The researcher must look elsewhere for evidence of the lived experiences of Black technical communicators in mid-20th century America.

In this study, I located and identified Black people who worked as technical communicators in the 1940s, 1950s, and 1960s. My goal was not to compile an exhaustive list, but to begin to compile a list that can inspire and serve as a resource for future research. Where did Black technical communicators work during these years? Who were they? What were their educational backgrounds? How did their careers develop over time? What experiences did they have as professionals and Black Americans before, during, and immediately after the Civil Rights era (1950–1963)? I was happy when I was able to answer the first two questions about an individual, even happier when I could answer three or four of the questions, and delighted on those rare occasions when I could answer the last question in any way.

I searched census records, especially the 1950 U.S. Census, which generally documented job titles more clearly and consistently than earlier censuses. I relied heavily on newspaper articles, especially in historically Black newspapers; articles such as feature stories, engagement and wedding announcements, and obituaries were helpful in identifying individuals who worked as technical writers, editors, and illustrators in earlier decades. Once I had identified a Black technical communicator, I was able to collect biographical information from a wide variety of genealogical sources. The lives of some of these technical communicators are better documented in these sources than others, as is the case in general. Occasionally, I came across interviews with individuals in which they spoke about their lived experiences in their own words. These interviews were relatively rare, however. Furthermore, I was able to inspect the federal civilian personnel files of several individuals. Most of my profiles were pieced together from fragments of information spread across multiple sources.[2]

2. The federal civilian personnel files are held by the U.S. National Archives and Records Administration (NARA). The personnel files of individuals who ended their federal

Antenarrative has been defined as "the fragmented, nonlinear, incoherent, collective, unplotted and pre-narrative speculation" that is constructed "out of the flow of lived experience" (Boje, 2001, pp. 1, 3). Taking an antenarrative approach for this study, I use the strategy of microstoria to focus on "stories of the 'little people' telling many histories that were omitted from the … grand narratives of great heroes or grand projects" (Boje, 2001, pp. 9, 11). This strategy necessitates an "improper" storytelling that is "fragmented, polyphonic, and collectively produced" (Boje, 2001, p. 1). Such a strategy can make possible a reconsideration of existing macrohistory by calling into question assumptions based on incomplete evidence, discovering gaps in the long-accepted versions of stories that had previously seemed complete, and undermining bias that wittingly or unwittingly causes narrative distortion.[3]

In this vein, my study is a reclamation project that brings visibility to individuals who have been predominantly invisible, expanding our knowledge of who mid-20th century technical communicators were, where they worked, and what they did. It also seeks to problematize existing historical narratives about the technical communication profession (for example, those that emphasize the roles of STC and IEEE) by calling attention to the hitherto unacknowledged presence and contributions of many Black technical communicators from the 1940s through the 1960s.[4]

As one of the anonymous reviewers of this manuscript emphasized, "this is Black history and Black history can be located in every aspect of American life—including in unearthing historic examples of Black technical communicators. Discrimination, oppression, and systemic racism are part and parcel of the Black experience in the US." The technical communicators discussed in my study "did not face discrimination (housing, employment, isolation, etc.) because they were technical communicators," but rather "because they were Black and most every Black person in America was facing the same things at the time." Thus, I ask readers to keep this caution in mind as they read this chapter, especially the section about housing discrimination.

In the following sections, I first discuss opportunities for Black technical communicators from the 1910s through the 1960s, with an emphasis

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service before 1952 are archival (open to the public for inspection at NARA's St. Louis facility) while the personnel files of deceased individuals who ended their federal service after 1951 are non-archival (available in slightly redacted form by Freedom of Information Act request to NARA's Valmeyer, Illinois facility).

3. For examples of the antenarrative approach in technical communication scholarship, refer to Alexander & Edenfield (2024); Jones, Moore, and Walton (2016); and Petersen & Moeller (2016), among others.

4. For examples of historical narratives about the technical communication profession, see Bayne (2008); Connors (1982/2004); Kimball (2017); Kynell (2000); Kynell & Tebeaux (2009), and Malone (2011), as well as the series of STC-related reminiscences published in *Technical Communication* from 1989 to 1991.

on civil service examinations, and then I present a series of brief profiles of mid-20th-century Black technical communicators who worked in government and industry. I conclude by offering several hypotheses, or antenarrative bets, in lieu of definitive conclusions, inviting future research to expand, reconsider, and revise established narratives about the history of the technical communication profession.

Early Opportunities for Black Technical Communicators

In the first half of the 20th century, civil service examinations offered Black people some of their best opportunities to become career technical communicators, at least in theory. Civil service examinations were competitive tests that allowed government agencies to identify and rank qualified applicants for government jobs. These examinations gradually became a standard requirement for many government jobs after the passage of the Pendleton Civil Service Reform Act of 1883, which created the Civil Service Commission as a regulatory body to oversee the federal workforce, including the hiring of civil servants based on merit rather than political patronage.[5] Under the new civil service regime (1883–1979), the percentage of Black Americans employed in civil service jobs rose from approximately 0.6% in 1881 to 16.6% in 1979 (see Table 11.1), even though the merit-based system was marred by racism and sexism.

The earliest announcement I have found for a civil service examination for a technical communicator was published in newspapers around the country in 1907. Specifically, the 1907 examination was created "to fill a vacancy in the position of assistant technical editor, $115 per month, in the U.S. Geological Survey, and similar vacancies that may occur" ("News," 1907, p. 16). The examination had three parts: a thesis on one of two or three given subjects (presumably to be written at a post office or other designated site and evaluated later); general and technical training (to be "rated on application"); and general and special experience (also to be "rated on application"). The Geological Survey was seeking an individual, at least 20 years old, who had a degree in civil engineering as well as specific kinds of experience, including technical writing experience. Individuals without such training and experience would "not be admitted to the examination" ("News," 1907, p. 16).

Later civil service examinations for technical editor positions probably had similar gatekeeping to this 1907 examination. Black male engineers and female engineers were statistically scarce at this time (see Table 11.2), but could they be

5. Here and elsewhere, I use the term "civil service" to refer to the vast majority of civilian employees in the executive branch of the federal government. I do not use the term to mean military personnel, employees of the federal judicial and legislative branches, or state government employees. The number of civil service positions subject to examination reportedly rose from 10.5% in 1883 to 75% by 1930 (White, 1933, p. 249).

barred from taking such an examination? The law did not permit the federal government to exclude applicants from examinations because of their race, but it is not difficult to imagine how it could have been done through a discriminatory interpretation of qualifications, restricted access to information about an exam, or other mechanisms. After an examination had been administered, the infamous "rule of three" allowed appointing officers to choose from the top three ranked eligibles, and some officers used this mechanism to bypass Black eligibles on their lists (Golightly & Hemphill, 1945, p. 27). Employers could also terminate Black employees after appointment on the pretext of unsatisfactory job performance or some other reason (King, 2007).

Table 11.1. Percentage of Black Employees in Federal Civil Service (by Selected Year)[a]

Year	Number of All Employees in Federal Civil Service [b]	Number of All Black Employees in Federal Civil Service	Percentage of Total
1881	107,000	620	0.6
1892	171,000	2,393	1.4
1910	384,088	22,540	5.9
1930	608,915	54,684	9.0
1944 [c]	2,295,614	273,971	11.9
1965	2,233,615	308,675	13.8
1979	2,419,047	402,358	16.6

[a] *Source of Data: Hayes (1941, p. 153) for 1881, 1892, and 1910; Golightly and Hemphill (1945, p. 28) for 1944; and King (2007, pp. 241, 248–249) for 1930, 1965, and 1979. More than 60 years after the passage of the Pendleton Act in 1883, Davis and Golightly (1945) observed, "The appearance of the Civil Service Commission marked the beginning of a steady increase in Negro employment" (p. 337). (Note: This chapter reproduces historical wording from archival sources. Period terms such as "colored" and"Negro/Negroes" appear only in quoted material and source titles.) The years selected for Table 11.1 highlight this general upward trend, though they do not capture the occasional decline from year to year. Nor do they reflect that Black workers were overrepresented in low-level positions, often employed in roles below their educational and experiential qualifications.*

[b] *Unless otherwise noted, it is assumed that the numbers in this column include all classified and unclassified civil service positions in the executive branch. Only classified positions were subject to the Pendleton Act. In the 1944 sample, 30% (82,183) of the 273,971 Black civil-service employees held classified positions, while 51% of all civil-service employees did (Golightly & Hemphill, 1945, p. 33)—meaning that Black employees were underrepresented in classified positions. Although the number of civil-service employees increased significantly during World War II, many employees in unclassified positions were let go after the war, with Black workers disproportionately affected.*

[c] *The numbers for 1944 represent a sample of 85% of all full-time civil-service employees in the continental United States (Golightly & Hemphill, 1945, p. 21). The source specifies that all employees of the Departments of Agriculture, Labor, and Justice and field employees of the Post Office were excluded. Also likely excluded were employees in the territories of Alaska, Hawaii, Puerto Rico, and Guam, as well as at overseas military bases and other international sites.*

Table 11.2. Percentage of Technical Engineers Who Were Female and/or Black (by Selected U.S. Census Year)[a]

Year	Total Number of Technical Engineers	Total Number of Female Engineers	Percentage	Total Number of Black Engineers	Percentage
1910	88,755	11	0.01	175	0.20
1930	226,249	113	0.05	351	0.16
1950	527,190	6,660	1.30	1,770 (1,620 male, 150 female)	0.34

[a] *The numbers for female technical engineers (civil, electrical, mechanical, mining, chemical, and metallurgical) in 1910 and 1930 come from Dempsey (1933, p. 71). The numbers for Black technical engineers in 1910 and 1930 come from Duke (1941, p. 102). Both Dempsey and Duke report the same total number of technical engineers for each census year. The 1950 numbers for all technical engineers, female technical engineers, and Black technical engineers come from U.S. Bureau (1955, p. 29), which also divides Black engineers into male and female.*

When interpreting the 1950 numbers, it is important to consider that women, comprising about half of the total U.S. population, had a much larger potential labor pool than Black Americans, who made up around 10%, contributing to the disparity in their representation in engineering.

Census data should be used cautiously due to incompleteness (not everyone was counted), misrepresentation (not all respondents were accurate or honest), and sampling. The numbers for 1950, for example, are not actual counts, but rather statistical estimates extrapolated from an analysis of 3.5% of the population. It is also possible that some locomotive and stationary engineers were confused with technical engineers and vice versa. Surveyors were sometimes treated as civil engineers. Aeronautical engineers became a category of technical engineers in the 1950 census.

Moreover, sex-based discrimination was officially sanctioned, further complicating Black women's prospects for being hired under the merit-based civil service system. An 1870 law gave the head of any government department the discretion to hire a woman for any "clerkship." This law paradoxically led to the discretionary exclusion of all women from many civil service examinations (for example, 60% of the exams in the first half of 1919) until a Civil Service Commission ruling opened all examinations to all qualified men and women in November 1919. However, the ruling reaffirmed that sex-based hiring was discretionary (Nienburg, 1920). Thus, even though all exams were open to both sexes, appointing officers could still hire only women as nurses, only men as prison guards, etc.

This merit-based system was especially weak during the Woodrow Wilson presidency (1913–1921), when the government began requiring applicants to submit photographs of themselves (King, 2007). Yet the system created more job opportunities for Black people than would have been available without the system.

In the late 1920s, the *Baltimore Afro-American* published announcements for civil service examinations for technical editor positions with the Department of Agriculture's Forest Service ("Civil," 1927a) and the Department of Commerce's Bureau of Mines ("U.S.," 1929). The Forest Service did not specify desired qualifications, nor did it interpret "examination" in the traditional sense of a test:

"Competitors will not be required to report for examination at any place, but will be rated on their education, training, experience, and fitness, and samples of work to be filed with the application" ("Civil," 1927b). By contrast, the Bureau of Mines required an examination and "a combination of engineering and editorial or journalistic experience" ("Positions," 1929). The Baltimore Afro-*American* may have received these announcements from a government employee, a representative of the National Urban League, or a member of its own staff who had read them in another newspaper. Whatever the source may have been, the intent of their publication was clear: to encourage readers to compete for these positions.

A 1935 editorial in the *California Eagle*, another historically Black newspaper, revealed that a high-ranking Black presidential appointee—himself a beneficiary of the patronage system—was actively encouraging African Americans to take technical editor examinations. Under the title "Not Favors, but Fair Play," the editorial seemed to uncut his recruitment effort with weary skepticism:

> Simultaneously with the arrival of a report from Dr. William J. Thompkins, U.S. Recorder of Deeds, that on July 15 there would be United States Civil Service examinations for Senior Technical Editor at $4600 a year; Technical Editor, $3800 a year; Associate Technical Editor, $3200 a year, in which he advised Negroes to compete, many reports reached the editor's desk stating that segregation and discrimination was rampant in all government setups. ("Not Favors," 1935, p. 10)

Thus, while the government appeared to be recruiting Black candidates for high-paying technical and scientific jobs, it was widely understood that they could not expect "fair play," even in an examination system that ostensibly promised it.

Responding to pressure from labor leader A. Philip Randolph, the NAACP, and other advocates, President Franklin Roosevelt issued Executive Order 8802 in 1941 to directly address employment discrimination. The order prohibited certain forms of discrimination in federal departments and agencies involved in vocational and training programs for defense production, as well as in defense companies under government contract. It also established the Fair Employment Practices Committee to investigate violations. In 1948, responding to ongoing pressure from civil rights advocates, President Harry Truman issued Executive Order 9980, mandating that all federal personnel actions be based solely on merit and fitness and establishing the Fair Employment Board to oversee compliance. However, enforcement of the order's provisions was soon called into question.

In an August 1948 letter to the *Washington Post*, **Alvin Aubrey Webb (nicknamed "Chick," 1911–1996)** complained that Truman's order did little to prevent discrimination in civil service hiring. Webb had accumulated at least 13 years of civil service experience in various messenger and clerk positions at the Department of Treasury (1931–1939), the New York Naval Yard (1939–1940), and the

National Housing Agency (1944–1945). Nevertheless, when he started looking for a new government job in 1948, he experienced "the prejudicial run-around and by-pass that so many other colored job-seekers are subjected to daily by personnel officers" (Webb, 1948, p. 6). He claimed to know personally many people who had had run-ins with racist personnel directors in government. The Civil Service Commission, he wrote, "is apparently helpless to do anything about rectifying this infringement on its merit system during peacetime," even though Truman's executive order had directed all federal government agencies to appoint an officer to ensure fair employment practices (Webb, 1948, p. 6). Either because of or in spite of his public protest, Webb secured a clerk's position with the Veterans Administration in November 1948. He remained a clerk in different positions with the VA until September 1950 and then sold insurance for Progressive Life for the next six months.

Drawing on years of moonlighting experience as a journalist, Webb took the information specialist examination in October 1950, earning a strong GS-8 rating. Hoping to become an editorial clerk, he applied for the position that same month (Taylor, 1950; Sweeney, 1950), but the application stalled. In April 1951, he accepted a probationary appointment as a Property and Supply Clerk GS-4 with the Department of Commerce's National Production Authority (NPA). In August 1951, he applied again for an editorial clerk position, but before any action could be taken, a background check—conducted in connection with his probationary appointment—led to his dismissal from the NPA. The stated reasons for the dismissal were "neglect in discharge of financial obligations, lack of moral responsibility and integrity, and record of failure to properly discharge family obligations."[6] His outspoken nature, perceived over-ambition, and financial struggles may have all contributed to his dismissal in a system rife with bias.

Later Opportunities for Black Technical Communicators

For more than two decades, articles in historically Black newspapers presented technical writing as one of several new fields that offered opportunities for Black Americans and yet were "completely unfamiliar to the average Negro job applicant" (Granger, 1957, p. 8). The Black press tried to make readers aware of these fields. Writing near the end of WWII, Preston (1945) told Black college graduates that they could aspire to be more than "clerks, typists, and stenographers"

6. Webb's federal civilian personnel file at NARA's St. Louis facility contains many letters between his employers and his creditors, going back as far as 1935. The letters illustrate the aggressive debt collection practices that were common before the passage of the Fair Debt Collection Practices Act of 1977, which now prohibits creditors from contacting employers of customers who are in arrears on their bills. Information about Webb's life after leaving the NPA is sparse. In the 1950s, he worked as a reporter and editor for the *New York Age* and the *New York Amsterdam News*. In 1952, *Ebony* magazine announced his marriage to Lillian Waring, the NAACP's chief accountant ("New York," 1952).

and advised them to consider several up-and-coming occupational fields, such as technical writing. An anonymous writer for the National Newspaper Publishers Association (NNPA) News Service informed readers that technical writing and editing was a new field welcoming to women in particular ("Woman's World," 1959).[7] An anonymous writer for the *New York Amsterdam News* assured Black high school students that, if they stayed in school and applied themselves, they would be able to make a good living after graduation. Technical writing was just one of "the jobs that are looking for people. Not just white people. Negro people. Puerto Rican people. Good people." To bolster their hope, the writer added, "Things are changing. Equal opportunity is in business" ("Stay," 1966, p 34). Offering career advice to young Black people, both McKinney (1966) and Marshall (1968) recommended the field of technical writing and described at length what a technical writer does. McKinney referred his readers to the Society of Technical Writers and Publishers, the previous name of STC, for more information.

Prime Alexander Norman (a.k.a. Prime T. Norman, 1930–1988) found hope and possibilities in technical communication. He was a firm believer that art in general and technical illustration in particular could help Black youth. Born in Georgia and raised in Springfield, Massachusetts, Prime came from a family that owned and operated a laundry, and he became an expert in the family's trade, but his true love was drawing ("Prime," 1988). Although he dropped out of high school and regretted it, he managed to complete his secondary education while in the U.S. Army. In the late 1960s, Prime tried to make a difference in a Brooklyn neighborhood by teaching art to children. He felt that being able to draw would empower the children by giving them a means of self-expression and the skills necessary for later employment. In support of this goal, he founded the African Technical Illustration Organization (ATIO) as a vehicle for his instruction. Despite his employment struggles and frequent clashes with the legal system, he made his mark as a serious artist when his drawings were showcased in a public art exhibition in his hometown of Springfield (Andrewes, 1970).

Two newspaper articles, published approximately one year apart, reported on Prime's organization and efforts. The first was written by a Black reporter, George Todd, well known for his articles in the *New York Amsterdam News*. The second was written by a white reporter, Patricia Burstein, who would become famous in later years as the author of celebrity biographies. The contrast between the two articles—the first, sympathetic; the second, far less so—is striking. The headline of Todd's article was "Encourages Youth: Artist Aids Kids while Developing Self," while the headline of Burstein's article was "Dropout, 37, Trains Kid [sic] in Art to Free Thinking." The lead paragraphs of the two articles were also quite

7. The *Negro Newspaper* Publishers Association, also known as the *National Negro* Publishers Association, was founded in 1940. It changed its name to the *National Newspaper* Publishers Association in 1953. Its acronym has remained the same throughout its history: NNPA.

different in tone and emphasis. Todd (1966) wrote, "Prime T. Norman, a slender, bearded and serious young man, is deeply concerned with the future of black youths in Brooklyn and he is anxious to do something constructive to help them toward a more useful life" (p. 19). Burstein (1967) wrote, "The 37-year-old, bearded Negro said he did not know if he was expressing himself clearly, if anyone would understand what he was saying because 'I'm a high school dropout'" (p. B3).

In the 1950s and 1960s, there were many vocational schools that prepared students for technical communication jobs, and a few of them used historically Black newspapers to recruit Black students. For example, a new aircraft technical writing course at Los Angeles Trade-Technical Junior College was the topic of a 1951 article in the *Los Angeles Sentinel* ("Aircraft," 1951). Rather than paying for a classified or display ad, the college may have sent a press release (a pre-written article) to the newspaper, hoping they would publish it as filler and thereby advertise the course for free. Such press releases were a common marketing tool of universities and colleges. In the early 1960s, the *Los Angeles Sentinel* published both classified and display ads (e.g., Untitled, 1961) for a technical writing course offered by the S&T Associates School, one of many private vocational schools in the Los Angeles area. The *Philadelphia Tribune* published ads for technical writing and other courses being offered at the Philco Technical Center (Untitled, 1963) and the Community College of Philadelphia (Untitled, 1967b). Most of these courses were taught at night and on weekends for adults who had full-time jobs during the day.

One school that was very effective in publicizing employment opportunities in technical communication was the Letcher Art Center in Washington DC. In the mid-1950s, this school ran several display ads in the *Washington Afro American*, touting the success of its graduates in finding art-related employment, mostly in the federal government in the DC area. The jobs of the graduates listed in one 1957 display ad included upholsterer, sign painter, exhibition specialist (at the Smithsonian), engineering draftsman, and technical illustrator ("Brotherhood," 1957). I suspect that all the listed graduates were Black people, and not just because the six illustrators I was able to further identify were Black.[8] The ad features

8. Of the thirteen illustrators listed in the 1957 display ad, ten of them worked for the federal government and three for private companies. Because I was able to confirm that six of the illustrators were Black, I included them in Appendices A and B as other government and industry technical communicators: Nathaniel Briscoe, Augustus Budd, Ana Aikens Edmonds, John Locksley, Jon Massey, and Tracy Spinks. I did not include the remaining seven illustrators in Appendices A and B because I could not confirm they were Black, but my strong hunch is that they were: Reginald Brooke, Solar Enterprise; Robert Exum, Department of Health; Christopher Ford, Quartermaster Corps; Clifford Harris, Department of Interior; Lawrence Roland, Fort Belvoir; Edward Ross, Presentation Inc.; and Charles A. Thompson, Bureau of Standards. George Olden was listed in the display ad as a graphic artist for CBS, but I had already discovered from other sources that Olden (see Appendix A) worked as an illustrator for the government at a much earlier date.

a classroom photograph of Black students at work. The text of the ad states, "The Record below [referring to the list of graduates] clearly shows Brotherhood in America is growing. Many of these private companies and government agencies are now employing our graduates on their ability to produce" ("Brotherhood," 1957, p. 21). Although it was self-serving, the ad conveyed a message of hope that times might really be changing, and the message was backed up by concrete evidence: specific names of graduates and their employers.

There were many university courses in technical writing throughout the 20th century (Fountain, 1938; Kynell, 2000), but there were only a few formal degree programs in technical communication at universities in the 1950s. The first such program, started in 1953, was the master's degree in technical writing at Rensselaer Polytechnic Institute; the second, started in 1956, was the bachelor's degree in technical writing and publishing at Simmons College; and the third, started in 1958, was the bachelor's degree program in technical writing and editing at Carnegie Tech's Margaret Morrison College (Malone, 2011).

RPI's English department apparently advertised its program informally at other universities. Now in her 80s, La Bonnie Bianchi Townsend (telephone interview, 21 February 2023) told me that she learned about RPI's program from a poster she saw at George Washington University, where she was taking a summer course in partial differential equations. The poster "looked like an engraved wedding invitation," she recalled. She had already finished her engineering degree at Howard University, and rather than accept an offer of a teaching assistantship at Stanford University, she applied to RPI, was accepted with a fellowship, and moved to Troy, New York, graduating in June 1960 with a master's degree in technical writing (Rensselaer, 1960). Not only was she reportedly the first woman to graduate with a degree in electrical engineering from Howard, but she was also likely the first Black person to earn a university degree in technical writing ("Woman," 1961).

Some private companies sought to recruit technical communicators by placing display ads in historically Black publications. Before the Equal Employment Opportunity (EEO) gains of the early 1960s, such display ads were practically non-existent in these venues.[9] In the second half of the 1960s, however, they

9. Companies also advertised through classified ads, which were smaller and less expensive than display ads, but I made no attempt to count classified ads. The EEO gains of the 1960s were built on decades of hard work by organizations such as the National Urban League, NAACP, and the Brotherhood of Sleeping Car Porters, as well as on World War II-era pressures for labor equality and key government actions like President Roosevelt's 1941 Executive Order 8802 and President Truman's 1948 Executive Orders 9980 and 9981 (the latter desegregating the military). More immediately, however, they resulted from President Kennedy's 1961 Executive Order 10925 (establishing a committee to ensure EEO in government agencies and by government contractors), the Civil Rights Act of 1964 (outlawing discrimination based on race, color, religion, sex, and national origin), and President Johnson's 1965 Executive Order 11246 (expanding the 1964 Act's enforcement framework to government contractors and requiring affirmative action to promote EEO).

appeared occasionally. Table 11.3 lists representative companies that placed such display ads in Black newspapers and magazines. Each of the aerospace-and-defense manufacturers (large companies producing high-tech systems under government contracts) included "technical writer" in a list of multiple available positions. Notably, the ad for Royer and Roger, a technical service contractor, sought only technical writers. Royer and Roger, Inc., was one of many small companies in the "Brass Age" (Kimball, 2017, p. 335) that contracted technical services, such as technical writing, commercial art, and engineering project management, primarily to government agencies, particularly the military. The purpose of their ad may have been to meet federal EEO requirements while focusing on their specific need for technical writers.

Not including announcements for civil service examinations, the government's advertising of technical communication positions in historically Black newspapers also began with the emergence of new EEO policies. One example is the 1963 display ad that was published in the *Jackson Advocate*, announcing examinations for several positions at Fort McClellan, Alabama, including Technical Publications Editor ("Fort," 1963). It is not clear whether the ad was paid for by the Fort or constructed free from a press release, but newspapers did not usually format press releases as advertisements. Another example is the display ad for the Federal Job Information Center in the *Cleveland Call and Post* in 1967 (Untitled, 1967a). I do not know when the first Federal Job Information Center opened, but the earliest reference I could find to one on Newspapers.com was in a Des Moines newspaper in 1962. Mentions of these centers proliferated in the second half of the 1960s. The 1967 ad lists 33 federal government positions in the Cleveland area, including one for a technical editor.

Table 11.3. Examples of Companies Using Display Ads to Advertise Technical Writer Positions in Historically Black Publications (1963–1968)

Company	**Publication**	**Year**
Philco Houston	*Baltimore Afro-American* and *Philadelphia Tribune*	**1963**
Royer and Roger [a]	*Baltimore Afro-American*	**1965**
Lockheed-Georgia Company [b]	*Louisiana Weekly* and *Ebony*	**1965**
Douglas Aircraft Company's Missile and Space Systems Division	*Los Angeles Sentinel*	**1965**
Pratt and Whitney Aircraft	*Baltimore Afro-American*	**1967**
General Dynamics	*New York Amsterdam News*	**1968**
General Electric	*Norfolk Journal and Guide*	**1968**

[a] *Royer and Roger, Inc., was trying to hire 120 technical writers. For more information about this company, see Francis H. Royer's testimony before Congress (U.S. House, 1960, pp. 5122–5127).*

[b] *See Patton (2021) for a book-length discussion of EEO policies at the Lockheed-Georgia Company during this period.*

Examples of Black Technical Communicators in Government and Industry

Formidable institutional challenges notwithstanding, many Black people found work as technical editors, writers, and illustrators in government as well as private industry in mid-twentieth-century America. In this section, the profiles of these technical communicators, cobbled together from many different sources, can provide only glimpses of their educational backgrounds, employment histories, and personal and professional achievements. They also offer insight into the ways these individuals used their communication skills and economic security to engage in social, political, and personal work. Some are known to scholars in other disciplines; most remain unknown to everyone except their relatives and friends.

I have divided this section into two subsections: one featuring technical communicators employed in state and federal government and the other featuring those employed in private companies. Although Black people worked as technical communicators in many federal and state agencies, most of the government communicators profiled here were civilian employees of the three main branches of the military. After introducing a technical communicator who worked for the U.S. Department of Agriculture in North Carolina, I profile five civilian employees of the Air Force, four of the Army, and two of the Navy. My profiles of technical communicators in private companies are not organized so systematically, although I do group those who worked at the same locations—for example, at companies in Buffalo and at Remington Rand UNIVAC in St. Paul. For my profiles, I chose individuals whose lives were better documented than others and sometimes individuals who worked with them at the same location.

For each subsection, a corresponding appendix appears at the end of the chapter, listing other Black technical communicators I was able to identify. These appendices provide only brief information, and the information is only as reliable as my sources. For example, a gossip columnist in the *Philadelphia Tribune* identified now-famous Fran Ross as a technical editor at McGraw-Hill (“Social,” 1961), while other biographical sources described her as a proofreader and copy editor for McGraw-Hill. Can the gossip columnist be trusted on this detail? Nevertheless, I included Ross in Appendix B because at times she may have worked on technical books for McGraw-Hill. For each individual in the tables, I cite at least one representative source to help future researchers locate them.

Some of these individuals worked as technical communicators only briefly; others did so long term. Not all of them held the formal job title of “technical writer,” “technical editor,” or “technical illustrator,” but I included them in Appendices A and B if I found evidence that they engaged in technical communication. My decisions were guided by a specific definition of “technical communicator” : an employee in government or industry whose main job responsibility was to engage in activities such as writing, editing, or illustrating in order to help specific audiences understand

and/or use specialized information or technologies. I realize that the definition of a technical communicator must be broader or narrower than this in other contexts, but my focus is mid-20th-century employees in government and industry.

Inclusion decisions sometimes required me to distinguish technical communication from related fields like journalism, public relations, and engineering. For example, I included Sherman Briscoe and Lucius Henegan, information specialists for the USDA, in Appendix A because I found evidence that their roles at times involved significant technical communication alongside journalism and public relations work. However, I did not include other information specialists such as **George Emanuel Norford (1912 or 1913–2004)**, Chief of the Negro Interest Unit in the War Department's Public Information Division, and **Lemuel Eugene Graves (1915–1972)**, Chief of the News and Writing Section of the Marshall Plan's Economic Cooperation Administration. Both men held prominent communication roles in government, but I found no evidence that their work extended beyond news dissemination and public relations.[10] Similarly, I did not include artist **Bernadine Celeste Wesley (née Blessitt, a.k.a. Warren, 1919–2006)** because her work as an engineering draftsman appeared to focus on design rather than technical communication.

Employed in Government

Dazelle Beatrice Lowe (née Foster, 1894–1984)

Lowe's career falls mainly within the pre-professional era in technical communication, but I included her in this study because she retired in the 1950s.[11] Lowe (see Figure 11.1) was a home demonstration agent, paid fully or partly with federal funds, to show women how to use household appliances and employ best practices in homemaking. She engaged in oral technical communication and report

10. Many Black journalists worked as government information specialists during this era. They included Edwin Bush Jourdain (1900–1986), Constance Eleanor Daniel (née Hazel, 1893–1962), Dorothy Hanley Davis (née Hodge, a.k.a. Johnson, 1916–2004), Antoine Higgins Fuhr (1892–1980), Theodore Roosevelt Poston (1906–1974), and Alvin Ellsworth White (1895–1985). Retired Colonel Frank Martin Snowden (1885–1977) was an atypical member of this group because he was not a journalist. The work of information specialists with a "press" specialization typically focused on public-facing communication tasks such as gathering information, writing press releases, and giving speeches, but the content of their communications was sometimes technical.

11. I did not include George Washington Carver (1864–1943) and Lewis Howard Latimer (1848–1928) in this study because their careers ended before technical communicators began their professionalization project. In his analysis of Carver's technical bulletins for farmers, Gresham (1979) treated Carver as a technical communicator without diminishing Carver's contributions and achievements as a scientist. Latimer, who illustrated new technologies for patent applications, might also be treated as a technical communicator, although no one in our discipline has done so, to my knowledge. Latimer was affiliated with both Alexander Graham Bell and Thomas Edison.

writing from 1916 until her retirement in 1955 and supervised other women in similar roles. In her study of report writing in North Carolina canning clubs, Haller (1997) provided some background information that illuminates Lowe's extension work, but Haller's study focused on the years 1912 to 1916 and did not mention Lowe. Although Lowe's work has received some scholarly attention (e.g., Engelhardt, 2009; Jones, 2002), so far as I know, no one has yet written about Lowe as a technical communicator.

Born in Louisburg, North Carolina, she moved to the nearby capital city, Raleigh, where she attended school and worked as a domestic servant ("District Home," 1955; "Raleigh," 2011). In 1916, she graduated from Shaw University with a "Diploma from the academy" and certificates in domestic science and dressmaking ("Shaw," 1916). Although she would later take summer courses at Boston University, Simmons College, Hampton Institute, and Cornell University, I have found no evidence that she completed a bachelor's degree ("Lowe," 1984). She was hired on an emergency basis in 1916 to show Black women in Davidson County, NC, how to preserve food and use a fireless cooker (a container that allowed heated food to retain its heat and continue cooking without fire) ("Mrs. Dazelle," 1967).

Figure 11.1. Photo of Dazelle Beatrice Lowe (née Foster, 1894–1984). (Used with permission by NC State University Archives Photograph Collection Home Demonstration Work UA 023.009)

Lowe was teaching home economics in Raleigh at Washington Graded Public School in 1919 and Crosby-Garfield School in 1921, but she left teaching in 1923 when she was offered a full-time job as a home demonstration agent for Black families in Wake County as part of the North Carolina Agricultural Extension Service ("Raleigh," 2011; "Mrs. Dazelle," 1967). In a technical communication activity reminiscent of Ellen Swallow Richards' Rumford Kitchen, she helped design a model kitchen and dining room as an exhibit for the 1924 Negro Fair in Raleigh, North Carolina (Lippincott, 2003; "N.C. State," 1924).

By 1925, Lowe had assumed supervisory duties, leading a small team of agents throughout North Carolina ("Negro Home," 1925). Her duties included organizing state-wide meetings and filing annual reports of activities (for example, see Lowe, 1931) as well as demonstrating the latest home technologies and improved methods. The number of Black women working as agents (as technical communicators) in North Carolina increased over the years, apparently reaching 51 by 1955 ("District Home," 1955). In the year of her retirement, the USDA recognized her with a Superior Service Award for her accomplishments ("District Home," 1955).

Cleophes Foraker Bruster (1909–1985)

At least two Black technical communicators worked at Lowry Air Force Base in Denver in the 1950s. According to the U.S. Census, Bruster (sometimes spelled "Brewster" in sources) was working as a civilian technical illustrator at Lowry in 1950. A native of Oklahoma, and the son of a Baptist minister, Bruster studied fine arts at Colorado College in Colorado Springs (c. 1927–1931) and Kansas State Teachers College (now called Emporia State University) and later took courses in engineering and drafting at the University of Denver (*Pikes*, 1929; "Negro Recruits," 1942). Throughout the 1930s, he worked as a commercial artist in Chicago, Boston, New York, and Kansas City as well as Denver ("Negro Recruits," 1942). He was elected vice president of the Colorado Springs branch of the NAACP in 1935—evidence of his political involvement and standing in his community ("Branch News," 1936). For several weeks in Spring 1938, a display ad in the *Denver Star* announced, "Cleo F. Bruster, Commercial Artist, Now with Artex Printing Service" ("Cleo," 1938). According to his draft registration card, he had his own sign-making company in Denver in 1940. During his army service (1942–1945), he created signs and posters for the squadron at Minter Field in California ("Negro Recruits," 1942). I do not know when his employment at Lowry began and ended, but by 1958, he was working as a technical illustrator at the Glenn L. Miller Company in Denver ("Denver," 2011).[12]

12. An archivist at NARA's St. Louis facility told me that Bruster's federal employment ended in 1956. I can only surmise that it ended at Lowry because I have not seen his personnel file.

William Arthur Walters (1918–2009)

Walters also worked as a civilian technical communicator at Lowry Air Force Base, but he is remembered chiefly in connection with the Tuskegee Airmen. An Oklahoma native who graduated from a Denver high school in 1936, Walters enlisted in the Army Air Corp in May 1941, completed the radio operators' course at Illinois' Chanute Field a few months later, and was assigned to Moton Field in Tuskegee, Alabama ("Completes," 1941; Culver, 2010). He helped to keep the radios working properly for the now famous squadron of African American pilots (Culver, 2010). After the war, Walters earned a degree in mechanical industries at Tuskegee Institute; by 1950, he was teaching electronics at Stillman College in Alabama (Ater, 2019; Culver, 2010). He moved back to Denver and taught electronics at Lowry Air Force Base and later Metropolitan College (Culver, 2010). A 1961 article about his wife identified him specifically as a technical writer at Lowry (Hilliard, 1961). His obituary mentioned that he taught technical writing while at Lowry (Culver, 2010). Walters and other Tuskegee veterans were awarded congressional gold medals in 2007, and Walters' voice can still be heard in an exhibit at the National Park Service's Tuskegee Airmen National Historic Site in Alabama (Ater, 2019; McDonald, 2007).

Ella Louise Anderson (née Mayle, 1924–2011)[13]

Several Black technical communicators had long careers at Wright-Patterson Air Force Base (WPAFB) and the Defense Electronics Supply Center (DESC) near Dayton, Ohio. One of them was Ella Anderson, a technical editor. She grew up in and around Zanesville, Ohio, and was mentioned frequently in the local newspaper for her achievements in school and other activities (Ohio, 2023; "Senior," 1942). After graduating from high school in 1942, she moved to Dayton, where her older sister was already living, and began working as a typist at Patterson Field ("Colored," 1942; "Wedding," 1943). A year later, she married a soldier, George Anderson, eventually a long-time employee for General Motors in the Dayton area ("Wedding," 1943; "George," 2007). By the 1950 U.S. Census, Ella's role had changed from typist at Patterson to technical editor at WPAFB. It was not uncommon during this period for typists, stenographers, and secretaries to become technical editors. In my research, I have found many examples of this career progression. Ella later moved with other technical communicators to the Defense Electronics Supply Center (DESC), also in the Dayton area, which supplied electronic spare parts to all branches of the military ("Ella," 2011). She worked on DESC documentation and publications. According to her death certificate, she had an associate's degree, but I do not know in what subject ("Ohio," 2023).

13. In this paragraph, Ella and her spouse George have the same last name, so I use "Ella" consistently rather than "Anderson" to avoid confusion. I follow this practice in other profiles when the use of a woman's married name would be anachronistic in one part of a profile or when family members (e.g., Cecil and Joseph Lewis) share the same last name.

Lillian Clark (née Teal, a.k.a. French, 1914–1988)

Another technical illustrator at WPAFB was Lillian Clark. The 1950 U.S. Census for Dayton identifies Lillian as an "artist illustrator" and her husband, Arthur, as an "electronic scientist" at an "army air field." The use of "army air field" in the 1950 census was a misnomer because the Army Air Corps' Wright Field and Patterson Field had already been merged as Wright-Patterson Air Force Base in 1947. Arthur once said, "The U.S. government didn't start hiring African-American men and women until after about 1940, except for maids or elevator operators or men who would push the broom or mop" ("Clark," 1991). Most of the pre-World War II government jobs available to Black people—such as messenger, porter, file clerk, typist, etc.—were at the lower end of the job hierarchy. Arthur and Lillian were fortunate to secure two professional jobs at the same military installation at such an early date. Lillian worked as an artist for the Air Materiel Command at Wright Field/WPAFB from 1946 to 1957 and an art director at DESC from 1957 to 1975 (Ferris-Olson, 1996). Her work for the military in these decades would have involved technical illustration.

Lillian had married her first husband when she was only 15 ("Married," 1929), but that marriage did not last long. She met and married Arthur, her second husband, at the University of Kansas, Lawrence, before World War II (Ferris-Olson, 1996). He graduated in 1942 with a degree in electrical engineering, she in same year with a degree in fine arts ("Lillian," 1988). While in college, the couple noticed how many "minority students" were having to drop out of school because they could not afford to finish their degrees ("K.U.," 1991). The couple agreed that, if they ever had the financial means to do so, they would create a scholarship for minority students at the University of Kansas ("K.U.," 1991). Before his death in 1995, in both of their names, Arthur pledged $300,000 to the university for minority scholarships, one in engineering and one in fine arts (Ferris-Olson, 1996; "K.U.," 1991).

Booker Taliaferro Whiteside (1912–1994)

As a technical editor at WPAFB in the 1940s and 1950s, Whiteside must have known Ella Anderson and Lillian Clark. Born in Troy, Alabama, Whiteside moved with his family to Hamilton, Ohio, at a young age ("Booker," 1994). In the 1930s, he earned a degree from Wilberforce State College, located about 20 miles east of Dayton ("Dunn," 1938). He worked as a laborer in the county engineer's office (not the county's "eugenics" office, as the newspaper reported in his wedding announcement); later, he worked as a courthouse deputy ("Dunn," 1938; "Named," 1941). In the 1940s and 1950s, city directories in Dayton identified residents by name, address, telephone number, and job title. Whiteside is listed as an editor at the Air Service Command in 1944, an editor at WPAFB in 1950 and 1951, and a data worker at Gentile Air Force Depot in 1959 ("Dayton," 1944). Thus, he seems to have moved out of technical editing and into data processing. Just like Anderson, he retired from the Defense Electronics Supply Center (DESC) in the 1970s ("Booker," 2011). His death certificate classified his occupation as "computer systems analysts and scientists" (Ohio, 2023).

Mamie Elizabeth Wiggins (née Jones, 1910–2011)

Like the Air Force, the U.S. Army employed Black technical communicators in the 1940s, 1950s, and especially the 1960s. Wiggins worked as a technical editor at the Frankford Arsenal in Philadelphia from 1951 to 1976; she also worked at the Naval Aviation Supply Depot in some capacity before retiring in 1982 ("Her Mission," 1991; Morrison, 2011). Born in Georgia, the daughter of a hotel chef, she moved north at a young age with her family. She dropped out of West Philadelphia High School so she could work full-time at a department store. About 25 years later, she completed her high school education at night while editing technical manuals during the day at the arsenal (Carey, 2000). It is surprising that she was hired as an editor in 1951 without a high school diploma, but her prior employment with Curtis Publishing in Philadelphia may have opened that door (Morrison, 2011).

The arsenal was a huge complex—a city within a city—where munitions were designed and manufactured and from which a steady stream of reports, manuals, and other print documents flowed. To further develop professionally, Wiggins attended Temple University for two years, hoping to earn a degree in writing, but other responsibilities (including parenting a child with severe asthma) prevented her from graduating (Carey, 2000). In her retirement, she made a significant contribution to the Philadelphia community as the co-founder and first director of the St. Barnabas Mission, a homeless shelter that is still in operation. She cooked meals, washed sheets, and tried to find jobs and housing for people ("Her Mission," 1991; Carey, 2000). "Associating with the public keeps you young and alive, along with helping other people," she told a reporter (Carey, 2000). Wiggins lived to be over 100 years old.

Ethel Louise Puryear (née Gardin, 1915–1996)

Puryear worked as a technical editor for the Signal Corps at Fort Monmouth, New Jersey, in the 1940s and 1950s. Born in Asheville, North Carolina, she received her schooling in South Carolina, graduating with a teaching degree from Claflin College in Orangeburg ("Teacher," 1996). She told a reporter that she moved north to Long Island in the late 1930s "after being spat upon for talking with a white man" (Chang, 1981, p. 1). She began her long employment at Fort Monmouth in June 1942, working her way up to chief technical editor with supervisory duties ("Ethel," 1942; "Teacher," 1996). She seemed to be well liked and respected by her colleagues ("Co-Workers," 1951).

In the late 1940s and throughout the 1950s, Puryear was very active in local politics in her hometown of Long Branch, New Jersey, first tackling the problem of housing discrimination (e.g., "Race," 1948; Isenberg, 1959) and later helping to integrate a local school ("Teacher," 1996). Her house was firebombed after she moved into a white neighborhood in Long Branch (Chang, 1981). Her son, the only Black child in his class, was classified as mentally retarded because he had a learning disability (Chang, 1981). This experience motivated her to leave her job with the Signal Corps in the early 1960s and become a special education teacher in Lakewood, New Jersey (Chang, 1981; "PTA," 1966). While working full-time as a teacher, she studied part-time at Newark State College and King's College, Union, earning a master's degree in special education ("Teacher," 1996). After her retirement in January 1981, she continued to tutor neighborhood children in her home (Chang, 1981).

Mabel Grammer (née Treadwell, a.k.a. Alston, 1906–2002)

Mabel is remembered today chiefly as the architect of the so-called Brown Baby Plan, an adoption program that placed Afro-German children in U.S. homes in the 1950s and 1960s, but she also worked briefly as a technical communicator for the U.S. Army. Born in Hot Springs, Arkansas, she reportedly attended Langston High School in Hot Springs, La Salle Beauty College in Pittsburgh (1931–1932), and North Carolina College in Durham (1933–1934).[14] Licensed in cosmetology, she taught "beauty work" at the Wilkins School of Cosmetology in Cleveland and the Poro School of Cosmetology in Columbus, Ohio (c. 1935–1938). She met her first husband, John C. Alston, in Ohio and moved with him to Washington DC so that he could pursue graduate studies at Howard University. Mabel wrote a beauty column and engaged in other newspaper work for the *Washington Afro-American* from late 1938 until early 1948, but her divorce c. 1945 seems to have disrupted her personal and professional life. She spent some time for "mental observation" in DC's Gallinger Hospital.

Mabel began her federal employment as a Clerk-Typist CAF-3 (Clerical, Administrative, Fiscal, grade 3) in the Office of the Quartermaster General (OQG) in February 1948. She was part of the "Return of the Dead" program that was still dealing with the remains of U.S. military personnel killed in World War II. Although her official job title never changed, her role advanced from basic clerk-typist to acceptance-clerk to change-clerk special cases in the Repatriation

14. These details were self-reported by Mabel on two different employment applications from the late 1940s that are part of her federal civilian personnel file at NARA's National Personnel Record Center in St. Louis. Many sources state that she earned a journalism degree from Ohio State University in the late 1930s, but she did not report attending OSU on her job applications. Nor was OSU archivist Michell L. Drobik (email communication, 23 September 2024) able to find a record of her enrollment or graduation during the relevant years. A copy of Mabel's birth certificate (issued in 1942) gives her birth date as December 16, 1906, while documents in her federal civilian personnel file and her tombstone in Arlington National Cemetery give her birth date as December 23, 1913. The 1910 U.S. Census corroborates the earlier date.

Branch of the Memorial Division.[15] Her duties as a change-clerk illustrate the often-repeated observation that technical communicators work under a variety of job titles. According to the job description for this position, her duties included determining whether requested changes in next-of-kin letters were permissible under regulations; extracting information from next-of-kin letters and writing interment directives; writing special instructions to overseas commands as addenda to disinterment directives; communicating with other OQG offices through memoranda, change-action sheets, and various forms; reviewing administrative decision forms for accuracy and completeness; and keeping thorough records and writing daily reports of activities.

In 1949, Mabel took the information specialist examination and earned the strong civil service rating of "Press GS-9 80.0" (with "GS-9" indicating the General Schedule grade level and corresponding pay range, and "80.0" representing her exam score) under the government's new job classification system. She was also rated "Visual GS-7" and "Motion Pictures GS-8." At the time, the information specialist examination included the following optional subjects: "Articles and speeches, campaigns, motion pictures, opinion analyst, press, publications, public relations, radio, technical editor and writer, and visual" (U.S. Civil, 1949, p. 46). Armed with her information specialist ratings, she advocated for a role change in December 1950 that would have allowed her to leverage her journalism experience, but her efforts were unsuccessful. Despite her qualifications, she remained officially a Clerk-Typist GS-3 (converted from the old system's CAF-3).

In March 1951, Mabel resigned from federal service to accompany her second husband, Oscar Grammer, whom she had married a year earlier, to his new posting in Germany. While living in Mannheim, she gained a deeper understanding of the attitudes and treatment directed toward the children of Black American soldiers and white German women. Mabel mobilized her connections in the American Black press to raise awareness about the children's vulnerability and to find homes for those in need, referring to the effort as the "Brown Baby Plan" (Lemke Muniz de Faria, 2003; Walker, 2023). By the time they returned (a second time) to the United States in the mid-1960s, Mabel and Oscar had adopted twelve children, including a little girl who would become the first Black woman to serve as the U.S. Army's surgeon general and a three-star general (West, 2018).

Mabel is sometimes compared to entertainer Josephine Baker, who adopted a "rainbow tribe" of twelve children (e.g., "Jo Baker Shows the Way," 1959), but Mabel started adopting children at least a year earlier than Baker. Both women challenged prevailing racial norms by creating multiracial families, offering a model of love and inclusion that stood in stark contrast to the widespread discrimination and segregation of the time.

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15. The standard biographical sources on Mabel Grammer do not mention her civil service. I was alerted to it by Taylor (1950), where her name is misspelled as Mable Alston Crammer.

Marian Elizabeth Miles (née Marion Foster, a.k.a. Downer, 1900–1982)

Marian worked for the U.S. Army for fifteen years (1950–1966), eventually as a technical writer/editor. However, she is best remembered as the journalist Marian F. Downer, a prominent figure in the Black press of the 1930s and 1940s.

Born in Salisbury, North Carolina, she attended Livingstone College (1929–1931) and Crane Junior College (1934–1935) but did not complete a degree ("Marian," 1982).[16] Around 1925, she married Fred Downer, a seasoned baseball player with the Pittsburgh Keystones. After the Downers moved to Chicago, Fred became a sportswriter for the *Pittsburgh Courier* (by correspondence) and later the *Chicago Defender* (Halper, 2023). Marian, too, became an influential journalist, covering Chicago's social scene and other topics for the *Pittsburgh Courier*, *Chicago Defender*, and *Chicago Bee*, as well as contributing to Fred Downer's national Atlas News and Photo Service. She traveled with actress Marva Louis, the wife of boxer Joe Louis, as a newspaper correspondent and later became Marva's personal secretary ("Noted," 1944; "Marian," 1945). Though primarily a social and cultural journalist, she also reported on baseball (e.g., Downer, 1935).

Beyond reporting, Marian was a publishing executive. She was the founding managing editor of the Chicago office of the *Pittsburgh Courier* and later served as comptroller of the *Chicago Defender* ("Noted," 1944). When Black publishers convened in 1940 to establish the Negro Newspaper Publishers Association, she was one of the few women with a seat at the table ("Newspaper Men," 1940). Widely recognized by readers of historically Black newspapers and respected by colleagues in the Black press, she must be regarded as one of the most important Black women in early 20th-century American journalism ("Noted," 1944).

Following her divorce in late 1947—reported in Black newspapers around the country (e.g., "Chicago," 1948)—Marian remained in Chicago, continuing in newspaper work until September 1948. She then worked as a register clerk at Spiegel before shifting to government employment in 1950. Although she started with the Quartermaster Corps, she soon moved to the Army Medical Service's Meat and Dairy Hygiene School, later known as the Veterinary School, where she advanced through roles from "clerk-stenographer" to "clerk-typist" to "editorial clerk (typing)."

A 1961 performance evaluation in her personnel file describes the final role as that of a full-fledged technical communicator, responsible for writing and editing "texts, papers, and manuals … of a highly technical nature." She was particularly commended for her contributions to research and development projects and her revisions of school texts. The work required not only expertise in written communication and English grammar but also "years of association with veterinary terminology."

16. Some sources indicate that Marian graduated from Shaw University (Halper, 2023) or studied journalism at Northwestern University ("Noted," 1944), but she did not list Shaw or Northwestern on her application for federal employment in 1950.

In 1955, Marian married her second husband, Arthur Miles, also a government worker. In 1966, thanks to their federal retirement benefits, they were both able to retire comfortably to Three Rivers, Michigan, where Marian remained active in church activities and social and political organizations (*Cook County*, 2008; "Marian," 1966; "Marian," 1982).

Herbert Gregory Odom (1915–1977)

The U.S. Navy was the third branch of the military that hired many technical communicators. After serving for more than 20 years in the Navy, Odom worked for seven years as a civilian technical writer at the U.S. Naval Electronics Supply Office in Great Lakes, Illinois (Odom, 1971d). The son of a South Carolina sharecropper, Odom joined the U.S. Navy in 1935 to escape poverty (Odom, 1971c, p. 11). Years later, in a series of articles in the *Pittsburgh New Courier*, he castigated the Navy for its treatment of Black men. After explaining how the Navy began recruiting Southern Black men exclusively for the Messman Branch after the Philippines gained its independence in 1932, he recounted his experience as a messman aboard ships in the late 1930s (Odom, 1971a). Messmen were used as de facto servants to white sailors and even house servants to officers and their wives when the officers were on shore duty (Odom, 1971b). "A logical question is, why would an intelligent young man enlist and re-enlist in the Navy under these conditions?" he wrote. "The simple answer is, we are poor. We were usually the sons of washer women, cooks, maids, laborers, sharecroppers. In the messman branch one seldom met the son of a craftsman and never the son of a professional man" (Odom, 1971b, p. 11).

According to Odom, the Navy began to improve in the 1940s, and he eventually prospered. From 1947 until his retirement from active service in 1958, he was stationed at the U.S. Naval School in Great Lakes, where he was trained and served as an electronics technician ("No Mystery," 1948; Odom, 1971d). This prepared him for his civilian employment with the Navy as a technical writer from 1958 to 1965, after which time he returned to the Naval School and worked on curriculum development for several more years (Odom, 1971d). In the 1970s, he taught electronics at Denmark Technical College in South Carolina, presumably as an adjunct instructor (Milkie, 1976). For the Bicentennial, Odom wrote and published a patriotic poem about the Black man and liberty, expressing in glowing terms how he felt about freedom and his country (Milkie, 1976). Shortly before his death in 1977, he told a reporter, "I wouldn't trade [my career in the Navy] for a Ph.D.!" (Milkie, 1976, p. 31).

Allan Rohan Crite (1910–2007)

Though remembered today chiefly for his fine art, Crite (see Figure 11.2) worked as a technical illustrator at the Boston Naval Yard for more than 30 years. The son of an engineer, Crite showed an early interest in art, and his parents and teachers supported this interest ("Allan," 2022). He studied at the School of the Museum of Fine Arts in Boston. After his graduation during the Depression, he produced paintings for the federal government as part of the Works Progress Administration (Brown, 1980). He moved into civil service employment in the late 1930s, working briefly for the Coast Guard and Geodetic Survey before beginning his long-term affiliation with the Boston Navy Yard (also known as the Charlestown Naval Shipyard) ("Allan," 2022). At first, he worked as a draftsman in the engineering sense, but the engineers were soon coming to him to produce perspective drawings of ideas for new technologies (Brown, 1980, p. 10). He illustrated propulsion systems for ships so that the shipbuilders could visualize them ("Allan," 2022).

Although Crite was laid off by the Navy three times between 1941 and 1974, including right after World War II during a massive reduction in force, these periods of separation were more like sabbaticals than unemployment (Brown, 1980; "Allan," 2022). During one of these periods, he was hired by the Rambusch Decorating Company of New York to create murals and other artwork for churches; he had already been making a name for himself as a liturgical artist (Brown, 1980, pp. 10, 49; Dinneen, 1944). Today his artwork can be found not only in churches, but also in museums such as the Smithsonian American Art Museum and the Boston Athenæum. The city of Boston named a park after Crite ("Allan," 2022).

Located at the end of the chapter, Appendix A identifies other Black technical communicators who worked in government before 1970.

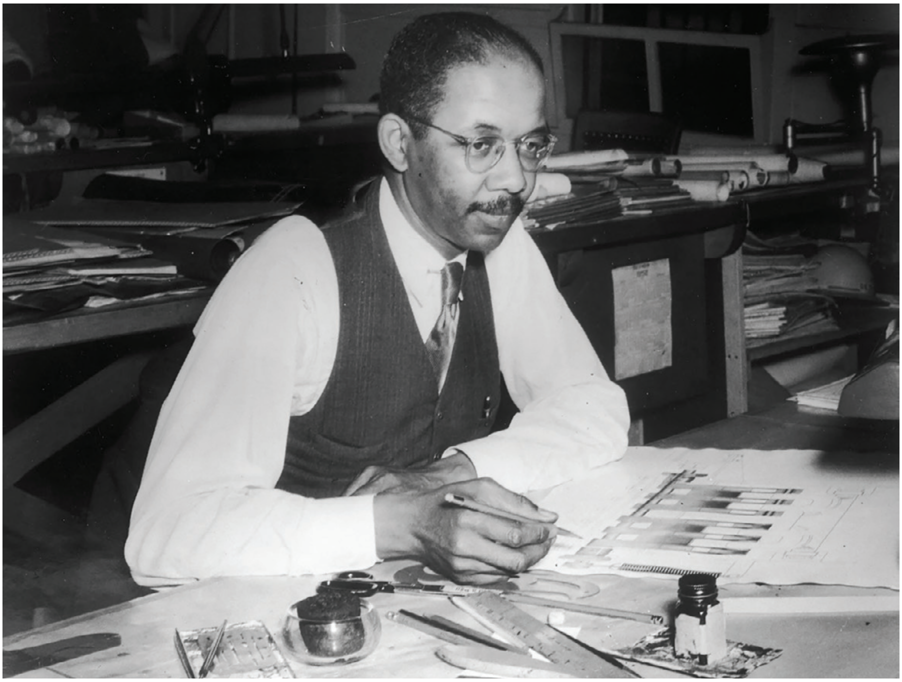

Figure 11.2. Photo of Allen Rohan Crite. (Photo is in the public domain.)

Employed in Industry

Rufus Paul Turner (1907–1982)

n the 1920s and 1930s, Turner earned a place in history by starting a radio station in Washington DC, reportedly the first in the United States owned and operated by a Black person, and by inventing a radio small enough to pass through the eye of a needle ("First," 1926; "Builds," 1934). Turner was also a prolific technical writer, publishing thousands of articles in trade magazines and journals as well as dozens of books on technical subjects ranging from using an oscilloscope to understanding the metric system to mastering calculus (Page & Roh, 1985). He held many jobs in industry from the 1930s to the 1960s. For example, he was a research engineer for Waltham Watch Company and Aerovox Corporation and an applications engineer for Sylvania Electric Products ("Memorandum," 1947). According to the 1950 U.S. Census, he was an electrical engineer for an aircraft company (probably Hughes or Douglas; he worked for both at different times).

As managing editor of *Radio* magazine, he read authors' manuscripts ("Turner's special job is to watch out for those 'boners' unlikely to be caught by non-technical proofreaders"), checked galley proofs, and helped design the page layouts ("He Crashed," 1938). He also worked as a technical editor in the electronics division of the National Cash Register Company and for Litton Industries (Turner, 1964). Based on his experience as a researcher, writer, and editor, he authored three technical communication textbooks in the 1960s: *Grammar Review for Technical Writers* (1964), *Technical Writer's and Editor's Stylebook* (1964), and *Technical Report Writing* (1965). He was a member of STC when it was called the Society of Technical Writers and Publishers (STWP) ("News," 1967), and his textbooks were advertised and reviewed in STWP's journal (e.g., Untitled, 1964; Galasso, 1965).

One of the most remarkable facts about Turner is that he became an English literature professor late in his life. He earned a BA in English from the Los Angeles State College of Applied Arts and Sciences (now California State University–Los Angeles) in 1958, an MA from the University of Southern California in 1960, and a PhD from USC in 1966 (Page & Roh, 1985). His dissertation was a study of the life and career of 18th-century British author Charlotte Turner Smith. From 1961 to 1972, he was employed by his BA alma mater, teaching technical writing as well as other English courses.[17] In an interview with the *Los Angeles Sentinel* in 1965, Turner must have raised some eyebrows when he advised aspiring scientists to earn an undergraduate degree in liberal arts before pursuing a degree in engineering or one of the sciences. He said they should study

17. Turner made his first appearance in the college catalog in 1961–1962 as a part-time faculty member and his last appearance in 1971–1972 as a full-time faculty member. He became a full-time assistant professor in 1963 and was promoted to associate professor in 1967 ("News," 1967).

literature, for example, to become better communicators, to sensitize themselves to the social and human consequences of scientific experimentation, and to discover "the joys of living" ("Prof Says," 1965).

Stanley Thomas Edmonds (1927–1993)

Edmonds was a technical writer at Hughes Aircraft in the 1960s, and he may have stayed with that company until the early 1980s. Born in Providence, Rhode Island, he and his mother must have moved to New York in the early 1940s because in 1945 he graduated from Benjamin Franklin High School in East Harlem ("Stanley," 1993). I have found no evidence that he earned a college degree, but he did serve in the Army Air Force in the mid-1940s, and by 1950, according to the U.S. Census, he was married, had a son, and was working as a repairman for the New York telephone company. He apparently became a "broadcasting engineer" at some point during his eight years with the phone company (Holder, 1962). After brief periods of employment as a technical writer with TechLit Services in New York and a project engineer with the McLaughlin Research Group, he moved his family to Southern California and managed a four-person team of technical writers at Hughes Aircraft (Holder, 1962; Institute, 1962). A 1962 article in the *Pittsburgh Courier* touted him as "among a growing number of young Negroes moving to the forefront of their profession" because "industry is beginning to hire 'qualified' persons regardless of racial background" (Holder, 1962, p. 5). In the 1970s, Edmonds incorporated two businesses: Ledger Demand Systems in 1975 and Publication Engineering, Inc., in 1977 ("Legal Notice," 1975, 1977).

Edmonds's professional status as a Hughes Aircraft "engineering writer" did not ensure that he and his family would be treated with respect.[18] When the Edmonds family hosted an Italian exchange student in 1966, the *Anaheim Bulletin* published a story about the intercultural exchange, but the article undercuts Edmonds's status in several ways. For example, the reporter comments wryly, "Tony also discovered that many American dads hold down two jobs to provide the standard of living envied all over the world" ("Fried Chicken," 1966, p. 4). Edmonds was apparently working evenings as a "financial counselor." The typical technical writer during this period did not have to work two jobs to support a family, especially a technical writer in private industry with supervisory duties (see Table 11.4). I don't know why Edmonds was doing so; but the reporter emphasizes this fact ironically. There is also a photograph of the Edmonds family and Tony at the dinner table, but the newspaper panders to stereotypes (both in the photo's caption and the article's headline) by suggesting that Tony does not need spaghetti when he has fried chicken.

18. I believe Edmonds was the unnamed technical writer in the 1962 Buena Park vignette (see the "Housing Discrimination" section below). The neighbors would not allow their children to play with his son.

Table 11.4. Salary Ranges of Technical Writers in Private Industry and Government in 1965[a]

Private Industry		
Level of Experience	**Salary Range in 1965**	**Equivalent in 2024**[b]
Inexperienced	$5,000–$7,000	$49,769–$69,677
Moderately Experienced	$7,000–$10,000	$69,677–$99,538
Highly Experienced	$11,000–$13,000	$109,492–$129,399
With Supervisor Duties	up to $17,000	up to $169,215
Government		
Level of Experience	**Salary Range in 1965**	**Equivalent in 2024**
Inexperienced	$5,000–$6,050	$49,769–$60,220
One Year of Experience	$6,050–$7,220	$60,220–$71,866
Two Years of Experience	$7,220–$8,650	$71,866–$86,100
Three Years of Experience	$8,650–$10,250	$86,100–$102,026

[a] *Source: Bureau of Labor Statistics' Occupational Outlook Handbook (U.S. Bureau, 1966, p. 236)*
[b] *The 2024 equivalents come from the Bureau of Labor Statistics' CPI Inflation Calculator (U.S. Bureau, n.d.). I compared dollar amounts in July 1965 and July 2024.*

James Harmon Lyons (1919–1981)

Lyons worked as a technical communicator in Buffalo, New York, in the 1950s. He graduated from Buffalo Technical High School in 1937, attended West Virginia State College for at least two years, and finished an engineering degree at the University of Buffalo at some point ("James," 1981; "James," 2024). After his military service during World War II, he worked at Westinghouse for a few years, then at Bell Aircraft Company for more than a decade (from 1949 into the 1960s), first as a technical illustrator and later as a technical writer ("James," 1981). He was reportedly one of only three Black people employed by the company at the time ("James," 2024).

From a young age, Lyons was a successful musician, winning awards for his singing in high school, performing in musical shows in the military, and moonlighting as an entertainer in later years ("Four," 1937). He became the Buffalo area's first Black disc jockey, eventually hosting his own show, "The Lyons Den" ("James," 1981). In 1965, he left radio work to start a construction company with his brother; later, he worked as a building inspector for the city ("Dream," 1965).

Although he is remembered today chiefly as a radio personality in the Buffalo area, he should also be remembered as an innovative entrepreneur who used his communication skills to promote the local economic interests of Black people.

In the late 1950s, Lyons co-founded the Niagara Negro Sales Service (NNSS), which provided information and assistance to businesses seeking to enter the "multi-million-dollar Negro market" in the Buffalo area (Cannon, 1958, p. 6). As part of its effort, the NNSS published the *1958–1959 Negro Directory of the Niagara Frontier*, which included the names and addresses of Black people of various occupations. This resource suggests that Black technical communicators were not as common as other Black professionals in the 1950s. For example, the directory lists eight attorneys, thirteen physicians, and fourteen engineers in the city of Buffalo. By contrast, it lists only one technical illustrator and three technical writers, in addition to Lyons himself (Cannon, 1958). The technical illustrator may be the same **Harold Hopkins (1924–1988)** who was murdered three decades later in Charlotte, North Carolina. That man was a native of Lockport, New York, a World War II veteran, and a retired IBM employee (Minter, 1988). The three technical writers were **Samuel Mitchell (probably 1930–1966)**, **Roosevelt Cutter (1923–2014)**, and **Robert Charles Warburton (1926–1979)** ("Robert," 1979; "Roosevelt," 2007). I do not know where Mitchell and Cutter worked in the Buffalo area, but Warburton was one of Lyons' co-workers at Bell Aircraft ("Robert," 1979).

Sperry-Rand's UNIVAC Division

In the late 1950s and early 1960s, the UNIVAC Division of Sperry-Rand in St. Paul, Minnesota, employed several Black technical communicators. It was such an unusual situation that a 1960 article in the *Minneapolis Spokesman* called attention to the number of "Negroes" employed in "important jobs" at UNIVAC: an engineer, an application analyst, and five technical communicators ("UNIVAC," 1960). Remington Rand purchased the Philadelphia-based Eckert–Mauchly Computer Corporation (including the UNIVAC computer) in 1950 and the St. Paul-based Engineering Research Associates in 1952. After Sperry Corporation purchased Remington Rand in 1955, these earlier acquisitions became part of the Remington Rand UNIVAC Division of Sperry-Rand ("Ground," 1955). The following profiles of the technical communicators at UNIVAC comprise a site-specific cohort in an unusual pre-1960 concentration of Black technical communicators that suggests the work of a network with hiring influence, such as the Urban League. The St. Paul Urban League may have been referring to these technical communicators as well as other white-collar workers when it claimed credit for "placement of scientific, clerical, and skilled workers" in 1955 ("Historical," 1960, p. 4B).

Beverly Young (a.k.a. Thompson, 1934–1987)

Beverly began her employment with UNIVAC as a technical editor in the 1950s. One source identified her as a graduate of Louisiana State University, another of Dillard University; the latter is probably correct because Beverly had family ties to New Orleans (DeMille, 1960; Klobuchar, 1987). After graduation, she may have moved to St. Paul specifically for the job with Remington Rand. A 1960 photograph published in the *St. Paul Recorder* shows her conferring with two other (white) editors in her workplace (Untitled, 1960). She left UNIVAC in 1963 to work for Control Data Corporation in Minneapolis, where she supervised a group of people working on Programmed Logic for Automatic Teaching Operations (PLATO), one of the first computer-facilitated instruction platforms (Klobuchar, 1987). She was still employed by Control Data in 1987 when she met with a tragic, violent death. In an argument between husband and wife about their son, Beverly was run over by her husband's car, and her body was dragged for nearly a mile (Hotakainen, 1987). The newspapers covered the police investigation, trial, and subsequent lawsuits.

Wilbur Vernon Kennedy (1928–2015)

Kennedy was employed by UNIVAC as a technical writer during the same period as Young. He, too, had family ties to Louisiana. In the late 1940s, he graduated with a bachelor's degree in math from Southern University in Baton Rouge ("UNIVAC," 1960). The 1950 U.S. Census for New Orleans identified him as a math teacher in a public school; at some point, he also taught mathematics at a high school in Lake Providence, LA ("Share," 1968). It is not clear when and why he travelled north to work at UNIVAC, but he did not stay in Minnesota for long. In July 1964, he was hired by Boeing to work at the Michoud Assembly Facility in New Orleans. He made news when he received half of a $5,000 award for co-suggesting that a change-record page be added to automatic test procedures ("Share," 1968). His obituary offers no biographical details about him except for his age and a list of relatives, but it does provide a photograph ("Wilbur," 2015).

Cecil Taylor Lewis (1907–1997)

Cecil and his brother Joseph both worked as technical writers at UNIVAC ("UNIVAC," 1960). A native of Pittsburgh, Cecil earned his bachelor's degree in education in 1930 and taught for a few years in one or more public schools on the East Coast (Untitled, 1937). For a number of years, he worked in the printing department at Hampton Institute, Virginia (Charles Allen, personal communication, 27 July 2023). For his master's degree (1943) at Hampton, he wrote a thesis about alumni programs at historically Black colleges; he was identified as an Assistant Professor of English at the time of his graduation ("Master," 1943). After teaching English at Tennessee State University for several years, he joined the staff at UNIVAC in the 1950s, and he was still working for UNIVAC in 1972 ("Bad," 1972).

Joseph Linwood Lewis (1929–2022)

Joseph was admitted to Hampton Institute in 1948 to study architectural engineering (Charles Allen, personal communication, 27 July 2023). As part of an exchange program to foster interracial understanding, he transferred to Denison University in Ohio for at least one semester in 1950 ("Hampton," 1950). He must have joined the Air Force before he completed a degree at Hampton. He was stationed as a radar technician at Bergstrom Air Force Base in Austin, Texas, when he married in 1952 ("Cash-Lewis," 1952). He spent time in Japan before leaving the service, and he joined the UNIVAC staff as a technical writer in the mid-1950s (Jordan, 1956; "Social," 1953). A 1958 newspaper article reported the tragic death of his infant son from accidental strangulation; in the article, Cecil is explicitly identified as the boy's uncle ("Nine," 1958).

Ed Rose was also identified in the 1960 article as a Black person working as a technical writer at UNIVAC. He apparently graduated from the University of Colorado ("UNIVAC," 1960), but I have not been able to identify him further.

Orville Wimberley Fraction (1929–1978)

Not mentioned in the 1960 article, Fraction was working as a technical illustrator for UNIVAC when a newspaper announced his engagement in 1957 ("Engagement," 1957). A star football player at Minneapolis's Central High School in the 1940s, Fraction went into the printing business after graduation (Bryne, 1946; "Engagement," 1957). He is identified as a printer in the 1950 U.S. Census. There is no evidence that he attended college or obtained a college degree, although it is possible he did. In either case, his print-shop experience may have prepared him for the position of technical illustrator at UNIVAC.

Barbara Sybil Cyrus, née Mallory (1917–2011)

Barbara was a technical publications editor at Minneapolis Honeywell Regulator Company in the mid-1960s. Later, she worked at Control Data and Investors Diversified Services (IDS). Her father, the son of a Mississippi sharecropper, had moved north to find work in the 1910s, and he was working as a hotel waiter in Minneapolis when Barbara was a child (Monaghan, 1985). One of the few Black families living so far south in Minneapolis, the Mallories faced difficult challenges: "[Neighbors] circulated a petition to have them removed. That didn't work. They threw burning rags on the porch, and they chased the Mallory children home from school" (Monaghan, 1985, p. 3).

In the late 1930s, Barbara transferred back and forth between the University of Minnesota and Spelman College in Georgia, eventually earning an associate's degree from the former school (Brady, 2007, p. 29). She recalled her sense of isolation at UM, often being the only Black person in her classes and largely being ignored by other students, even her former high school classmates attending the same university (Carew, 2006). World War II created unprecedented employment opportunities for Black people in Minneapolis, and both Barbara and her sister were hired to operate machinery at the Twin Cities Ordnance Plant. She told a reporter that "it was the first time I really felt like an American" rather than "a black person in America" (Monaghan, 1985, p. 3). After she married in 1944, she moved with her military husband to Seattle and was put in charge of an ordnance library ("Barbara," 1944; Roberts, 1997). She recalled how important she felt in this position (Roberts, 1997).

After returning to Minneapolis, Barbara worked in public and university libraries in the late 1940s and the 1950s ("Minneapolis," 2011). She moved into technical communication in the 1960s, first as a technical editor of military manuals at Honeywell and later as a technical writer at Control Data ("Technical," 1964; Von Sternberg, 2011). From the 1970s until her retirement, she was the editor of an in-house magazine at IDS (Peterson, 2003). During these decades, she also wrote for local newspapers, especially the *Minneapolis Spokesman*—for example, covering the 1968 Democratic Convention in Chicago ("Barbara," 2017). Her obituary in the *Star Tribune* described her as a "Minneapolis civil rights pioneer" (Von Sternberg, 2011).

Frank Neptune Jones (1929–2007)

In the mid-1960s, a wire story about Jones appeared in several historically Black newspapers, including the *New York Amsterdam News* and the *Chicago Defender* (e.g., "Radar," 1965). The story noted that Frank was working for Radio Corporation of America (RCA) as an editor, with duties that included revising engineers' reports, editing technical manuals, and corresponding with customers about company products ("Radar," 1965). In other words, he was performing some of the typical job duties of technical editors and writers in the 1960s. However, his job was national news in historically Black newspapers because the job was held by a Black man.

Frank's father worked for over 30 years (1921–1954) as a porter and elevator operator in the Littlefield Building in Austin, Texas ("Rest Earned," 1954). He told a reporter covering his retirement in 1954 that he was proud of the fact that he had put his three sons through Huston-Tillotson College. All of them were successfully employed in 1954. His eldest son, Frank, had graduated with a bachelor's degree in mathematics in 1951, and, at the time of the interview, he was working as a civilian radar instructor in the Signal Corps School at Fort Monmouth, New Jersey ("Rest Earned," 1954; "Frank," 2007). Frank must have received training relevant to radar technology during or after his college education, because the job at Fort Monmouth would have required more than courses in advanced mathematics.

In the 1950s and 1960s, RCA was publicly committed to hiring Black people, including as technical writers and editors ("R.C.A.," 1954). In fact, RCA would become one of the first eight U.S. companies to sign a Plan-for-Progress pledge to improve their EEO practices at the invitation of the Kennedy-Johnson administration (Braestrup, 1961). RCA's 1959 hiring of Jones aligned with both the company's public commitments and his evident qualifications. He began work in the company's Harrison, New Jersey, plant under the title "Associate Engineer for Product Development," though his responsibilities were those of a technical editor ("Radar," 1965). In the 1940s through the 1960s, it was not uncommon for technical writers and editors in industry to work under an engineer job title even when they did not have a degree in engineering. One of the projects he contributed to was the annual editions of the *RCA Receiving Tube Manual*, a comprehensive reference source for professionals and amateurs on vacuum tubes used in electronic equipment ("Radar," 1965). Frank remained in publications throughout his career and eventually became Manager of Engineering Publications (RCA, 1980).

Located at the end of the chapter, Appendix B identifies other Black technical communicators who worked in industry before 1970.

Housing Discrimination

The profiles above offer a glimpse into the lives and work of Black technical communicators, but the ability to do that work—particularly in the industrial and government centers where such jobs were concentrated—depended on finding suitable housing. In my archival research, housing discrimination emerged repeatedly as a formidable racialized barrier. It was the only form of racial discrimination for which I found multiple, substantial examples involving technical communicators—enough to support an antenarrative bet that it affected their work.

Like other Black Americans in mid-20th-century America, Black technical communicators often faced significant challenges in obtaining safe, affordable housing near their places of employment due to discrimination by real estate agencies, banks, landlords, and homeowners. These experiences reflect the broader social, psychological, and economic barriers that shaped Black workers' lives and careers (Randol, 1972). After recounting examples of housing discrimination involving technical communicators, I speculate on its consequences for various aspects of work—such as commuting, health and absenteeism, productivity and efficiency, career progression, and professionalization—because, as research shows, "discrimination in one domain or at one point in time may have consequences for a broader range of outcomes" (Pager & Shepherd, 2008, p. 199). This form of structural discrimination is referred to as "accumulated disadvantage."

In testimony before Congress, a staff member of the organization Freedom of Residence reported that, from 1966 to 1969, no fewer than 43 employees of McDonnell-Douglas Corporation in St. Louis faced housing discrimination. The testimony alleged that the company had two housing lists for new employees: a list for Black employees of housing available in Black areas of the city and a very different list for white employees—an allegation that the company denied. One of the cited examples involved a newly hired technical illustrator:

> Until he found suitable housing in mid-September 1969, almost six months later, he stayed at the YMCA. McDonnell-Douglas Corporation's Housing Department provided him with a lengthy list of rental housing located both in the city and the county. He contacted many of the apartment complexes on the list, and also followed up on newspaper advertisements. Place after place advised him there was no vacancy. On several occasions, he shared this with McDonnell-Douglas Corporation's Housing Department, asking them for assistance. Repeatedly he was told that all

> they could do for him is give him an updated list and suggested that he keep on trying. Finally, early in September 1969, in utter despair, he went door to door, asking if an apartment is available, and found an apartment that was vacant and that he liked. When he called the Real Estate Company who was leading this unit, he was told the apartment was rented. A white checker from the Freedom of Residence office then phoned the Real Estate company and was told the apartment was available. The following morning the McDonnell-Douglas Corporation employee personally went to the Real Estate office to inquire about the apartment and again was told the apartment was rented. Two hours later another white checker from Freedom of Residence was told this same apartment was still available. (U.S. Congress, 1970, p. 7757)

The technical illustrator was able to rent the apartment after a Freedom of Residence representative told the real estate company about their investigation and indicated that "their client" intended to file a lawsuit.

In a 1954 newspaper report, a "silk screen worker and technical writer" named Neville Baron Lake (1913–1963) recounted his experience in a white neighborhood in St. Albans, New York ("Brotherhood," 1954). After moving into the neighborhood with his wife and three children, most of his neighbors put up "For Sale" signs in their yards. Lake sent his neighbors a letter commending them for their peaceful action; he pointed out that a family like his in another state might have been "beaten, bombed, or perhaps murdered." He invited remaining neighbors to keep their houses and make the neighborhood "a shining example of racial amity" ("Brotherhood," 1954, p. 18). In response to his letter, some neighbors put up "Not for Sale" signs in their yards. Lake did not persuade all his neighbors to stay, but he developed positive relationships with those who did.

Writing in 1962 for the *Los Angeles Sentinel*, a columnist shared a "vignette" with his readers (Robertson, 1962). He met a grandmother from Buena Park, California, in a bus station. Her son had been hired as a technical writer at Hughes Aircraft in Fullerton and had moved his family from the East Coast to the small California town, where, at the time, only one other Black family lived. The son in question was almost certainly Stanley T. Edmonds, profiled earlier, who had relocated to Buena Park with his mother and two children. His son would have been no older than twelve at the time—matching the likely age of the grandson in the story. The grandmother explained that the family didn't mind when many townspeople ignored them on the street. "What hurt," she said, "was when the parents saw their children playing with my grandson and called them home, refusing to let them play with him." The children, however, disobeyed their parents secretly. One boy "snuck into the backyard of our house and called my grandson." He gave him a map showing how to get to a play area outside of the housing development. Her grandson went there the next day and played with the children all day, as he did for many days, all summer long.

When the school year began, they continued to play together after school, but they separated on the way home each night so their parents wouldn't know.

Placing a classified ad for housing in a newspaper was one strategy for cutting through the time-consuming and emotion-draining rejections based on race. In 1967, for example, a technical writer placed the following ad in the "Wanted to Rent" section of the *Rock Island (Illinois) Argus*: "COLORED—Government technical writer needs apartment or nice room. Ph. 786-4411. Ext. 518 or leave message" ("Wanted," 1967, p. 20). The Rock Island Arsenal was a major government employer of technical communicators, so the technical writer who placed the ad may have been working at the arsenal. The ad is interesting for several reasons. First, it does not mention gender. The person who placed the ad may have assumed that "man" was implied by "technical writer." Second, the word "colored" is positioned at the beginning of the sentence in all capital letters. The technical writer clearly wanted to emphasize race, presumably their own racial identity rather than that of a landlord. Third, the term "colored" is used instead of "Negro" at a time when the latter had largely replaced the former. This choice of terms probably spoke to some readers differently than others, keeping away landlords who would not rent to a Black person while inviting contact from those who would.

After moving into white neighborhoods, Ethel Puryear and Barbara Cyrus (profiled earlier) and Lydie Allen and Bertha Bragg (listed in Appendix A) encountered hostile and, in some cases, violent responses. Arsonists targeted the homes of both the Puryear and Cyrus families in New Jersey and Minnesota, respectively. In Washington DC, someone painted "Remember Little Rock—K. K. K." on the sidewalk in front of Allen's house ("Farce," 1958). She and her husband Ervin had three small children at the time. As reported nationally in *Jet* magazine, Bragg returned home from an Elks convention in Chicago to find her furniture on the sidewalk in front of her DC apartment building (Burley, 1954).

The relationship between housing discrimination and health and wealth in Black communities has been well documented (e.g., Lipsitz, 2024), but while its impact on work has been acknowledged (e.g., Desmond & Gershenson, 2016), it remains less explored. The types of housing discrimination illustrated in the preceding examples may have impacted technical communicators' work in several ways:

- Increased commuting distances, leading to longer workdays and reduced personal time;
- Health issues resulting in absences and diminished work continuity;
- Worry and distractions, compromising productivity and efficiency;
- Location and job changes, disrupting career progression; and
- Depletion of time and energy necessary for networking, continuing education, and other professional development activities.

These outcomes would have been compounded by other forms of discrimination, including employment (hiring, raises, promotions), workplace (treatment by co-workers, access to mentorship, recognition of contributions), education, healthcare, and financial services. Just as localized instances of fraud, incompetence, and confusion in the post-World War II technical writing industry allegedly cost the United States billions of dollars (Bishop, 1964), the cumulative effects of housing discrimination would have resulted in significant losses for not only the individuals involved but also their employers and the broader American economy. This pattern illustrates the trap of the zero-sum paradigm, where one group's progress is wrongly perceived as a threat to others, reinforcing discrimination and inequality. It also underscores the importance of adopting the "solidarity dividend" mindset, where addressing inequality collectively leads to shared benefits for all (McGhee, 2021).

Conclusion

In this reclamation project, I have begun the process of compiling a registry of Black people who worked as technical communicators in mid-20th century America, merely scratching the surface of this important historical record. The number of Black technical communicators from the 1940s through the 1960s was far greater than their representation in STC and IEEE historical documents and other traditional scholarly sources might lead people to believe. While mid-20th-century technical writers, editors, and illustrators were increasing in number and beginning to form a unified professional identity as technical communicators, many Black technical communicators were actively present in workplaces. Their contributions were crucial to the growth, significance, and professionalism of technical communication as a community of practice.

In addition to providing their names, my project documents where and when they worked, how long they lived, where they received their educations, and other biographical and professional details about them. This information not only individualizes them as people with unique backgrounds and lived experiences, but it also provides concrete evidence of their presence in our profession and lays the groundwork for more fully assessing their individual and collective contributions.

The few stories of technical communicators in this study cannot support dependable generalizations, nor coalescence into a broader, coherent narrative. Through abduction rather than induction, however, they can be used to form hypotheses or "bets" (Boje, 2001). In line with this antenarrative approach, I will propose several hypotheses based on the data I have collected.

First, Black technical communicators contributed substantially to the emerging profession of technical communication, but their contributions have been largely overlooked and unacknowledged in existing narratives of the profession's history. Their presence and contributions were sometimes documented in contemporaneous sources, such as magazines like *Ebony* and *Jet* and historically Black newspapers, but those sources have not informed historical scholarship in technical communication. A student looking through STC and IEEE publications from the 1950s and 1960s will see so few Black people in photographs that it might lead them to believe that Black technical communicators were rare in those decades. Although they may have been few in number when compared to white technical communicators, they were not rare.

Second, like other Black people in mid-20th-century America, Black technical communicators in mid-20th-century America had to overcome formidable challenges and barriers in their personal and professional lives, obstacles that their white colleagues did not face, yet they still made significant professional contributions and achievements. They had to contend with unfair hiring practices; underrepresentation and invisibility (or negative visibility) in the workplace; feelings of isolation rather than community; undercutting of their value and status in many domains, including the white media; and discrimination in many facets of life, from the housing market to daily transportation to schools for their children. I would wager that their struggles with systemic racism were reflected in their contributions to the emerging profession and in the technical communication they produced and that their lived experiences enriched the practice of technical communication by broadening its perspective.

Third, informal networks and communities of Black technical communicators supported one another professionally and socially. Although solitary Black technical communicators might feel isolated in some workplaces, groups of technical communicators or groups of Black employees in other workplaces may have banded together and helped one another. The concentration of Black technical communicators at UNIVAC and TACOM suggests networks with hiring influence (e.g., a local affiliate of the Urban League in the case of UNIVAC). They may not have found community with other Black technical communicators in professional organizations such as STC and IEEE, but they may have interacted in political, religious, and social organizations, particularly in big cities. For example, several technical communicators at TACOM (see Appendix A) were officers in the same political organizations and co-owners of businesses.

Finally, awareness of historical Black technical communicators and their stories can contribute to a more inclusive understanding of the profession's history, revising the traditional genealogy of the profession to include many Black technical communicators as first-generation professional technical communicators. Reclaiming their legacy may further affirm Black voices by strengthening their professional identities and shared sense of ownership in the profession. The challenges that historical Black technical communicators faced and overcame can inspire all technical communicators to pursue their professional goals with tenacity.

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Note

I do not formally cite the databases listed below, even though I made extensive use of them. When necessary, I have written "According to his draft registration card" or "According to the 1950 US Census."

- Archive.org
- Ancestry.com
- Department of Veterans Affairs BIRLS Death File, 1850-2010
- Find a Grave, https://www.findagrave.com
- Google Books
- Newspapers.com
- Proquest Historical Newspapers
- Social Security Applications and Claims Index, 1936-2007
- Social Security Death Index, 1935-2014
- United States Federal Censuses, especially the 1950 Census
- World War II Draft Registration Cards

Because database annotations—such as Newspapers.com, ProQuest Historical Newspapers, and so on—have been removed from the entries, these citations now refer to the original newspaper issues rather than their database digitizations.

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Appendix A. Other Technical Communicators Employed in Government

Name	Job Title	Agency	Location	Date	Comment
Lydie Foster Allen (née Coleman, 1917–1974)	Editorial Clerk[a]	Unknown ("National Defense")	Washington, DC	1950 [b]	See the photo of her in "Three" (1935); graduated from Virginia Union University circa 1940 ("Allen," 1974); was living in DC during the 1950 census; experienced housing discrimination ("Farce," 1958)
Herbert Esau Augustus (1919–1973)	Technical Publications Writer	Army Chemical Center	Harford County, MD	1956	Earned a BS from Morgan State College (1942) and an MA from Ohio State University (1947); published an article in *Technical Writing Review* (Augustus, 1956)
Charles Alfred Bankhead (1924–2000)	Illustrator	Federal Civil Defense Administration's Civil Defense Staff College	Olney, MD	1952	Previously worked as an illustrator for the Army and CIA; patented several inventions; see the workplace photo of him in Taylor (1952)
Oscar Lee Banks (1929–1993)	Visual Information Specialist	Department of Agriculture's Forest Service	Milwaukee, WI	1950s and 1960s	May have designed the visual on the cover of Horn (1954); graduated with a BFA from the University of Illinois (1957); see U.S. Department (1968) for a workplace photo
Earl Elmer Bass (1917–2000)	Technical Manuals Editor	Army TACOM	Warren, MI	1960s	Worked as a reporter for the *Nashville Globe* in the 1940s; attended every World Series from 1956 to at least 1968 (Neuman, 1968)
Joseph Bradford (1907–1991)	Information Specialist	Department of Agriculture	Washington, DC	1960s	Began his career in the early 1940s with the Alabama Agricultural Extension Service; earned a PhD in 1962; see U.S. Department (1965) for workplace photos of Bradford, S. Briscoe, and Green

Name	Job Title	Agency	Location	Date	Comment
Bertha May Bragg (née Martin, 1913–1989)	Editorial Clerk	Pentagon	Washington, DC	1954	Performed as a soprano in the National Negro Opera Company; held leadership positions in the Prince Hall Masons and the Daughters of the Elks ("Elks," 1954); evicted from her DC apartment (Burley, 1954, p. 47); retired from the Army Military Personnel Center in 1982 (Council, 1982)
Nathaniel Irving Briscoe (nicknamed "Bris," 1928–1999)	Illustrator	Department of the Navy	Washington, DC	1950s–1980s	Described as a "scientific illustrator" in one source; founded the Woodridge Warriors Youth Organization, Washington DC, in 1963 ("Brotherhood," 1957; Woodridge, 2019)
Sherman Briscoe (1908–1979)	Information Specialist	Department of Agriculture	Washington, DC	1941–1968	Became the executive director of the National Newspaper Publishers Association in 1970 (Hoopes, 1977, pp. 58–59; "Sherman," 1979)
Margaret Ophelia Brooks (a.k.a. Johnson, 1915–1993)	Editorial Clerk	Department of the Army	Washington, DC	1950	Born in Amory, Mississippi; lived in DC during the 1950 census, which identifies her employer anachronistically as "War Department"
Edward Milton Broom (1926–2002)	Technical Illustrator	Army TACOM	Warren, MI	1951–1981	Founded a greeting card company, Broom Designs, that marketed exclusively to African Americans (May, 2002; Brogdon, 2024)
Austin Thomas Brown (1932–2019)	Supervisor, Technical Publications Group	Naval Ordnance Laboratory, later the Naval Surface Weapons Center	White Oak, MD	1960s–1990s	Joined STC in 1967; served as chairman of STC's Washington, DC chapter (1971–1972) and national president of STC (1988–1989) (Lockley, 2021)

Name	Job Title	Agency	Location	Date	Comment
Warren Wesley Buck (1915–1988)	Engineering draftsman; scientific illustrator	Weather Bureau, Department of Commerce, later NOAA	Washington, DC	1942–1970s	Educated at Lincoln University in Missouri; father of the well-known physicist by the same name (Buck, 2021, pp. 7–9)
Augustus Luther Budd (1924–1978)	Illustrator	"U.S. Government"	Unknown	1956–1957	Described as a "draftsman" in one source and an "illustrator" in another ("Brotherhood," 1957)
Nathaniel Cannon (1923–1985)	Technical Illustrator	Army TACOM	Warren, MI	1950s–1980s	Served as Chief of TACOM's Illustration Branch in the 1960s and 1970s (May, 1985)
Bernice Lucille Carroll (née Emmons, a.k.a. Davis, 1915–2001)	Illustrator	Bureau of Reclamation	Billings, MT	1947–1952	Attended Ohio State University, but graduated from Virginia State, majoring in art; was the first Black certified public school teacher in Billings, MT ("Bureau," 1952; "Bernice," 2001)
Germaine Alvon Culver (1909–1984)	Editorial Clerk	Unknown ("Federal Government")	Baltimore? Washington, DC?	1950	Began his federal service as a messenger with the National Park Service in 1933; was living in Baltimore during the 1950 census ("Culver," 1984)
Richard William Dempsey (1909–1987)	Illustrator	General Services Administration	Washington, DC	1950–1974	Created statistical visuals and other illustrations for the GSA ("GSA," 1951); recognized for his fine art, represented in the Smithsonian American Art Museum and the National Gallery of Art
Leatrice Joyce Dowd (née Matthews, 1923–1987)	Technical Writer-Editor	Army Troop Support Command	St. Louis, MO	1960s – 1980s (?)	Elected Mayor of Pagedale, MO, in 1986; died while in office ("Pagedale," 1979: "Leatrice," 1987)

Name	Job Title	Agency	Location	Date	Comment
Andrew Rapp Edelen (1925–2002)	Statistical Draftsman; Visual Information Specialist	(1) U.S. Post Office Department; (2) Industrial College of the Armed Forces; (3) Army Armament Materiel Readiness Command	Washington, DC; Rock Island, IL	1940s–1980	Began his federal service as a messenger at 16; prepared graphs and charts for postal officials; designed the red, white, and blue color scheme for postal vehicles and mailboxes; designed exhibits and memorials for the Army ("Exhibits," 1980)
Ana Adeline Edmonds (née Aiken, 1921–2019)	Illustrator	Navy Hydrographic Office	Suitland, MD	1954	Served as a WAC during WWII ("Disillusioned," 1945); graduated from Letcher Art Center in Washington, DC ("Brotherhood," 1957)
Donald Anderson Edwards (1905–1999)	Technical Editor	Signal Corps' Publication Agency, Fort Monmouth	Monmouth County, NJ	circa 1943	See the photo of him in "The Better" (1945); earned a PhD in 1953; enjoyed a long career as a physics professor (Sammons, 1990, p. 82)
Charles William Enoch (a.k.a. Agbo, 1926–1994)	Technical Illustrator; Writer and Editor	Army TACOM	Warren, MI	1955–mid 1980s	Served as Deputy Minister of Information for the Republic of New Afrika in the late 1960s ("Charles," 1994; Karolczyk, 2014, p. 187)
Ella Gerralldine Green (née Jones, b. 1927)	Writer-Editor	Department of Agriculture	Washington, DC	1960s	Joined the USDA as a clerk-typist in 1946; promoted to Writer-Editor ("USDA," 1963); later worked for the Women's Bureau
James Archie Hargraves (1916–2002)	Junior Editor-Writer	Office of Price Administration	Washington, DC	1941–1942	Earned a doctorate in religion at Chicago Theological Seminary (1968); served as president of Shaw University (1971–1976) (Simmons, 2002; "Straws," 1941)

Name	Job Title	Agency	Location	Date	Comment
Lucius Herbert Henegan (1901–1979)	Information Specialist	Department of Agriculture's Farmers Home Administration	Washington, DC	1942–1954	Engaged in public relations writing, specialized journalism, and technical communication; moved to the USIA in the 1950s (Waldrop, 1958)
Richard Bullock Henry (a.k.a. Imari Obadele, 1930–2010)	Technical Writer	Army TACOM	Warren, MI	1960–1968	Co-founded the Republic of New Afrika and served as its second president (1971–1991) (Guzmán, 2021)
Oliver Windell Holmes (sometimes spelled "Wendell," 1918–1992)	Editorial Clerk	Atomic Energy Commission	Washington, DC	1948	Previously worked as a journalist; see the workplace photo of him in "Our Scientists" (1948)
Charlotte Russell Hutton (née Coles, 1917–1998)	Technical Writer and Editor	Department of Defense's Armed Services Technical Information Agency	Alexandria, VA	1961–1963	Earned a BS from West Virginia State College (1938) and an MS in Botany from Catholic University of America (1953); pursued further graduate study (1955–56); became a high school science teacher, curriculum developer, and school system administrator in DC; taught as adjunct at Howard University (Hast, 1984, p. 386)
Constance Jackson (life dates unknown)	Editor	Department of Commerce's Coast and Geodetic Survey	Jackson, MS	1960s	Served as a WAC (1949–1954); worked for the Department of Defense (1950s); joined C&GS as a clerk-typist in 1959 and promoted to editor in 1961 (Dunnigan, 1962)
Lawrence Daniel Jenkins (1933–2018)	Technical Illustrator	Wright-Patterson Air Force Base	Dayton, OH	1960s	Graduated Central State College in Wilberforce, OH; painted a portrait of JFK and LBJ together and presented it to Luci Johnson ("Portrait," 1964)

Name	Job Title	Agency	Location	Date	Comment
Alexander Wood Johnson (1902–1970)	Technical Writer	Army Training Center, Fort Monmouth	Monmouth County, NJ	1940s–1960s	Had his own radio repair business in 1940; usually used his first initial in place of his first name ("A. Wood," 1970)
Edward A. Jordan (life dates unknown	Technical Writer	Atomic Energy Commission	New York City? Washington, DC?	1953	Reportedly won the George Polk Award as a journalism student at Long Island University ("Polk," 1953)
Henry Leroy King (a.k.a. Henri Umbaji King, 1923–2004)	Technical Illustrator, then Visual Information Specialist	Army TACOM	Warren, MI	1957–1984	Co-founder with Enoch and Orr of Kumasi Mart (specializing in African attire) and Kumasi Art Gallery in Detroit in the 1960s ("Visiting," 1966; Maidenberg, 1971)
David Alphonso Lane (1895–1985)	Information-Education Specialist	Office of Armed Forces Information and Education	Fort Huachuca, AZ; Pacific theater; Arlington, VA	1942–1955	Earned a BA from Bowdoin College and an MA in English from Harvard University; served as a dean at West Virginia State College and Louisville Municipal College; pursued further graduate study at the University of Chicago; edited *Armed Forces Talk* ("Defense," 1951).
Arthur Douglas Lanier (1925–2011)	Technical Writer	Rossford Ordnance Depot	Toledo, OH	before 1962	Served as a long-time administrator in Toledo's Urban Renewal Agency ("Gets," 1962)
William Manly Leak (1914–1990)	Technical Editor, later Head of Publications Group	Naval Research Laboratory	Washington, DC	1953–1976	Worked in the War Department from 1942 to 1953 and at Howard University from 1976 to 1987 ("William," 1990); presented "Teamwork in Producing the Annual Report" at the 1973 STC conference

Name	Job Title	Agency	Location	Date	Comment
James Curtis Leveye (1925–1984)	Technical Writer	Redstone Arsenal	Huntsville, AL	1950s–1980s (?)	Served as treasurer of STC's Central Florida Chapter in 1969; see Caputo (1969) for a photo
W. T. Lyons (1919–2006) [c]	Technical Writer	Naval Personnel Research and Development Laboratory	Washington, DC	1960s	Author of many technical documents for the Navy; also author of three collections of poems, including *Soul in Solitude* (Shockley & Chandler, 1973, p. 102)
Jon Brutus Massey (1919–2008)	Illustrator	Department of Labor	Washington, DC	1950s–1970s	See Harrison (1951) for a photo; created freelance surgical drawings for Johns Hopkins; designed the cover of the 1961 edition of *Occupational Outlook Handbook* ("Brotherhood," 1957)
Catherine Ernetta Mauldin (a.k.a. Kay Alvarado, Emmermann, 1916–2004)	Senior Engineering Draftsman	Army Quartermaster Corps	Chicago, IL	1945	Earned an MA from Lincoln University; served as Arts and Crafts Director for the Army Special Services; lived in Europe for many years ("Catherine," 2004); see Lopez (1945) for a workplace photo
Harry Sylvester McAlpin (1906–1985)	Information Specialist	Department of Agriculture's Sugar Rationing Administration	Washington, DC	1947	Worked as an interviewer, editorial clerk, information specialist, and magazine editor for several government agencies in the US and Korea (1935–1949); later became the NNPA's first White House correspondent (Brodsky, 2018)
Gayle A. Nolan, née Foust (b. 1941)	Cartographer	Chicago Department of Urban Renewal	Chicago	1967	Trained as a graphic artist; drew urban planning and real estate maps; created illustrations and covers for promotional documents ("Cartography," 1967)

Name	Job Title	Agency	Location	Date	Comment
George Elliott Olden (1920–1975)	Senior Artist; Illustrative Draftsman	(1) Works Progress Administration; (2) Office of Strategic Services	Washington, DC	1940–1942; 1943–1945	Studied under Amaza Meredith at Virginia Union University; created WWII posters about gasoline conservation ("Aids," 1941); worked as a graphic artist for CBS (1950s); designed an Emancipation Proclamation stamp for the Post Office Department (1963) (Aller, 2016)
Henry Leon Orr (a.k.a. Obanji, 1927–2014)	Publications Writer; Technical Manual Editor; among others	Army TACOM	Warren, MI	1956–1986	Earned a master's degree in music from the University of Detroit; active in Group on Advanced Leadership (GOAL) with Henry, Enoch, and King (Gaskill, 1969)
Alyce Ruth Peyton (a.k.a. Bledsoe, 1927–2001)	Clerk (Editing and Tabulating)	Bureau of the Census	New York, NY	1950	Earned a degree in music from Lincoln University; described as an "editor" in the 1950 census; co-founded the Blackpool Brighton Candy Corporation in Los Angeles in the 1980s (Faris, 1984)
Elwood Eugene Randol (1916–1981)	Chief of the Editorial Section	Army's Aviation Materiel Command	St. Louis, MO	1965	Employed by the army from the 1940s to the 1980s; wrote a column titled "It Seems to Me" for the *St. Louis American* ("Army," 1965; "Elwood," 1981)
Eugene Anton Raymond (1909–1989)	Technical Illustrator	Marine Corps Clothing Depot	Philadelphia	1950s–1970s	Founder of the United Friends of Africa; commissioned to paint a portrait of Liberian President W. V. S. Tubman (St. George, 1989)

Name	Job Title	Agency	Location	Date	Comment
Charles Archie Reynolds (b. 1927)	Illustrator	Quarter-master Corps' Heraldic Services Division	Washington, DC	1958	Studied at the Philadelphia Museum School of Art (1945–1949); see Peeks (1958) for a photo; supervised the 1975 design of the current seal of the U.S. Vice President
Maggie Lena Robinson (1918–1983)	Editor	Signal Corps, Fort Monmouth	Monmouth County, NJ	1950	Described as "editor" at "government laboratory" in the 1950 U.S. Census; became a school teacher in later years ("Maggie," 1983)
Betty Jane Slade (née Edmonds, a.k.a White, a.k.a Buckner, 1925–2006)	Statistical Artist	Unknown	Columbus, OH	1949–1950	Identified as a "statistical artist" on her 1949 marriage license application and a "graphic artist" in government employment in the 1950 U.S. Census
Tracy Ashton Spinks (1925–1966)	Illustrator	Fort Belvoir	Fairfax County, VA	1956–1957	Served in the army during WWII ("D.C.," 1945; "Brotherhood," 1957)
Marshall Victor Stokes (1922–1969)	Medical Illustrator; Supervisor	Veterans Administration Hospitals	Tuskegee, AL; Boston	before 1950–1969	Specialized in biological photography ("Biological," 1967)
Melvin Burnie Swan (1923–2002)	Illustrator	(1) Demobilized Personnel Records Center; (2) Aeronautical Chart and Information Center	St. Louis, MO	1946–1964	Designed displays for exhibits and visual aids for briefings ("Melvin," 1954)
Patricia Ann Tatem (b. 1946)	Technical Editor	Naval Research Laboratory	Washington, DC	1967–1972	Earned a PhD in Chemistry from George Washington University in 1984 (Henderson, 2000, p. 1293)

Name	Job Title	Agency	Location	Date	Comment
George Robert Taylor (nicknamed "Ronnie," 1926–2010)	Technical Publications Editor	Wright Patterson Air Force Base	Dayton, OH	1950s – 1990s (?)	Held this job for 37 years, eventually becoming head of his department ("Taylor," 2010)
John Henry Terrell (1902–1978)	Technical Illustrator	Philadelphia Naval Shipyard	Philadelphia	1945–1973	Created the comic book detective Ace Harlem for *All Negro Comics* (1947); featured in a national ad campaign for Viceroy cigarettes (Untitled, 1959)
Jeremiah Timothy Weaver (1929–1996)	Illustrator	Department of Recreation	Washington, DC	at least from 1967 to 1970	Had previously been employed by the Department of Agriculture ("Government," 1970)
Charles Herbert Winslow (1925–1998)	Technical Illustrator	Redstone Arsenal	Huntsville, AL	late 1950s	Was a staff member of two magazines for Black readers: *Snap* in San Antonio and *Tone* in Huntsville ("Negro," 1958; "Edmonton," 1960;)
Daniel Leopold Witter (1932–1962)	Technical Writer	Air Force? Private company?	New York City	1962	Born in Jamaica, naturalized in 1951, committed suicide under sensational circumstances ("Writer's Death," 1962)
Lionel Frazier White (b. 1942)	Visual Information Specialist	Department of Labor	Washington, DC	1969	Began as a draftsman circa 1961; promoted to illustrator in 1967, visual information specialist in 1968, and Chief of the Graphics Branch in 1969 (U.S. Department, 1971)
Gretta Viola Whitted (née Spivey, 1937–2016)	Technical Illustrator	Army Ammunition Procurement and Supply Agency (APSA)	Joliet, IL	1959	Previously worked in Joliet's Engineering and Planning Department; later was owner of Graphic Tee Art and Design; founded the Joliet chapter of National Hook-Up of Black Women ("Miss Greta," 1959; "Gretta," 2016)

Name	Job Title	Agency	Location	Date	Comment
Oswald Sparrow Williams (nicknamed "Ozzie," 1921–2005)	Supply Cataloger (Mechanical Equipment) [d]	Naval Material Catalog Office, Bureau of Supplies and Accounts	New York City	1949–1951	As an engineer, helped design the P47 Thunderbolt for Republic Aviation during WWII; worked on the Apollo Lunar Module in the 1960s; became an adjunct university professor in the 1970s (Romano, 1995, p. 2216)
Lymme Masco Young (1922–1989)	Special Assistant (Editor)	Philadelphia Gas Works	Philadelphia	1962	Hired to help create a communications program for employees; edited the personnel manual and employee handbook ("Philadelphia," 1962)

[a] *People who worked under the job title "Editorial Clerk" in the federal government in the 1940s and 1950s often performed technical editing duties for less pay and with less authority than those classified as "Technical Editor." For example, at the Atomic Energy Commission, Black editorial clerk Oliver W. Holmes (CAF-5) was to be paid $2,645 in 1948, while white technical editor Robert C. Tumbleson (CAF-13) was to be paid $7,102 (U.S. House, 1947, p. 868). After adjusting for inflation, the difference was equivalent to approximately $38,696 versus $103,901 in 2024 dollars.*

[b] *A single year in the "Date" column means that the person was known to be working in this job during that year, not necessarily that the person worked in this job for only one year.*

[c] *Lyons had only the initials "W. T." as first and middle names.*

[d] *Romano (1995) and other sources identified Williams as a technical writer for the Naval Material Catalog Office. Documents in his federal civilian personnel file revealed that he did, indeed, perform the work of a technical writer even though his official job title was "Supply Cataloger (Mechanical Equipment)."*

Appendix B. Other Technical Communicators Employed in Industry

Person	Job Title	Company	Location	Date	Comment
Jackie (Jack) William Adams (1927–1975)	Engineering Artist / Technical Illustrator	Lockheed Georgia Company	Marietta, GA	1953–1975	Studied at Clark College, Morris Brown College, and Tuskegee Institute; known publicly for his fine art (Carter, 1968)
Willie Ruffin Adams (b. 1938)	Technical Illustrator	Western Electric	Winston-Salem, NC	1969	Attended Agricultural and Technical College in North Carolina ("Nancy," 1969)

Person	Job Title	Company	Location	Date	Comment
Bernard Ammons (nicknamed "Bernie," a.k.a. Williams, 1935–2005)	Technical Writer	Raytheon Company	Oxnard, CA	1967–1969	Served in the Air Force in the early 1960s; featured in a national ad campaign of the Advertising Council and Plans for Progress ("Oxnard," 2011; "Who," 1967)
Edith Lorraine Atkinson (née Reed, 1919–2000)	Editor	Collins Radio Company	Cedar Rapids, IA	1959 to at least 1961	Was a typist at Collins for seven years before becoming an editor; edited instruction manuals for grammar and nomenclature ("Editor," 1961)
Albert Lee Barringer (1924–1986)	Proposal Manager	Philco-Ford's Western Development Laboratories	Palo Alto, CA	1964	Received a Purple Heart in WWII; became the director of an anti-poverty program in Berkeley in 1967 and later a HUD administrator in the 1980s ("Philco," 1964; "Albert," 1986)
La Bonnie Bianchi (a.k.a. Townsend, b. 1937)	Technical Writer	Martin Marietta	Baltimore	1960–1963	Graduated from RPI with a master's degree in technical writing (1960); subject of a cover story in *Ebony* ("Woman," 1961); later worked for LTV Aerospace and Ford Motor Company in the Detroit area
Benjamin Elias Booze (1928–2011)	Technical Illustrator	Sperry Rand's Ford Instrument Corporation	Long Island City, NY	1958	Illustrated manuals for Jupiter missiles; see "Long Island Negroes" (1958) for a workplace photo.
Louis Levi Brent (1906–1973)	Technical Writer	Emerson Electric Manufacturing Company	St. Louis	c. 1957–1963	Earned a BS in science from Ohio State and a PhD in psychology from Indiana University ("Funeral," 1973); served as the second chairman of STC's St. Louis Chapter ("Names," 1963)

Person	Job Title	Company	Location	Date	Comment
Clarence LeRoy Campbell (b. 1939)	Technical Writer	Aircraft Armament	Cockeysville, MD	1962	Majored in electrical engineering at the University of Maryland ("Miss Jennie," 1962)
Carole Olivia Chaney (1942–1982)	Technical Writer and Editor	(1) Philco-Ford; (2) IBM	Philadelphia	1960s–1970s	Graduated from Central State University; later known as a radio personality on WEAM in Arlington, VA ("Social," 1967; "Carole," 1982)
David John Chesnut (sometimes misspelled "Chestnut," 1910–1983)	Technical Writer, Manager of Proposals and Presentations	(1) American Machine and Foundry Co. (2) Raytheon Wayland Laboratories	Boston area	1950s–1972	Played drums with Count Basie's band in the 1930s; earned a PhD in psychology; became the first African American fellow of STC in 1969 ("Chesnut," 1969; Burawa, 1970, p. 78)
Eugene Collins (b. circa 1930)	Technical Writer	Technical Services Corporation	Philadelphia	c. 1957–1960	Wrote operation and maintenance manuals and specifications for military equipment ("Writer," 1960)
Marvin Carlyle Dean (1932–1997)	Artist, Draftsman	Training Aids Department, Chrysler Corporation	Detroit, MI	1950s	Joined Chrysler on co-op while attending Cass Technical High School in 1950 (Nunn, 1957); profiled in *Ebony* in 1955
Thomas David Diggs (1927–2020)	Engineering Writer	Bettis Atomic Power Laboratory (operated by Westinghouse for the Navy)	Pittsburgh	1964	Earned a mechanical engineering degree from "Chicago Tech," probably Illinois Institute of Technology (Delahan, 1963, p. 5)
Joseph Dyer (1934–2011)	Technical Editor	Cal Tech's Jet Propulsion Lab (JPL)	Pasadena, CA	1963–1965	Became a reporter, then an executive of a major network television station in Los Angeles (Dyer, 2002, esp. pp. 74–78)

Person	Job Title	Company	Location	Date	Comment
Carl Clifton Frazier (1924–2017)	Technical Writer	General Electric	Cincinnati	1960s–1990s	Earned an associate's degree in electrical engineering from the University of Cincinnati; "sent to the mail room" near the end of his career (Hobson, 1992)
Stephen Bruce Guillory (1935–1999)	Technical Writer	(1) Hughes Aircraft (2) RCA	unknown	1956–1960	Served in the Air Force (1952–1956); graduated from UCLA (1963); worked as a senior field engineer for Litton Industries in Europe (Pryce, n.d.)
Harvey Earl Gordon (1934–1993)	Engineering Writer	Westinghouse Corporation	Baltimore	1968	Graduated with an electrical engineering degree from Howard University in 1959 ("Housing," 1968; "Harvey," 1993)
Vernon "Gil" Gilbert Graves (1934–2023)	Technical Illustrator	Massachusetts Institute of Technology	Cambridge, MA	1964	Studied electrical engineering at Harvard University (Garrett, 1964)
Robert Carter Hayden (1937–2022)	Science Editor	Xerox Educational Division	Middletown, CT	1966–1969	Later directed Boston's METCO program and MIT's Secondary Technical Education Project; wrote books about Black history and scientists; served as Boston NAACP president (Marquard, 2022)
Samuel Lloyd Haynes (1934–1987)	Technical Illustrator	(1) Bell Helicopter; (2) Fisher Engineering	San Jose, CA	circa 1960	Played teacher Pete Dixon in the TV series *Room 222* ("TV," 1971)
George Ficklin Keyser (1932–2013)	Technical Writer	Philco Corporation, Western Development Laboratories	Palo Alto, CA	1960–1965	Later became a professor at Howard University; published "Learn Through Writing in an Engineering Course" in *IEEE TPC* (Keyser & De Loatch, 1984)

Person	**Job Title**	**Company**	**Location**	**Date**	**Comment**
Horatius David "Hoe" Johnson (1921–1991)	Technical Illustrator	Cooper Publications	Los Angeles	1959	Studied fine arts at Lincoln University in Missouri ("Johnson's Scene," 1945; "Most," 1959)
Jennie Ruth Johnston (a.k.a. Bookhart, possibly Jones, b. circa 1933)	Technical Editor	Bell Laboratories	New York City	1959–1960	Attended City College of New York ("Enchanting," 1959; "Pound," 1960)
John Augustus Locksley (1923–2008)	Technical Illustrator	John I. Thompson & Company	Washington DC	1956–1957	Attended Dunbar High School and Howard University ("Tuberculosis," 1942; "Brotherhood," 1957)
Alfred Edward Martin (1911–1993)	Technical Editor	McGraw-Hill	New York City	1957–1959	Enjoyed a long career as a physics professor (Sammons, 1990, p. 162)
Melmon May (b. 1940)	Trade and Technical Copywriter	Smith, Kline, & French Laboratories	Philadelphia	1966	Graduated from Miami University in 1962; became an insurance company executive in later years ("SK&F," 1966; "Career," 1993)
George Daniel Mercer (1923–2012)	Technical Illustrator	Vitro Laboratories	Silver Spring, MD	Unknown (probably 1950s or 1960s)	Drew cartoon strips for the *Baltimore Afro-American*; later designed stamps as a visual information specialist for the USPS ("After," 1948; McDonough, 2012)
William Harrell McPherson (1927–2016)	Technical Writer	North American Aviation	*El Segundo, CA*	1963–1967	Graduated from Morehouse College in 1948 (Matney, 1976, p. 432)
Donald Ross McSween (1932–2000)	Technical Writer	Jervis B. Webb Company	Detroit	1968–1970	Served in the Air Force in Korea ("Motor," 1970)

Person	Job Title	Company	Location	Date	Comment
Ronald Lescor Mimms (b. 1935)	Technical Writer	IBM	Poughkeepsie, NY	1964	Active in STC's Mid-Hudson Chapter in the early 1960s; served as president of an NAACP branch ("Writer," 1964)
George Frederick Moore (1926–2019)	Technical Illustrator	Warner Company	Syracuse, NY	1951	Publicized as the first Black man to be hired as a technical illustrator at the Warner Company ("Corporation," 1951)
Naida Alzaida Page (née Willette, 1925–2013)	Medical Illustrator	(1) Johns Hopkins University (2) Howard University	Baltimore; Washington, DC	1949–1960s (and likely beyond)	Reportedly the first Black woman to be formally educated as a medical illustrator ("Medical," 1951)
James Eugene Pittman (1925–2013)	Technical Writer	AC Electronics Division of General Motors	Milwaukee	1960s	Graduated with a BS in electrical engineering from the University of Maryland in 1960; served as Vice Chairman of STC's Milwaukee Chapter ("January," 1963; "James," 2013)
Donald E. Ried (b. 1933)	Technical Writer	Hewlett-Packard Company	Palo Alto, CA	1968	Led a campaign to change the name of East Palo Alto to "Nairobi" (Spangler, 1968)
Adolph Joel Robinson (1915–2012)	Technical Illustrator	William Douglas McAdams Pharmaceutical Advertising Agency	New York City	1940s	Educated as an architect; became famous as a fabric designer; also engaged in furniture design, book cover design, and fine art ("Fabric," 1952)
Frances Delores Ross (1935–1985)	Technical Editor	McGraw-Hill Publishing	New York City	1961	Better known as "Fran Ross"; remembered for her novel *Oreo* and as a comedy writer for Richard Pryor ("Social," 1961; Mullen, 2015)

Person	Job Title	Company	Location	Date	Comment
Ralph “Sonny” Satterthwaite (1938–2019)	Illustrator	General Electric	Philadelphia	at least 1966–1971	Was GE’s art director for the Air Force’s Manned Orbiting Laboratory (“Creative,” 1971; “Satterthwaite,” 2019)
Richard Tom Satterwhite (1932–1992)	Scientific Illustrator	Carnegie Museum	Pittsburgh	1968	Specialized in entomological illustration (“Entomological,” 1968)
Robert Francis Scott (1918–1989)	Technical Editor	*Radio-Electronics* magazine	New York City	1940s–1970s	Graduated from Agricultural and Technical College, Greensboro, NC, in the 1930s; invited to visit Japan as a speaker (“Invited,” 1965)
Harry Cornelius Taylor (b. 1938)	Technical Editor	National Radio Institute	Washington DC	1960s–1970s	Wrote and edited “lessons and kit manuals” for NRI courses; served as NRI national secretary in the 1980s (“Miss Browne,” 1962; Taylor, 1979, p. 23)
Genevieve Rucker (née Teague, a.k.a. Jean-Pierre, b. 1940)	Technical Illustrator	IBM	Binghamton, NY	1965	Graduated from Spelman College in 1962; participated in IBM’s Executive Loan Program in the 1990s (“IBM,” 1965; “Women,” 1964; “Appointments,” 1993)
Arzell Thompson (b. 1943)	Technical Illustrator	Twin Disc	Racine, WI	late 1960s	Trained as a technical illustrator in the Air Force (Thompson, 2016)
Ruth Eileen Turner (a.k.a. Baccus, Mitchell, b. 1944)	Technical Writer	IBM	*Poughkeepsie, NY*	1965	Graduated from Fisk University in 1964 (“Ruth,” 1965); earned a PhD from the University of Connecticut in 1978; served as president of two colleges (Chassie, 2005, p. 30)

Person	Job Title	Company	Location	Date	Comment
Edwin Clinton Washington (1922–2020)	Technical Illustrator	Ling-Temco-Vought	Dallas	1964	Was an NAACP leader in Dallas in the 1950s and 1960s ("NAACP," 1964); co-founded Black Citizens for Justice, Law & Order in 1969 ("Edwin," 2020)
William Joseph White (1926–2014)	Technical Writer	Andrea Radio and TV	Unknown (Long Island, NY?)	1955	Published his memoirs as *Triangle Hill* (White, 2011, p. 223)
Ray Hicks Waters (sometimes spelled "Warters," b. 1938)	Technical Illustrator	McDonnell Aircraft	St. Louis	1963	Attended San Diego State University ("Miss Brenda," 1963)
John Wilbert Weaver (1921–1996)	Technical Writer	"several corporations" (possibly Sylvania)	East Coast (likely Boston area)	1950s–1960s (?)	Graduated from Howard University in 1944; served in the Navy during WWII; see "AVCO-Roxbury" (1969) for a workplace photo
Nasira Fatima Wilkins (née Ledbetter, 1929–1994)	Technical Editor	Rocketdyne (North American Aviation)	Los Angeles	1959	Earned a master's degree in physics from Howard University (1953); described as a "space rocket editor" ("Space," 1959)

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Liminality

The chapters in this edited collection represent the final essays accepted for publication in *Technical Communication*, the journal of the Society for Technical Communication (STC). In January 2025, after the STC filed for bankruptcy and ceased operation, we brought together these essays for publication. Scholarship in the field of technical and professional communication (TPC) has always resided in something of a liminal space—between academics and practitioners; between the classroom and the workplace; between subject matter expertise and writing and communication expertise. This liminality has been a hallmark and a strength of TPC. Bringing together scholars and practitioners, this volume exemplifies the diverse range of work that technical and professional communicators do. The chapters illustrate various component parts of the field's identity and what it has long valued. Equally important, this collection demonstrates the resilience of ideas that has long defined TPC as a field and a practice.

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