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COMMUNICATION DESIGN QUARTERLY

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Communication Design Quarterly

CDQ Editors

Empowerment through Authorship Inclusivity: Toward More Equitable and Socially Just Citation Practices

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ABSTRACT

Citation injustices have a long history in scholarly writing and have led to underrepresentation and silenced voices of certain author groups (e.g., women and people of color). Concerns about whose voices are cited, heard, and privileged have encouraged interventions for Technical and Professional Communication (TPC) scholars to promote inclusivity and equity in scholarly writing and the design of communication. This article examines another aspect on citation injustices tied to publishing policies and style-guide conventions and conformity: practices for crediting shared first authors and equally contributing authors for their scholarship. We question current citation practices and examine style-guide rules and conventions of 115 TPC and communication-related journals to identify where citation injustices may occur in scenarios with shared first authors and equally contributing authors. We argue that TPC scholars should pushback against style-guide conformity in their publications and citations to embrace more equitable and socially just practices. We conclude by presenting five opportunities for TPC and communication scholars to change current citation practices in our field.

CCS Concepts

Social and professional topics

Keywords

Publishing policies, Style-guide conformity, Authorship, Recognition, Equity and inclusion, Citation injustices, Bibliometrics

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INTRODUCTION[1]

Citations matter in scholarly writing. "Citations are a rhetorical device; they say something" (Fowler, 2019, p. 2). They identify the creators of intellectual property via authorship and document that these (cited) voices matter: citations are privileged in meaning or are valued for what they say. Furthermore, "Citing is a political act. It is a practice that can work both sides of the same coin: it can give voice, and it can silence" (Chick et al., 2021, p. 1). Citations are "political acts" in the sense that selecting whose scholarship to cite, and thus to promote, privileges some voices over others. The decisions that authors make about whose work to cite is a communicative activity that connects with others and forms relationships via related perspectives within a scholarly conversation. Selecting whose voice to cite and promote reflects those relationships as well as the underlying authority and power structures of the publishing process—the writer's decisions, the peer reviewers' suggestions that certain literature be cited before acceptance, and the editor's requests for additions and revisions before publishing the article. Per this privileging, concerns about whose voices are cited in scholarship have been discussed in recent technical and professional communication (TPC) and communication-related literature (e.g., Chakravartty et al., 2018; Itchuaqiyaq & Frith, 2022; Mayer et al., 2017; Moore et al., 2021; Palermo, 2022; Stevens, 2024); however, citation practices related to style-guide conventions and conformity and their impact on authorship inclusivity and equity in scholarly writing are not the focus of those conversations and research.

As scholarly journal editors,[2] we use the American Psychological Association (APA) style guide for article publications, and we saw recent changes to the seventh edition that influenced how authors are cited and credited for contributions to co-authored works. First, co-authored works from three or more authors now

1 We request citations include both names in the first-author position: (Lancaster/King, 2024).

2 Lancaster is Associate Editor for *Communication Design Quarterly*, and King is Managing Editor of Publications, Sigma Tau Delta—*Sigma Tau Delta Review* and *Sigma Tau Delta Rectangle*.

use “et al.” for first and subsequent in-text/parenthetical citations, omitting any in-text mention of contributors in three or more author positions (see APA, 2020, Section 8.17, p. 266). Second, journal articles co-authored by 20 or more authors cite up to the twentieth author. For articles with more than 20 authors, APA uses an ellipsis to replace the names of authors listed between the nineteenth and last co-author in the references list, removing the twentieth to the second-to-last authors from the manuscript contributors (see APA, 2020, Section 10.1.5, p. 317). The style guide does include all authors in the byline on the title page of the original article (APA, 2020, pp. 33–35), but this credit does not extend to citations of the manuscript in other published works.

When an author uses “et al.” (Latin for “and others”; “et al.,” n.d.) to replace co-authors’ names (suggested for simplicity in citing), those authors are silenced as contributors and the work is identified solely by the named first author. Similarly, when authors replace names with ellipses, they omit those co-authors and contributors from the manuscript. Simply put, some authors’ names are visible in manuscript citations, but other authors’ names are not listed and those authors are not credited.

As scholarly journal editors, we questioned APA’s publishing policies and, more broadly, how style-guide citation practices impact authorship inclusivity and equity in scholarly writing and the design of communication. In a recent article, Stevens (2024) highlighted the “dual roles of an editor as both a guide to an author through [the publishing] process and ultimately an interpreter of the [publishing] policy, which can be particularly problematic when we consider inclusion in the publishing process” (p. 31). Although our editor roles may require compliance with style-guide conventions as part of publishing policies, we cannot ignore another role we play to advocate for socially just policies. Recognizing our dual roles, we ask ourselves if style-guide citation requirements align with our field’s efforts to embrace more equitable and socially just practices and what implications current citation practices create.

To honor the value of *all* contributing authors, we consider new directions for publishing policies and citation practices that empower authors and that are more inclusive, equitable, and socially just. We consider four research questions and investigate the style-guide standards to answer those questions. First, we searched and reviewed current literature related to publication practices and research related to citations. Second, we considered our own recent editorial and authorship experiences through two applied publication examples, illustrating how style-guide conventions attribute authorship, crediting (and silencing, in some cases) authors’ voices, and how these style guides might contribute to citation injustices. Third, we expanded our inquiry of publishing policies and citation practices by examining 115 journals in TPC and communication-related fields to determine the most used style guides, authorship criteria, and citation requirements. Fourth, we more deeply examined authorship criteria and citation practices for seven style guides used by journals identified in our research to see where citation injustices may occur. We conclude by calling for new perspectives and further research on more equitable and socially just citation practices.

RELEVANT LITERATURE

Citation injustices in publication practices have a long history tied to gender and racial biases that continue to exist today. Historically, women authors often have adopted men’s names or used their initials only to mask their full identities because they were not recognized as equal to their men counterparts or were not legally allowed to publish (Claro, 2020; Fowler, 2019).[3] In more recent publications, women have been underrepresented as single authors (West et al., 2013), and recent studies report that women authors are cited less frequently than are men in scholarly publications (Pells, 2018; Teich et al., 2022) and that, in communication journal articles, “reference lists include more papers with men as first and last author, and fewer papers with women as first and last author” (Wang et al., 2021, p. 134).[4] Racial biases also have affected citation and publication visibility, with people of color experiencing suppression and underrepresentation of their ideas. For instance, in a 2018 study, Chakravartty et al. reported that “non-White scholars continue to be under-represented in publication rates, citation rates, and editorial positions in communication studies” (p. 254) and demonstrated that “[c]itational practices structure a collective body of work: disciplines that cohere around masculinity and Whiteness” (p. 257). As Chakravartty et al. noted, “Publication and citation practices produce a hierarchy of visibility and value” (p. 257), resulting in citation injustices.

Citation injustices in our field continue to exist; however, we are moving toward positive change and an increasing awareness and intentionality of who we cite in our scholarship. For example, Moore et al. (2021) have drawn attention to academia’s “political nature of who we cite and also how we cite the knowledge of those who have traditionally been marginalized” (p. 3). Additionally, Itchuaqiyaq and Frith (2022) highlighted academia’s infrastructural breakdown, “as increasing amounts of people call for more just citational practices that surface multiply marginalized and underrepresented (MMU) scholar voices […] as more and more scholars have cast light on the unjust and unrepresentative politics of citation and how that affects disciplines and academia as a whole” (pp. 10–11).

As scholarly writers and editors, we see the need for our field to question citation practices that minimize voices. In this article, we highlight another form of citation injustices—one that minimizes collaborating authors (i.e., shared first authors and equally contributing authors) by style-guide conformities and publishing policies. Recently, scholars (in various communication fields) have embraced practices that empower voices in the design of communication (e.g., Acharya, 2022; Funk & Guthadjaka, 2020; Jones & Walton, 2018; Murthy, 2020; Rivera, 2022; Smith, 2022; Stevens, 2024), and we argue that these empowerment practices should extend to how we cite those voices.

A CAUSE FOR PAUSE & CALL FOR ACTION

In the December 2022 *Communication Design Quarterly* issue, co-authors Clay et al. requested in a footnote that a source they used be cited in the references list with two first authors, attributing equitable credit to both authors in the first-author position. The source authors’ request read, “McGreavy and Ranco share the first authorship and request that references to this paper acknowledge this in citation practices (e.g., McGreavy, Ranco, et al.)” (2021, p. 945). The request caused some pause, generating questions about style-guide conformities and citation practices: why are shared first authors not recognized as equal contributors in current publishing

3 Women authors who masked their sex include sisters Charlotte, Emily, and Anne Brontë; Louisa May Alcott; and J.K. Rowling (Mireles, 2021).

4 First and last author positions are often held for the lead or senior researcher on publication manuscripts.

policies and citation practices, and why have style guides not considered the need to equally credit shared first authorship? Such a request deviated from the style guide but made sense and served as pushback on a larger, more powerful system of practices—job-market competition, promotion and tenure, annual reviews, merit-raise considerations, research-funding opportunities, sabbatical awards, etc. are all tied, in some way, to the "credit" authors receive for their contributions to published scholarship. If we (as a field) want to reject patterns of marginalizing voices and practice inclusivity and equity in empowering and representing *all* voices, we must also embrace inclusivity and equity in our scholarly writing citation practices and publishing policies.

In two recent special-issue scenarios, we questioned style-guide conventions for inclusivity and equity. As co-editors of a special issue in the journal *Programmatic Perspectives*, we encountered two related situations. The first was when the co-authors of a manuscript included a statement on the cover page that all authors should be listed as first authors to reflect equal contribution: "Names are listed alphabetically to convey shared first-author roles in composing and editing" (Burnett et al., 2022, p. 11). With six first authors, the article is cited in APA using "et al." for in-text/parenthetical citations, using only the first author's name in the alphabetized list. Thus, shared first authorship is invisible to readers. The reference list will provide all six authors' names, but the fact that all authors equitably shared first-author roles is lost in citing this source.

The second situation was in citing our CFP as co-authored/created knowledge in the Editorial Introduction article of this same special issue. The CFP—co-created by Amber Lancaster, Carie King, and Susan Rauch—was posted on the journal organization's blog; according to APA 7th edition style guide, the post's authorship was credited to the organization (not the co-editors/creators of the CFP). When we considered this shift in authorship, we explored citing the email sent to the organization's list, which then gave authorship back to the co-author who sent the email (Lancaster, 2022). Citing only one contributor, however, seemed selfish and Amber wanted to give credit to her colleagues for their equal contributions, but we ultimately defaulted to the style-guide conventions. Consider for a moment, the impact of reading (CPTSC, 2022) versus (Lancaster, 2022) versus (Lancaster et al., 2022) versus (Lancaster, King, & Rauch, 2022) for citing and referencing our co-authored CFP for our special issue. In the first citation form, CPTSC receives credit and authorship for the ideas that the authors developed. In the second and third citation forms, only one author receives credit and authorship, silencing the voices and identities of two collaborators. Only in the last citation form do all authors receive credit as authors. However, even in this last citation form, the order suggests hierarchical contributions—first-author positions suggest something else in authority and ownership.

The publication industry has presented a new system—the CRediT taxonomy, which provides 14 roles related to the research and publishing processes (Contributor Roles Taxonomy, n.d.). This system requires that contributors document and report the roles they fulfill and the tasks they complete in the creation of a project. However, even with this system, author workloads are not hierarchical, and shared first authorship is not addressed.

Applied Publication Examples: Two Cases in Point

The two recent citation experiences noted above generated more questions for us, and we reflected on past projects to determine when first, second, third, etc., authorship caused concerns. We specifically discussed two previous collaborative projects that resulted in published works with shared first authorship but, because of publishing policies and style-guide conformity, shared first authorship is not equitably represented.

In the first example, Carie co-authored with five scholars who collaborated to share their experiences as they pursued review-board approval for their research in health communication, resulting in a publication published in *Health Communication* (King et al., 2018). Four doctoral students were reporting their individual research experiences during their doctoral work, and the fifth author (the faculty PI) mentored the other authors and helped to author the article. In submitting the article, the five authors had to determine how to list their names; the doctoral-student authors each provided a case study and contributed similar amounts to the article, so the faculty mentor determined to list the authors per their seniority in the doctoral program. Although that order benefited the first graduate of the group, Carie, it meant that the scholar who graduated last chronologically and who was listed fourth, Susan Rauch, and the faculty PI, Amy Koerber, were frequently left out of references to the article.

In the second example, 12 scholars collaborated to develop a new usability design method; the resulting publication—"A New Method in User-Centered Design: Collaborative Prototype Design Process (CPDP)" (Andrews et al., 2012)—was published in the *Journal of Technical Writing and Communication*. The manuscript was equally authored by Christopher Andrews, Debra Burleson, Kristi Dunks, Kimberly Elmore, Carie S. Lambert, Brett Oppegaard, Elizabeth E. Pohland, Danielle Saad, Jon S. Scharer, Ronda L. Wery, Monica Wesley, and Gregory Zobel. All authors were involved in developing the new method, the testing, the writing, and the final editing of the manuscript. Together, the authors determined to alphabetize authors by last name, as all authors had equally participated in the process and publication. However, in many publications referencing this article, authors 4–11 and sometimes the twelfth author have been omitted from citations due to publishing policies and style-guide conformity. Thus, the alphabetized approach to listing equitable authorship and contributions results in citation injustices. Per a search for the study on Google Scholar, their manuscript has been cited in flagship TPC journals like *Technical Communication, Journal of Business and Technical Communication, Journal of Technical Writing and Communication, Communication Design Quarterly,* and *Computers and Composition* as well as in interdisciplinary journals including *BMC Medical Informatics and Decision Making*, *IEEE Proceedings*, *International Journal of Environmental Research and Public Health*, *Journal of Technology in Human Services, International Journal of Human-Computer Interaction*, and *International Journal of Sociotechnology and Knowledge Development*. The citation styles for these and other journals referencing the manuscript differ in how they attribute shared first-authorship contributions, thus effectively illustrating a need for change in citation practices.

We cited this example publication using style guides from our own scholarly writing and editing experience to illustrate how style-guide conventions create citation injustices[5]. We created Table 1, which includes the in-text narrative, parenthetical, and end-of-text citations[6] per style guide, and then we documented the implications of these citation practices for authorship and contribution recognition. As shown in Table 1, no style guide lists beyond the first-named author for in-text/parenthetical citations (despite the co-authors sharing "first authorship" for this manuscript). Only five style guides—American Chemistry Society (ACS), APA, CMS, MLA, and NML—list all contributing authors in the end-of-text citations, and none suggest that all authors share "first authorship." No special designation or formatting sets apart this equally shared first-authorship list from other manuscripts that have hierarchical authorship.

From these selected style guides and example citation formats (Table 1), we argue that several injustices result from the citation conventions/requirements: order of authors builds a hierarchy or indicates that the first author invested more than the last author, and the use of "et al." eliminates the names of many of the authors in the in-text/parenthetical citations and some also in the end-of-text citations list. At a glance, we may dismiss these citation practices as "ease of citing" or "simplified documentation." However, the practices of reducing, eliminating, or prioritizing names have implications (even if unintentional) for these scholarly writers. "Andrews," for example, receives first mention and is always mentioned in the in-text/parenthetical and end-of-text citations; therefore, "Andrews" receives greater name recognition among readers than the other first authors and contributes to greater reputation building for this first-named scholar that other shared first authors may not receive. Consider a publication with Institute of Electrical and Electronics Engineers [IEEE], for instance: "Andrews et al." is the only citation form used throughout the entire article, silencing other authors' voices as contributors. Consequently, readers may be unaware that 11 additional authors contributed to this article. For all 12 authors, authorship has great professional value (Chick et al., 2021; Fowler, 2019), particularly to those in higher education as they compete for job opportunities, seek research funding, and pursue promotion and tenure. Thus, excluding 11 authors creates a citation injustice by silencing their contributions and inequitably recognizing only the first-named collaborator.

To use more equitable and socially just citation practices, we must note (as do the examples noted above) that we wish to convey shared first-author roles. This note serves as an attempt to be more inclusive and equitable, but it gets lost in the in-text/parenthetical

5 We selected style guides that we have been required to use for editing, writing, and teaching roles. We recognize some of our selected style guides are less frequently required for use in TPC journals. However, we included these style guides because of their use in medical and scientific writing, which we see in TPC-related sub-fields.

6 For this article's purposes, we use "end-of-text citations" to refer to all bibliographical citations (e.g., "References" for APA and IEEE; "Works Cited" for MLA; "Bibliography" for CMS and Harvard).

Style Guide*	In-Text/ Parenthetical Citation	End-of-Text Citation	Implications for Authorship and Contribution Recognition
ACS	[1] (1) Andrews, Burleson, et al. (2012)	Andrews, C.; Burleson, D.; Dunks, K.; Elmore, K.; Lambert, C.S.; Oppegaard, B.; Pohland, E.E.; Saad, D.; Sharer, J.S.; Wery, R.L.; Wesley, M.; Zobel, G. A New Method in User-centered Design: Collaborative Prototype Design Process (CPDP). *J Tech Writing Comm* 2012, 42, 123–42.	• In-text/parenthetical citations may not list any author names or may list only the first two authors. • End-of-text citations credit all 12 authors of the shared-first-authorship list. • No special designation indicates shared first authorship.
AMA	[1]	1. Andrews C, Burleson D, Dunks K, et al. A new method in user-centered design: Collaborative prototype design process (CPDP). *J Tech Writing Comm.* 2012;42(2):123–142.	• In-text citations do not list any author names. • No parenthetical citation is offered. • End-of-text citations credit only the first, second, and third named authors of the shared-first-authorship list; authors 4–12 do not receive recognition. • No special designation indicates shared first authorship.
APA	According to Andrews et al. (2012) (Andrews et al., 2012)	Andrews, C., Burleson, D., Dunks, K., Elmore, K., Lambert, C. S., Oppegaard, B., Pohland, E. E., Saad, D., Scharer, J. S., Wery, R. L., Wesley, M., & Zobel, G. (2012). A new method in user-centered design: Collaborative prototype design process (CPDP). *Journal of Technical Writing and Communication, 42*(2), 123–142.	• In-text/parenthetical citations credit only the first named author of the shared-first-authorship list. • End-of-text citations credit all 12 authors of the shared first-authorship list. • No special designation indicates shared first authorship.

Style Guide*	In-Text/ Parenthetical Citation	End-of-Text Citation	Implications for Authorship and Contribution Recognition
CMS	1. Andrews et al., "A New Method," 2012. 1. Andrews et al., *Journal of Technical Writing and Communication 42*, no. 2: 123.	Andrews, Christopher, Debra Burleson, Kristi Dunks, Kimberly Elmore, Carie S. Lambert, Brett Oppegaard, Elizabeth E. Pohland, Danielle Saad, Jon S. Sharer, Ronda L. Wery, Monica Wesley, Gregory Zobel. "A New Method in User-centered Design: Collaborative Prototype Design Process (CPDP)," *Journal of Technical Writing and Communication, 42* no. 2 (2012): 123–142.	• In-text/parenthetical citations credit only the first named author of the shared-first-authorship list. • End-of-text citations credit all 12 authors of the shared-first-authorship list. • No special designation indicates shared first authorship.
CSE	Andrews et al. [1] (Andrews et al. 2012)	Andrews C, Burleson D, Dunks K, Elmore K, Lambert CS, Oppegaard B, Pohland EE, Saad D, Sharer JS, Wery RL, et al. 2012. A new method in user-centered design: Collaborative prototype design process (CPDP). *J Tech Writing Comm.* 42(2): 123–142.	• In-text/parenthetical citations credit only the first named author of the shared-first-authorship list. • End-of-text citations credit only the first 10 named authors of the shared-first-authorship list; authors 11–12 do not receive recognition. • No special designation indicates shared first authorship.
IEEE	According to Andrews et al. [1] [1]	[1] C. Andrews et al., "A new method in user-centered design: Collaborative prototype design process (CPDP)," *J. Tech. Writing Comm.*, vol. 42, no. 2, pgs. 123–142.	• In-text citations credit only the first named author of the shared-first-authorship list. • Parenthetical citations do not list any author names. • End-of-text citations credit only the first named author of the shared-first-authorship list; authors 2–12 do not receive recognition. • No special designation indicates shared first authorship.
MLA	According to Andrews et al., "..." (123) (Andrews et al. 123)	Andrews, C., Burleson, D., Dunks, K., Elmore, K., Lambert, C. S., Oppegaard, B., Pohland, E. E., Saad, D., Scharer, J. S., Wery, R. L., Wesley, M., & Zobel, G. (2012). A new method in user-centered design: Collaborative prototype design process (CPDP). *Journal of Technical Writing and Communication, 42*(2), 123–142.	• In-text/parenthetical citations credit only the first named author of the shared-first-authorship list. • End-of-text citations credit all 12 authors of the shared-first-authorship list. • No special designation indicates shared first authorship.
NLM	NA	Andrews C, Burleson D, Dunks K, Elmore K, Lambert CS, Oppegaard B, Pohland EE, Saad D, Sharer JS, Wery RL, Wesley M, Zobel G. A new method in user-centered design: Collaborative prototype design process (CPDP). *J Tech Writing Comm* 2012;42(2):123–42.	• No in-text/parenthetical citation style is offered. • End-of-text citations credit all 12 authors of the shared-first-authorship list. • No special designation indicates shared first authorship.

Table 1. "Andrews et al." (2012): *Citation Styles with In-Text, Parenthetical, and End-of-Text Citation Standards and Implications.*

*Abbreviations for Style Guides in Table 1: *American Chemistry Society (ACS), American Medical Association (AMA), American Psychological Association (APA), Chicago Manual of Style (CMS), Council of Science Editors (CSE), Institute of Electrical and Electronics Engineer (IEEE), Modern Language Association (MLA), and National Medical Library (NML).*

and end-of-text citation practices. In short, the attempt is silenced unless future authors who cite the source provide footnotes or endnotes to communicate source attributions as shared first authors, as Clay et al. (2022) did.

Situating and Expanding our Case

As we reflected on our recent experiences concerning authorship recognition, we questioned the broader implications of publishing policies and style-guide requirements on authorship, leading us to expand our inquiry and investigate journal style guides. We recognized from our own publishing experiences that some journals may adapt standard style guides, use in-house style guides, or adopt standard style guides; thus, we included these options in our inquiry. We aimed to answer four research questions (RQ):

> RQ1: Which style guides are used in communication-related and TPC journals for publications?
>
> RQ2: Do journals and their style guides explain criteria to determine authorship and order of listing contributing authors?
>
> RQ3: Do journals and their style guides provide guidance on publishing shared first authorship or group authorship with equal contributions?
>
> RQ4: Do journals and their style guides allow deviations for citing shared first authorship or group authorship with equal contributions?

To answer these questions, we examined 115 journals in TPC and communication-related fields. Early in the process, we discovered that for many journals, the editorial authority for style-guide conventions rested with the publisher; thus, we included situations in our data in which the publisher provided style-guide requirements for authors to follow. In our results, we identify the style guides used in each journal, and then, based on the most frequent style guides used across these journals—APA, CMS, Harvard Style, IEEE, MLA, Vancouver, and NML—we offer a closer look at authorship criteria and conventions for citing authors.

To address more inclusive and equitable authorship recognition and scholarship contribution, we end by providing suggestions that scholarly writers should demand and use in their publications—as intentional pushback to a larger, more powerful system of practices.

PROCESS OF INQUIRY

To conduct our inquiry, we used descriptive research methods "to identify characteristics, frequencies, trends, and categories" (McCombes, 2023) in web-based information (journal databases and publisher websites), focusing on frequency of style guides used (RQ1) and characteristics and trends in publishing policies—i.e., criteria for authorship (RQ2), guidance, and deviations on publishing shared first authorship or group authorship with equal contributions (RQ3 and RQ4). Using the Observatory of International Research (OOIR) from March to September 2023, we searched for journals in TPC and communication-related fields. The OOIR is a database of journals published in social sciences with three primary aims:

1. promote research discovery
2. reduce research waste
3. share scholarly communication.

Specifically, it exists to draw attention to overlooked scholarship:

> With millions of scientific papers published in tens of thousands of academic journals each year, the discovery of relevant research outputs cannot be but a flawed process. Facing cognitive finiteness and time limitations, the exploration [*sic*] of the latest findings is biased towards a handful of so-called top journals. Findings in lesser-known outlets are overlooked, and interdisciplinarity is discouraged, which gives rise to a culture of research waste. ("About OOIR," n.d., para. 2)

Reducing "research waste," the OOIR aims to "[p]luralize the disciplines by directing attention to articles which may otherwise be overlooked" (para. 1). We felt it appropriate to identify as many journals from OOIR as possible to ensure that we examined a diverse dataset.

We first identified journals that publish TPC and communication-related articles. To develop our corpus, we started with the OOIR, noting that "communication" is the seventh topical area on the OOIR website[7], which lists 94 journals that publish articles in communication-related fields ("List of Journals," n.d.). We then added journals from our own familiarity of TPC scholarship, searching titles in the Scimago Journal & Country Rank website (SCImago Lab, 2022). For each journal, we also used Scimago Journal & Country Rank to review the scope of topics published and ensure that communication-related areas were included. We omitted journals with less-related topic scopes (e.g., telecommunications, electronic communications, computer communications), such as those focused more on technology applications.

After identifying journals, we used the link "How to publish in this journal" from Scimago Journal & Country Rank to access the style-guide requirements or we accessed the journal websites via a Google search for journals that were not in the Scimago Lab database. In some cases, we were required to click through several webpages from the journal's main page to find style-guide requirements (often taking us to the publisher's general webpage for authors). For each journal, we reviewed the style-guide requirements and any guidelines for determining authorship criteria and listing contributing authors. Then, we determined if the journal allowed deviations for attributing shared first authorship and equal contributing authors on the byline and in end-of-text and in-text citations. We recorded our findings in a Microsoft Excel spreadsheet (see Table 2 in the Appendix[8]), and we present our findings in the Results section.

RESULTS

We began with 118 journals in TPC and communication-related fields but removed two journals that are no longer published and one journal that is published only in Spanish. Then, we examined the 115 remaining journals: we visited their websites and mined their style-guide requirements (listed in Table 2 in the Appendix). As shown in Figure 1, of the 115 journals, APA was the most used style guide (69 journals, 60.00%), followed by CMS (18, 15.65%); Harvard (12, 10.43%); and MLA (3, 2.61%). One journal each (0.87% each) required IEEE, Vancouver, and NML. Four journals

7 The OOIR website (at the time of writing this article) listed eight topic search areas: "All Categories, Political Science, Sociology, Geography, History, Communication, Asian Studies."

8 The Appendix includes a comprehensive 18-page table of journal informaion, so we are hosting it online rather than in the text of this article to make it more accessible to readers.

(3.48%) indicated that a style guide is applied after acceptance but did not specify which style. Four journals (3.48%) did not specify a style guide but offered in-house citation formats. One journal (0.87%) did not specify any style (no guide or in-house formats).

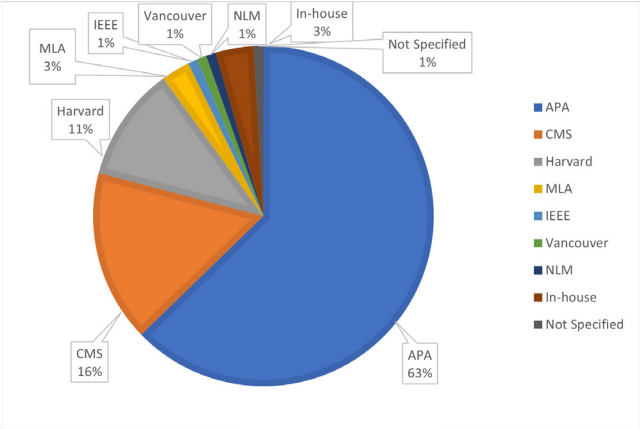

Figure 1. Pie Chart of Style Guides for 115 Journals

Of the 115 journals, 29 publishers are represented: 11 publishing companies; 9 professional organizations; and 9 university presses, departments, or schools. Of the 29 publishers, 8 represent and publish 94 journals (80.00%), and these publishers include Taylor & Francis (43 journals, 37.39%); Sage (31, 26.96%); Elsevier (5, 4.35%); Oxford UP (4, 3.48%); Wiley & Sons (4, 3.48%); John Benjamins Publishing Co. (3, 2.61%); Association for Computing Machinery (2, 1.74%); and APA (2, 1.74%). The remaining 21 publishers each publish 1 journal (0.87%) of the 115 journals examined, grouped as "Other" (18.26%; see Figure 2).

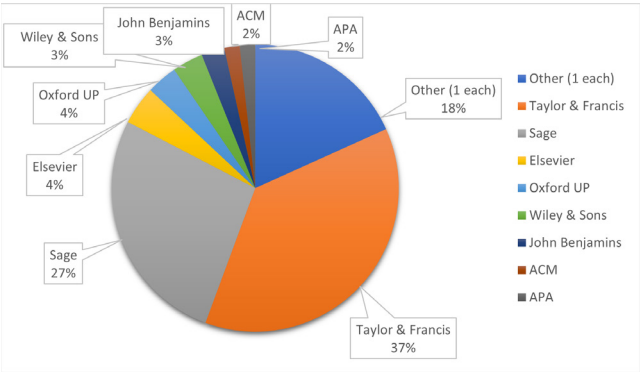

Figure 2. Pie Chart of Publishers for 115 Journals

Of the 115 journals examined, 69 journals (60.00%) offered no guidelines for determining authorship or ethical guidelines for crediting all contributors; 20 (17.39%) referred to the publisher's website for determining authorship and crediting contributors; 24 (20.86%) provided guidelines for determining authorship and crediting contributors; and 2 (1.74%) referred to a professional organization's guidelines for authorship and crediting contributors (International Committee of Medical Journal Editors [ICMJE]; see Figure 3). Of the 24 journals that provided guidelines for determining authorship and crediting contributors, 4 (3.48%) referenced CRedIT taxonomy for determining rank/order of contributing authors based on the percentage of contributions.

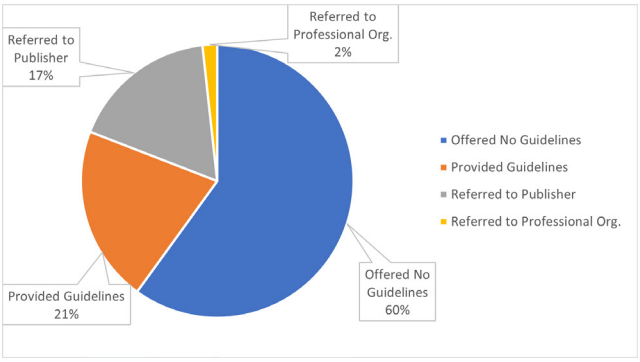

Figure 3. Pie Chart of Authorship Guidelines in 115 Journals

Considering that most journals did not provide guidelines for determining authorship criteria or crediting contributions, we next looked at the publisher's websites for this information. Of the 69 journals that did not offer guidelines, 49 (42.60%) of these journals' publishers offered guidelines, which were represented by 7 publishers (Taylor & Francis: 23 journals; Sage: 15; Elsevier: 3; John Benjamins Publishing Company: 3; Wiley & Sons: 3; De Gruyter Mouton: 1; ACM: 1).

Of the remaining 20 journals (17.39%) that did not offer guidelines and whose publishers did not offer guidelines, 9 publishers were university presses, departments, or schools, representing 11 journals (9.57%); 7 publishers were professional organizations, representing 7 journals (6.08%); and 2 publishers were private companies, representing 2 journals (1.74%).

Of the 24 journals that did offer guidelines for determining authorship criteria and crediting contributors, 20 (17.39%) of the journals' publishers also provided guidelines for determining authorship criteria and crediting contributors. Of the 4 journals whose publishers did not provide guidelines, 2 were private global publishers (Hogrefe Publishing and Mary Ann Liebert Inc.), 1 was a university press (Oxford UP), and 1 was a professional association (Institute of Rhetoric and Communications).

When we examined publisher websites for guidelines on determining authorship criteria and crediting contributors, we also noted if publishers offered specific guidance for shared-first-authorship publications or equal-contributor group-authorship publications. Thirty-four (29.56%) journals' publishers provided guidance on crediting co-author contributors using either in-house guidelines (Mary Ann Liebert Inc.: 1 journal; Springer: 1 journal) or CRedIT taxonomy for determining rank/order of contributing authors based on the percentage of contributions (Sage: 31 journals; ACM: 1 journal); however, none of the publishers offered guidance on shared first authorship. Eighty-one (70.43%) journals' publishers did not provide any guidance for addressing shared first authorship or equal-group contributor-authorship scenarios. Of these 81 journals, 43 (37.39%) were published with Taylor & Francis, which did provide a link to a white paper that offered some guidance on shared first authorship and crediting contributors. (It is worth noting that the link to the white paper was obscurely listed under "Additional Resources" at the bottom of the page for "Defining authorship in your research paper.") Taylor & Francis Group (2017) noted,

> [Authors can be] listed alphabetically, in order of seniority, or reflecting the relative levels of intellectual contribution to a paper. […] Where no author has made

> a dominant contribution there are a range of possibilities which aim at fairness. […] The most popular solution is that all authors should be named as joint 'first' authors, although it is not clear how many publications currently facilitate such a joint listing. […Another is] listing of author names alphabetically, which may be more common in practice. (p. 8)

Of the 115 journals, none specifically addressed deviations for citing sources in end-of-text and in-text citations for shared first authorship and equal-contributing co-authors; however, a small number of journals (4, 3.48%) deviated in other ways. For example, 1 journal (0.78%), *Science Communication*, indicated that "some flexibility is permitted to accommodate varying disciplinary traditions" (Sage Publishing, n.d.a., n.d.b., para. 1), but the instructions did not specify what flexibility Sage permits. Three journals (2.60%) deviated from the standard style guide chosen for citing authors in-text or in the bibliography; e.g., *Programmatic Perspectives* (APA) requires using the full first and last names of authors in the references and first full names in the first in-text/parenthetical citation in the manuscript, giving credit to all authors versus defaulting to using "et al." *Journalism & Mass Communication Quarterly* (APA) requires citing up to five authors in the first in-text/parenthetical citation and then using "et al." for subsequent in-text/parenthetical citations. *Journal of Information Technology & Politics* (APA) requires citing all authors' names for three to five authors in the first in-text/parenthetical citation but then using "et al." for six or more authors; for citing sources in end-of-text citations, *Journal of Information Technology & Politics* includes all authors' names in the reference list for three to seven authors, but for more than seven authors, it requires listing the first six names, followed by an ellipsis "…" and then the last author's name.[9] Thus, we see some attempt to recognize and credit more authors than default style guides permit, a sign that some journals can deviate from the standard style-guide conventions.

A Closer Look at Style Guides in TPC for Implications on Citation Justice

At the start of this manuscript, we highlighted authorship and citation issues from publication cases that create citation injustices. Additionally, we identified in our inquiry of 115 journals the specific journals' authorship rules and style-guide conventions that may contribute to citation injustices. Of the 115 journals, none provided any deviations or allowances for citing shared first authors or equal-contributing authorship among co-authors, and the journals referred authors to field-specific style guides in submission guidelines: in other words, these journals take no authority in circumventing style-guide rules and conventions that may create citation injustices.

Because many journals default to standard style-guide conventions, we then sought to determine if style guides provide guidance for determining authorship criteria and grant authors liberties to address unique authorship cases (e.g., shared first authorship or equal-contributing co-authors) and to change how authors cite such cases in end-of-text and in-text citations. In this section, we more closely examine the seven style guides used by journals identified in our inquiry (APA, CMS, Harvard, IEEE, MLA, NML, and Vancouver) to consider rules and conventions.

9 Though these results do not answer RQ4, per se, we include these results to note that some journals do deviate from the style-guide requirements, suggesting that authority to deviate does exist with some journals—a point we return to later in the Discussion section.

American Psychological Association

American Psychological Association (APA, 2020) states,

> Authorship is reserved for persons who make a substantial contribution to and who accept responsibility for a published work. Individuals should take authorship credit only for work they have performed or to which they have substantially contributed (APA Ethics Code Standard 8.12a, Publication Credit). Authorship encompasses, therefore, not only persons who do the writing but also those who have made substantial scientific contributions to a study. (p. 24)

The APA style guide also refers authors to the CRedIT taxonomy website for acknowledging lesser contributions that "do not constitute authorship" (p. 24). In this way, the APA style guide establishes authorship criteria.

The style guide continues to establish the order of authors, giving authors the responsibility to determine who earns authorship and to decide the ordering of multiple authors (APA, 2020, p. 25). APA provides one sentence about equal roles in authorship: "If authors played equal roles in the research and publication of their study, they may wish to note this in the author notes (see Section 2.7)" (p. 25). This should be noted in the third paragraph under "Acknowledgements of Financial Support and Other Assistance"—"End this paragraph by explaining any special agreements concerning authorship, such as if authors contributed equally to the study" (p. 37). However, no guidance is provided for specifically attributing shared first authorship when publishing (e.g., a manuscript may have two shared first authors and additional contributing authors).

The APA style guide (2020) defines "Author" in Section 9.7 ("Definition of Author") for reference elements (pp. 285–286) and in Section 9.10 ("Identification of Specialized Roles") offers options for citing specialized roles in end-of-text citations, such as Editor(s), Director(s), and dual roles like "Writer & Director" (pp. 287–288). Though APA does not address citing shared first authors or equal contributing authors as a specialized role, we include this information to illustrate deviations exist in some cases: "In these references, the role is placed in parentheses after the inverted surname and initials. Put a period at the end of the author element" (p. 287). Specialized roles could be used to note that authorship is shared first authorship or co-authorship of equal contributions.

The APA (2020) style guide also deviates from the standard in-text citation requirement when ambiguity or clarification about the author(s) is needed. APA requires, "For a work with three or more authors, include the name of only the first author plus 'et al.' in every citation, including the first citation unless doing so would create ambiguity…" (p. 266). The guide establishes an exception when multiple works are published in the same year and with the same first author; in that situation only, the citation in the text should include enough authors to eliminate that ambiguous citation. Matching the in-text citation, the reference-list items include a limited number of authors: "Provide surnames and initials for up to and including 20 authors…. When there are 21 or more authors, include the first 19 authors' names, insert an ellipsis (but no ampersand), and then add the final author's name…" (p. 286). Only in the exception for avoiding ambiguity does APA deviate from the citation rule for citing co-authors. No special designation is offered for acknowledging shared first authorship or co-authorship of equal contributions in end-of-text or in-text citations.

The Chicago Manual of Style

The Chicago Manual of Style (CMS) offers three explanations for types of authorship: individual, joint, and collective works ("Varieties of Authorship," University of Chicago Press, 2017, p. 174). Authorship criteria is not defined, but CMS refers to "the Copyright Act of 1976 (Public Law 94-553)" to identify authorship; individual authorship refers to a single author; joint authorship refers to "a work prepared by two or more authors with the intention that their contributions be merged into inseparable or interdependent parts of a unitary whole" (Public Law 94-553, as cited in "Varieties of Authorship," University of Chicago Press, p. 174); and collective works authorship refers to "the independent contributions of two or more authors are combined and considered collective, rather than joint, works" (p. 174). CMS provides no guidance on attributing shared first authorship or co-authorship of equal contributions when publishing but does note in "Biographical Notes and Acknowledgements" that "a brief biographical note on the author or authors may appear as an unnumbered note on the first page of each article or chapter" (p. 773), which could serve to note when authorship is shared first authorship or co-authorship of equal contributions.

For attributing authors in end-of-text citations, CMS states, "For a book with four or more authors, list all the authors in the bibliography entry…. In the note, however, cite only the name of the first-listed author, followed by *et al*." (University of Chicago Press, 2017, p. 754). In this way, CMS does give credit to all authors in end-of-text citations in the reference list but limits acknowledgement in in-text citations and does not acknowledge if authors share first authorship, which requires that authoring parties choose one name to be included in the in-text citations.

Harvard Referencing Style

The Harvard Referencing Style guide is difficult to find[10]; the Harvard Library shares a style guide (Presidents and Fellows, 2023c), and the Faculty of Arts and Sciences provide guidelines on how to establish authorship (Presidents and Fellows, 2023a). The latter document states,

> Designing an ethical and transparent approach to authorship and publication of research… is a shared responsibility of all research team members but is primarily the responsibility of the Principal Investigator. The University recognizes that there are different standards across disciplines regarding authorship and the order in which authors are listed or acknowledged. Additionally, journals often specify their requirements in their guidance for authors and require attestations regarding individual authors intellectual contributions to the work. As a result, each laboratory, department, and/or school should engage in conversations regarding their own discipline-specific standards of authorship and, if needed, are encouraged to supplement the Guidelines herein with a description of these respective discipline-specific processes for deciding who should be an author and the order in which authors will be listed. (para. 4)

The style guide does not address shared first authorship, leaving that decision to the group authoring to decide the order and practice. The guide does not provide direction on how authors should share that determination with readership.

The *Writing Guide* (Presidents and Fellows, 2023c) does not address citation practices; instead, it presents directives related to mechanics (e.g., capitalization, punctuation). In finding Harvard Referencing Style guide standards for citation, we searched for primary sources and found the Harvard University Press (2021) style, which referred us to CMS and stated, "For works with multiple authors, for the in-text citation use only the name of the first author, followed by 'et al.': [example] (Chen et al. 2011)" (p. 1). Additionally, the *Harvard Guide to Using Sources* from the Harvard College Writing Program (Presidents and Fellows, 2023b) provides minimal instruction on citation styles, offering MLA, APA, and CMS as the "Citing Sources" drop-down menu options.

The only resource (and only source that did not require payment for other services on the site) we could find was Mendeley's resource on the Harvard Referencing Style (Elsevier, 2023); this source states that, per Harvard Referencing Style guide, "Four or More Authors: In this case, the first author's surname should be stated followed by 'et al.'…" (section 2). This resource provides instruction for in-text citations but does not address end-of-text citations. Thus, no special designation is offered to acknowledge shared first authorship or co-authorship of equal contributions in end-of-text or in-text citations.

Modern Language Association

The Modern Language Association (MLA) style does not explain authorship criteria but defines "an author" as "a writer, artist, or any type of creator. The author can be an individual, a group of persons, an organization, or a government" (The Modern Language Association of America, 2021, p. 107). MLA provides no guidance for attributing shared first authorship or co-authorship of equal contributions when publishing.

The MLA style (The Modern Language Association of America, 2021) lists up to two authors and notes to list them "in the order in which they are presented in the work" (p. 111). For works with three or more authors, in-text citations have options:

> If the source has three or more authors, the entry in the works-cited list begins with the first author's name followed by *et al*. If you refer to the coauthors in your prose rather than in a parenthetical citation, you may list all the names or provide the name of the first collaborator followed by "and others" or "and colleagues." In a parenthetical citation, list the surname of the first author and *et al*. (p. 232)

MLA does offer these options for in-text citations, allowing all authors' names to be included in the narrative; however, they are omitted in the end-of-text citations list. MLA also requires the hierarchy of the first listed author being the most invested author.

MLA notes about end-of-text citations, however: "Sometimes a label must be used to describe the role of the person or persons listed in the Author element. This most often occurs when the person is not the primary creator" (The Modern Language Association of America, 2021, p. 107). MLA provides the following example of

10 We were unable to locate a physical or electronic copy of an official Harvard Referencing Style guide. Internet searches located *Quick and Easy Guide for Harvard Referencing* (Mothiravally, 2020), websites on writing resources for citing in Harvard Style, *The Writing Guide* created for Harvard Library Employees (https://library.harvard.edu/writing-guide#style-guide), and Faculty of Arts and Sciences Research Administration Services website that provided guidelines on authorship criteria "adapted from the International Committee of Medical Journal Editors (ICMJE) framework for broader applicability across scientific fields" (https://research.fas.harvard.edu/links/guidelines-authorship-and-acknowledgement#_ftn1).

adding a label to a work with two authors: "To include a label, such as *editors* or *translators*, add a comma after the second author's name and then add the label" (italics in original, pp. 111–112). MLA's use of labels parallels that of APA's specialized roles designations. But again, there is no specific mention of various authorship circumstances that may be appropriate to use this added label. There could be an option to add a label like "shared first authors" after the author names.

Institute of Electrical and Electronics Engineers

Institute of Electrical and Electronics Engineers (IEEE) does not define authorship criteria; however, IEEE does provide guidance for manuscripts of shared-first authorship or equally contributing authorship in the form of a first footnote—corresponding author(s) affiliation (unnumbered) on the byline page. For "Equally contributed authors," IEEE notes, "In some cases, the authors may have contributed equally to the work. This is added in italics at the very end of the first paragraph before the corresponding author" (IEEE, 2022, p. 6) and offers the example *"(Shanjin Fan and Shiyuan Fan contributed equally to this work.) (Corresponding authors: Jessie Y. C. Chen; Shiyuan Fan.)*" (italics in original). For "Co-first Authors," IEEE explains:

> In many fields, it is viewed as good to be the first author. But only one person can be first author, which leads to the practice of some labs having "co-first" authorship. The wording for this is: *(Shanjin Fan and Shiyuan Fan are co-first authors.)* There is no need to include the "contributed equally" phrase. In the byline, one of the authors must be listed first, but the last line in the first paragraph will indicate both authors as co-first authors. (italics in original, p. 6)

In IEEE format, in-text citations use sequential numbering that align with citations in the end-of-text citations: "References need not be cited in the text. When they are, they appear on the line, in square brackets, inside the punctuation. […] Use "et al." when three or more names are given for a reference cited in the text" (IEEE, 2022, p. 3). And "IEEE publications must list names of all authors, up to six names. If there are more than six names listed, use the primary author's name followed by et al." (IEEE, 2022, p. 3). Thus, in an IEEE publication, publications with more than three authors omit reference to all but the first author, giving authorship credit only to the first listed author. Nowhere, though, does IEEE attribute shared first authorship or co-authorship of equal contributions in end-of-text citation entries; nor does it appear to provide labels or allow deviations to clarify in end-of-text citation entries when a manuscript's byline footnote indicated authorship is "co-first authors" or "equally contributing authors."

Vancouver Style

Vancouver Style is a style maintained by the International Committee of Medical Journal Editors (ICMJE) and developed in 1979 by the National Library of Medicine (EBSCO Connect, 2019, para. 1). The style guide does not define authorship criteria, explain how to credit multiple first authors, or identify how to cite more than three authors. It does refer the reader to the ICMJE website (International Committee of Medical Journal Editors, 2023a), but the link provided (http://www.icmje.org) is a homepage "About ICMJE" with no information or links specifically labeled for authorship, citation style, or giving credit.

The ICMJE instructions for "Preparing a Manuscript for Submission to a Medical Journal" (International Committee of Medical Journal Editors, 2023b) provides general information but refers the authors to the National Library of Medicine style (which is the next bullet on this list of style guides).

National Library of Medicine

National Library of Medicine (NLM) does not define authorship criteria nor does it provide authors with guidance for attributing shared first authorship or co-authorship of equal contributions when publishing.

The NLM style guide notes three systems for bibliography entries may be used, but authors should select only one form and use it consistently—"citation-sequence, citation-name, and name-year"—and refers readers to "Scientific Style and Format (7th ed. Reston (VA): Council of Science Editors; 2006)" for details of all three systems (Patrias & Wendling, 2007/2015, p. xi). The citation-sequence system lists end-of-text citation entries in the order in which they appeared in the text with a numerical sequence system for in-text citation; the citation-name system lists end-of-text citation entries in alphabetical order with a numerical sequence system for in-text citations; and the name-year system lists end-of-text citation entries in alphabetical order with "(last name date)" for in-text citation. The NLM style guide provides no guidance for attributing shared first authorship or co-authorship of equal contributions.

The NLM style guide now includes all authors: "Give all authors, regardless of the number" (Patrias & Wendling, 2007/2015, p. 4), although the instructions suggest authors may deviate when saving space in a manuscript: "If space is a consideration, the number of authors may be limited to a specific number, such as the first three authors or first six authors. Follow the last named author by a comma and 'et al.' or 'and others'" (p. 10). With the change, NLM does allow all authors to be listed but still focuses on a linear listing, with the first author indicating the most investment in the publication.

One special rule concerning first authorship recognition exists, permitting adding the affiliation of the first author if it is provided on the source manuscript (see "[source][11] with author affiliation included (give the affiliation of only the first author or all authors)" (Patrias & Wendling, 2007/2015, pp. 53, 147, 699, 781, 826, 953, 1118, 1230). An additional appendix note provides some distinction between "authorship" and "investigator (also known as collaborator)" when citing from MEDLINE®/PubMed®, which makes a distinction between authorship and investigators (also known as collaborators). "The latter were implemented in journal citations created in late March 2008 forward; they are individuals who contributed to the research study but are not necessarily authors" and "includes the affiliation of the first author only; took the affiliation as given in the article (1988–2013)" (p. 1661). These deviations, however, favor the first author listed; the NLM style guide does not address citing situations when a source has a shared first author or co-authorship of equal contributions in end-of-text citations or in-text citations.

DISCUSSION

We answer four research questions by examining 115 journals and seven style guides used by journals within the corpus.

11 Source type could be journal article; book; manuscript; audiovisuals; article in audiovisual format; book on CD-ROM, DVD, or disk; computer program on CD-ROM, DVD, or disk; and e-book.

RQ1. Which style guides are used in communication-related and TPC journals for publications? Of the 115 journals we examined, APA is the most used/required style guide (60.00%), followed by CMS (15.65%). The remaining 24.35% of journals use the other five style guides *or* apply style after a manuscript is accepted. In TPC-specific journals, the majority of journals use APA (*Communication Design Quarterly*, *Computers and Composition*, *Journal of Business and Technical Communication*, *Journal of Response to Writing*, *Journal of Technical Writing and Communication*, *Journal of User Experience*, *Rhetoric and Communication*, *Rhetoric of Health & Medicine*, *Technical Communication Quarterly*, *Technical Communication*, *Programmatic Perspectives*, and *Written Communication*). Consequently, we see these two most frequently used style guides (APA and CMS) may hold authority in TPC and communication-related fields on publishing policies and citation conventions and may greatly influence (either positively or negatively) citation injustices that silence some authors because of style-guide conformity and citation practices.

RQ2. Do journals and their style guides explain criteria to determine authorship and order of listing contributing authors? Of the journals examined, we respond yes and no. Of the 115 journals, only 24 journals (20.86%) explained criteria for determining authorship or provided ethical guidelines for crediting all contributors. Considering that many journals point authors to the publisher's or a professional organization's authorship guidelines, we see this number increase to 46 (40.00%) if we include these data. Four journals (3.48%) provided guidance for order of listing contributing authors ranking/ordering authors based on CRedIT taxonomy. Surprising to learn, of the 20 journals that did not offer guidelines and whose publishers did not offer guidelines (17.39%), 9 publishers were university presses, departments, or schools, and 7 publishers were professional organizations—perhaps indicating these publishers may have less stringent rules to follow and may be places where authors find greater flexibility with citation practices.

Only two—APA and Harvard Referencing Style guides—of the seven style guides explained criteria to determine authorship and order of listing contributing authors. Vancouver style guide, however, links to the ICMJE, which provides criteria for determining authorship and order of listing contributing authors (aligning with Harvard's adaptation of this organization's explanations and definitions). This relatively low number of style guides providing authors this guidance also surprised us, given that many journals and publishers relied heavily on a standard style guide to provide authors with publishing guidance.

RQ3. Do journals and their style guides provide guidance on publishing shared first authorship or group authorship with equal contributions? Of the journals examined, no, none of the 115 journals provided guidance on publishing shared first authorship or group authorship with equal contributions. As previously mentioned, four journals (3.48%) provided guidance for order of listing contributing authors ranking/ordering authors based on CRedIT taxonomy; though the taxonomy offers some guidance for ranking/ordering authors, it assumes co-authors contributions are not equal (i.e., it helps group authors determine order based on percentages of contributions). It offers no guidance for crediting co-shared first authors or equally contributing authors.

Three of the style guides we examined provide guidance on attributing shared first authorship or group authorship with equal contributions when publishing. IEEE offers the most detailed guidance and provides two options for noting in the author byline that authors are co-first authors or equally contributing authors. CMS style guide provides authors the option to include a brief biographical note that could be used to indicate shared first authorship or equally contributing authors. Similarly, APA style guide offers guidance for shared first authors to provide a note in the manuscript byline.

APA is the only style guide of the seven we examined that mentions CRedIT taxonomy for ranking/ordering contributing authors.

RQ4. Do journals or their style guides allow deviations for citing shared first authorship or group authorship with equal contributions? Of the journals examined, no, none of the 115 journals allow deviations for citing shared first authorship or group authorship with equal contributions in end-of-text or in-text citations. However, three journals deviated from their standard style guide in other ways to aim to give credit to a greater number of contributing authors: *Programmatic Perspectives* (APA), *Journalism & Mass Communication Quarterly* (APA), and *Journal of Information Technology & Politics* (APA). Such deviations suggest that these journals may take liberties to also deviate in ways that result in more equitable and socially just citations to credit all authors, shared first authors, and equally contributing authors.

None of the seven style guides we examined allow deviations for citing shared first authorship or group authorship with equal contributions in end-of-text or in-text citations.

Based on our findings from our journal inquiry and style-guide analysis, we argue that TPC and communication-related fields need to lead in changing citation practices in more equitable and socially just ways. We discuss these implications in the following section.

IMPLICATIONS: EMPOWERING AUTHORS THROUGH EQUITABLE AND SOCIALLY JUST CITATION PRACTICES

Authorship and citations have value for those who hold the intellectual property and publish their work. The citation labels ownership of intellectual property and thus credits those who create the works. The U.S. Department of Health & Human Services further explains the value of authorship:

> [T]he credit derived from publications is used to determine a researcher's worth. Researchers are valued and promoted in accordance with the quality and quantity of their research publications. Consequently, the authors

> listed on papers should fairly and accurately represent the person or persons responsible for the work in question. (n.d., para. 1)

In this way, authorship identifies the creator of intellectual property and helps build a researcher's reputation. Additionally, authorship and citation practices have significant weight and meaning in the academy for considerations of tenure, promotion, research funding, and professional reputation. Thus, how we cite scholarship has implications for research value.

Given the high importance and prestige tied to authorship (and citations) for tenure, promotion, and funding, we see this article as a call for change. If our field aims to be inclusive and equitable, then what changes must we advocate for in our citation practices to ensure authorship and recognition is socially just?

Based on our inquiry of 115 journals and seven style guides, we see opportunities for TPC and communication scholars to lead in changing current citation practices in five ways:

- When journals have shared first authors and/or equally contributing authors, we must include a note on the byline or footnote on the manuscript's first page to credit author contributions accurately. When journals' guidelines do not specify this practice, we must request the deviation and explain why noting shared first authorship or equally contributing authors is important for name recognition, tenure, promotion, research funding opportunities, and professional reputation.
- For end-of-text citations, when we cite sources that indicated authors are shared first authors and/or equally contributing authors, we must seek deviations from the journal guidelines and style-guide conventions and provide attribution notes in the citation entry. Options could include adding a "label" (The Modern Language Association of America, 2021, p. 107) or "specialized role" (APA, 2020, pp. 287–288) after the author names, such as "*(co-first authors)*" or "*(equal contributing authors)*."
- For in-text/parenthetical citations, we must additionally deviate from the journal guidelines and style-guide conventions to indicate authors are shared first authors and/or equally contributing authors. Options could be to group co-first authors as one unit in the author function position; an example of a shorter author list with three co-first authors and other collaborators might be (Author/Author/Author et al., date). Another option might be to include labels like (F) for first author and or (EC) for equally contributing authors: (Author/Author/Author [F] & Author, Author [EC], date). For longer author lists, an asterisk or other symbol might signal, as a new convention, that authors are shared-first authors or equally contributing authors (Author* et al., date), connecting readers to the end-of-text citation entry that explains this. Whereas this solution addresses the first-author challenge, it leaves unaddressed the issues related to large name lists in in-text/parenthetical citations.
- We might request with style-guide organizations, such as APA and CMS, that changes occur to the style guide (or explicitly state allowable deviations) to ensure readers of our research know the authors desire accurate representations of their contributions—for greater inclusivity and equity in how others represent our contributions.
- Finally, another solution might be to list each author's percentage of investment with authorship in author byline and the end-of-text citation list: that is, five equal authors each are listed with 20%, thus indicating equal investment: Author, Author, Author, Author, Author (20%) or two shared first-authors are listed with 60% and three equally contributing co-authors are listed with 40% contributions: Author, Author (60%), Author, Author, Author, Author (40%). This method also justifies authors and indicates primary authors, thus requiring that authorship be quantified and indicating first joint authorship when applicable; however, this option may be challenging with long lists of authors or may complicate readability of citations. Additionally, sharing percentages forces authoring groups to ensure that they can validate secondary authors and alleviate articles with hundreds or thousands of authors. Furthermore, those who have contributed but do not qualify for a percentage of authorship will be acknowledged. The field can also dignify acknowledgements, recognizing the role that these individuals may play in the research process.

CONCLUSION

To address our own concerns with how we are cited and how we cite others, we sought to answer questions about our field's citation practices, who/what informs those citation practices, and what authorities exist in how and whom we cite. We recognize that issues related to citations are more complex than only adhering to citation style guides. We also recognize our research is limited by our own publication experiences, as both scholarly writers and editors, and by our positionality in academia as cis, white female senior faculty. Finally, we recognize that citation practices across the globe differentiate and that our study represents a time-bound sample corpus of journals and their practices. A larger sample of journals, with expanded sub-fields in which scholars of TPC and communication-related fields publish, may find different results. Thus, sampling journals in expanded timeframes and across the globe may find different results.

Further research on publishing policies and citation practices should examine the larger power structures and authorities that design them, including primary data sources for more diverse perspectives, such as surveys and interviews with scholars and editors in expanded disciplines about their publishing experiences, especially for shared-first authored and equally-contributing-authored scholarship. We also call on future scholars to examine the complexity of power relationships in authorship, the differences and relationships between writing as a communicative activity and research as a communicative activity, and the negotiations in collaborative writing and research activities—something beyond the scope of this study.

We see a need in our field's citation practices to empower authors and editors, creating more socially just citation practices and authorship credit. We see a need to reconsider the design of communication for and about scholarship (practices related to mentioning sources, attributing authorship, and promoting publication). In a field that embraces collaboration (in research, design, and practice), TPC is uniquely situated to lead scholarly conventions for inclusive and equitable citation practices.

In theories of social justice, TPC scholars have situated calls for actions in the hands of those who can make change—not in the regulatory bodies who own authority but in those of everyday people caught up in systems that oppress, silence, or reduce the

voices and identities of those affected by injustices (e.g., Colton & Holmes, 2018; D'Enbeau et al., 2021; Jones & Walton, 2018). In short, TPC scholars can disrupt the system by advocating for and practicing new publishing policies and citation norms. As one example, some journals may reject adopting APA 7th edition in favor for the 6th edition practices for citing works with six or more co-authors, as *Technical Communication Quarterly* did:

> From the Editor in Chief @rebeccawwalton2: Because of our concerns with @APA_Style -7 (author erasure in et al.-only citations for 3+ authors), TCQ will not be adopting APA-7. We're sticking with APA-6 for the increased visibility of co-authors. (TCQ, 2020)

Other scholars have recognized the "author erasure in 'et al.'" Rebecca Walton noted in the shift to APA 7th edition in scholarly conversations: in email correspondence on these issues, Cana Itchuaqiyaq commented, "there is resistance to the multiple-author visibility issues" and "nuance in how that resistance can happen." However, we note also that

> these in/visibility issues in citation practices [are] in relation to page counts (i.e., journal publication costs), which are closely monitored and regulated by publishers (rather than EICs [Editor in Chiefs]). Reference sections and in-text citations are "costly" in relation to page counts and one way to economize page counts (and costs to publisher in both physical and virtual publishing) is to reduce word count in citation practices. […] Publishing is a business and therefore these discussions of injustice are related to capitalism. (Personal Communication, 2024)

As journal editors and editors of book collections, we relate to Itchuaqiyaq's important observation: in cases in which page counts have limited our editing decisions, we almost always suggest authors to "gut source content and references." Though beyond the scope of this article, our own experiences with this "reducing citations" in practice also results in removing authors' contributions from scholarly conversations (i.e., reducing the literature review and/or eliminating authors from lists of multiple works in the in-text and parenthetical citations). Reflecting on this "citation reduction" practice, we also see a need for further scholarship that examines publishing policies and approaches to editing scholarly works.

We acknowledge that concerns for social justice for publishing policies and citation practices are considerably larger and more complex in scope than shared-first author and equally contributing author citation and recognition issues addressed in this article. Related broader concerns for social jutice should also be addressed, such as

- job market and economic security issues (job opportunities and promotions with increased pay are linked to scholarship production);
- immigration issues (citation index scores may impact time to receive a U.S. green card for some scholars, as they work to prove their scholarship has relevancy and impact on their field);
- communication engagement/partnership research issues (intellectual property may be protected under partnership agreements, preventing scholars from sharing their contributions in published works); and
- seniority power issues (early career faculty, postdocs, and graduate students may experience "power struggles" with advocating for authorship ordering and fair recognition for their contributions).

Embracing an active "disruptive" approach to changing publishing policies and citation practices, we can align with Colton and Holmes (2018): "...an active theory of social justice recognizes that equality is something that any individual, including professional technical communicators, can enact independent of a permissive institutional or governmental structure" (p. 12). Rather than taking a passive "waiting" approach for publishing policies and style guides to change, we (TPC scholars and, more broadly, scholarly writers and editors) can advocate for new publishing policies and citation practices with the suggestions we offer and, as creators and authors and editors, demand that our publications be represented in formats that we desire and of which we approve. Shared first authors and/or equally contributing authors should demand from journal editors that their works be clearly communicated as such on author bylines but also the in-text/end-of text citations that other scholars use to cite such first-authored and equally contributed authored works. Beyond this, however, is a much greater need to change a system that privileges first-author recognition. With increased faculty collaborations in TPC-related fields,[12] we need in place guidance for determining and communicating authorship, from journals and editors, but we also need scholarly societies and academic organizations to take a more active role in establishing best practices for publishing policies.

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Heat Vulnerability Mapping: Designing Visual Tools that Effectively Communicate Risk

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ABSTRACT

As the impacts of extreme heat escalate, digital maps have been designed to triangulate the location, timing, and level of risk. To understand how these tools align with a range of heat communication needs, rhetorical topology is used to analyze three mapping tools that make projections at global, national, and local levels. While these tools seek to make heat risk visible, the reliance on numerical definitions and comparative statistics gets prioritized over lived experiences of heat, which could limit their impact. I argue that broadening the focus to include causal relationships and narratives may communicate extreme heat risk more equitably.

CCS Concepts

Human-computer interaction

Keywords

Risk communication, Visual communication, Mapping, Extreme heat

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INTRODUCTION

Extreme heat communication is suffering from an alignment problem that those working in communication design may be able to help fix. The issue with communicating about heat is that we rely on numbers to communicate risk (temperatures, heat indices, change over time, etc.) but without grounding these numbers in a local context, they can fail to encourage protective behaviors (VanderMolen et al., 2022). While changes in these metrics signal to some audiences (such as those working in emergency management and weather hazard mitigation) that we are currently at risk and are likely to grow more at risk (Guyer et al., 2019), increasing the frequency of numbers shared via maps may not resonate with all audiences. As scholars and practitioners who are used to adapting communication technologies to capture a range of needs (Ding, 2014; Sauer, 2003; Tham, 2021; Tillery, 2017), we have a role to play in improving digital maps designed to communicate risks related to escalating impacts of heat.

Though there are many extreme-weather conditions linked to climate change, unrelenting heat is the deadliest in the United States, highlighting inequalities and entrenching climate injustice (National Weather Service, 2019). Known as a silent killer, heat risk is greater for those living in isolation who do not have consistent access to technologies like air-conditioning, which saves some lives while exacerbating the impacts of climate change for others, ultimately causing further harm to those most vulnerable (Chowdhury et al., 2012; Costello et al., 2009; Klinenberg, 2015). When it comes to heat, escaping or being free of risk oftentimes means a tradeoff that keeps those with fewer resources in the community subjected to increased heat vulnerability. Rose (2016) used the term "resource-constrained contexts" to discuss this reality, and for those living in these contexts, impacts from heat are further exacerbated by a cycle of climate injustice. There is an awareness of the overlapping conditions that give rise to heat vulnerability, and accordingly, technologies and tools seeking to mitigate heat impacts or communicate heat vulnerability are being designed to respond to these growing concerns. However, while the efforts to map heat risk vulnerability are a step in the right direction,

their scope may be limited because the risk metrics they highlight may not be in alignment with those who rely on an experiential or embodied sense of risk rather than on statistics alone.

In this article, I use a topological method to highlight differences in what heat mapping tools produce and the more embodied ways of thinking about heat risk that are familiar to those who encounter dangerous levels of heat. I draw on conversations regarding heat and climate risks (Cagle & Tillery, 2015; Kain & Covi, 2013; VanderMolen et al., 2022) and digital mapping (Butts & Jones, 2021; Stephens & Richards, 2020) to frame recommendations for how heat vulnerability maps can expand their contribution to extreme heat risk communication. Current heat maps tend to rely on comparison—mapping tools enable us to compare our heat levels across time, conditions, and geography. While this is useful for the big picture of how extreme heat is changing, immediate heat impacts tend to be rendered in ways that are experiential and contextual—heat and temperature thresholds in Arizona are not experienced in the same way as heat in Tennessee or heat in Bangladesh. Some communities have been dealing with extreme heat regularly for years, where others are experiencing deadly heat waves on a scale that is less common for their regions, such as the case of the United Kingdom heat wave of 2022 (Sullivan, 2022). Beyond regional impacts, individual bodies experience heat differently depending on a host of factors related to health, location, age, consistency of exposure, and others. For this reason, while these tools capitalize on comparison to produce relevant data visualizations linked to numerical estimates, relying on these metrics alone downplays the experience of heat and leaves out the differential impacts of vulnerability. Rather than relying primarily on comparing heat to other places or times, I advocate for adding a layer of communication that focuses on narratives and causal relationships to clarify what heat *does,* rather than how heat *compares*.

DESIGNING MAPS, DEFINING VULNERABILITY

Because heat and climate impacts are linked to place, mapping is a natural fit to visually express the risk levels associated with each locale. Maps help people understand, in a tangible way, where they are in relation to the world around them, allowing for a visual that can be scaled up and down depending on the comparative needs of the context. Despite its utility in articulating spatial relationships, mapping is a digital technology that can be a double-edged sword: it has enormous potential, but also comes with inclusion/exclusion risks. Anytime boundaries are drawn around the human experience, some perspectives get highlighted, and others get left out. For this reason, it is all the more important to design mapping tools with the intent of ensuring that multiple stories and perspectives are included from the ground up. In his work on design thinking, Tham (2021) discussed advocacy as a core part of technical communication, which "means recognizing equal power dynamics, actively combating unjust treatments through design and communication, and positioning justice at the center of our practice" (p. 66). Ensuring that mapping technologies account for risk in a way that is inclusive and meaningful to the populations impacted is one way of building advocacy into extreme heat communication, especially given the differential impacts of extreme heat.

In the best-case scenario, mapping tools can offer context and information in a structured and meaningful way. In his study of interactive sea level risk viewers, Richards (2018) suggested that digital mapping tools are "a potential avenue for communication designers to translate the importance of localized messaging in risk communication to an interactive map-based tool" (p. 61). As Stephens and Richards (2020) later showed, mapping can combine digital tools with deeply situated local contexts to highlight stories of climate related impacts. Because vulnerability mapping using digital tools can help communities identify heat risk, they can be used to engage multiple audiences and increase awareness (Sackey, 2020; Schmeltz & Marcotullio, 2019). For example, Butts and Jones (2021) described using deep mapping to incorporate complex stories into a tool designed for environmental advocacy which allowed for a balance of understanding larger scale climate risk with local context. These studies show that mapping technologies hold immense promise when they are designed in a way that accounts for the lived experience of those vulnerable to climate impacts by centering humans in environmental stories.

Because our experiences of climate-related impacts are localized and require context, mapping tools designed to make risks visible to a range of audiences have their limitations. While there are benefits to mapping, communication research has shown that reliance on this type of tool can over-emphasize empirical data (Walton, 2016) and misalign global and local contexts (Agboka, 2013; Stephens & Richards, 2020). Efforts have been made to shift these tools to encourage a "humanizing understanding of technical subjects" (Dragga & Voss, 2001, p. 266) through frameworks that expand our ways of knowing (Graham & Herndl, 2013; Olman & DeVasto, 2020) and highlight the role of embodiment (Jack, 2022). This study seeks to build on these efforts by offering recommendations for how heat maps can expand the important work they are already doing to account for more embodied, diverse, and experiential ways of assessing risk.

Heat vulnerability is linked to systemic issues that develop over time, constituting a form of slow violence that further complicates communicating the associated risks. Nixon (2011) has discussed slow violence as a "violence that is neither spectacular nor instantaneous, but rather incremental and accretive" (p. 2). At all levels, heat risk is cumulative and often linked to decades-long processes that increase risk for some individuals more than others, particularly due to socioeconomic conditions. When staying safe from extreme heat, there are a cascade of socioeconomic circumstances developed over time that form barriers for individuals. Take, for example, the infrastructural requirements for someone seeking shelter from the heat. If an individual cannot afford to keep their air-conditioner running (assuming they have shelter and air-conditioning in the first place), they may seek out spaces where they can escape heat impacts. Transportation to cooling centers, proximity to public resources, access to spaces where no purchases are required, and even the level of infrastructure investment in environment (such as planting shade trees or providing water access) all become factors in helping individuals survive the heat. These are the kinds of conditions that arise from a system that benefits some, while disadvantaging others, and extreme heat health impacts are one facet of slow violence that has accumulated over years to lead to these circumstances. While mapping can empower groups and individuals to understand risk and prepare mitigation plans, issues of access and scale emerge, failing to capture the texture of human experience as it relates to systemic issues of slow violence and limiting the power to communicate equally and effectively. This is particularly relevant in heat communication, where numbers and statistics that are not grounded in context and localized understandings of risk can be misleading.

Previous work in extreme heat research showcases the importance of context and local experience in determining ways forward in heat mitigation efforts and offer some hope for combating this particular articulation of slow violence (Chowdhury et al., 2012; VanderMolen et al., 2022). In Eric Klinenberg's (2015) book *Heat Wave: A Social Autopsy of Disaster in Chicago* about a deadly heat event in 1995, he shared an ethnographic account of the relationship between heat and vulnerability. In reviewing the mortality rates collected during the Chicago heat wave, Klinenberg found that higher death tolls were mostly consistent with geographic inequality, as one might expect. However, as he noted, "that's not the whole story. Three of the ten neighborhoods with the lowest heat-wave death rates were also poor...which means that neither race, nor ethnic cultural practices and values, nor violence or poverty are sufficient to explain who lived and who died" (p. xxiii). In this case, statistics alone could not capture how or why people in some of the most resource-constrained neighborhoods were also some of the most protected from extreme heat. Upon a deeper dive into the lived experience of the heat wave during that time, Klinenberg argued that these neighborhoods ultimately benefited from a "social infrastructure" that helped keep people safe:

> In 1995, residents walked to diners and grocery stores. They knew their neighbors. They participated in block clubs and church groups. Residents there told me that during the heat wave they knew who was alone, who was old, and who was sick. They did wellness checks and encouraged neighbors to knock on each other's doors—not because the heat wave was so exceptional, but because that's what they always do (p. xxiv).

There is much that numerical estimates of heat reported over time or across different places can teach us about heat vulnerability. Klinenberg made the point, though, that they can't tell us everything. In order to truly understand heat vulnerability, we must first know about the conditions, stories, experiences, and embedded realities of those subjected to extreme heat. Regarding addressing slow violence, Nixon posed the question: "How can we turn the long emergencies of slow violence into stories dramatic enough to rouse public sentiment and warrant political intervention?" (2011, p. 3). In the context of heat, I echo this question and ask: how can we share stories that make heat risks intelligible to people who primarily associate weather-related hazards with immediate impacts, such as tornadoes, hurricanes, and snow? As a starting place, communication tools that visualize heat vulnerability could draw on both numerical and community-grounded approaches to present risks in ways that are meaningful to both heat mitigation professionals and public audiences. Sharing high temperatures alone is unlikely to motivate change, but perhaps other strategies more grounded in community awareness and lived experiences can. The goal of this research is to offer suggestions for how a balance between these two ways of knowing might be achieved more effectively in existing and future heat mapping tools.

Although there are many new heat mapping tools being introduced as heat risk expands to new communities and levels, this research will assess three heat-mapping tools associated with tracking heat impacts in global, national, and local contexts: the ClimateCHIP (Change Heat Impact & Prevention) tool used by the Global Heat Health Information Network; the Heat & Health Tracker tool used by the Centers for Disease Control and Prevention, and the EPHT (Environmental Public Health Tracking) Explorer used by the Arizona Department of Health Services (2023). These tools were chosen because they each represent an example of a heat mapping tool used across different geographical scales. This is important because considering multiple contexts and how they relate helps us broaden the conversation around heat as a social justice issue. As Tham (2021) wrote, "although social justice begins at home, it's important to understand the relationships between local and global injustices" (p. 58). While heat is only one part of climate change risk, this is a risk that impacts the entire planet, not just our national and regional contexts.

Using topological coding (Walsh & Boyle, 2017) to identify norms and values embedded in the design and functionality of each tool, I argue that the mapping tools discussed here rely on statistics and comparative metrics in a way that downplays the human experience of heat, regardless of scale. These tools, while useful in many contexts, leave gaps in mapping communities that are most vulnerable, limit risk assessment information to those who are familiar with statistics, and divert focus away from the experience of those living with the fewest resources to combat heat health consequences. However, because these tools also hold potential to increase awareness of climate justice issues, guidance will be offered for how they can be repurposed or expanded with a focus on participatory localization (Agboka, 2013). The goal is to contribute to ongoing conversations about climate inequity and the technologies that mediate our experience of risk by offering ways for heat mapping tools to include narratives and experiences of the users they seek to protect, taking a step toward providing more equitable risk communication (Butts & Jones, 2021; Eichberger, 2019; Richards, 2018).

METHODS: CONTEXT AND TOPOLOGICAL CODING

This work began with identifying a trend while engaging in extreme heat conversations through the Arizona Heat Resilience Workgroup. The group, which began meeting in 2020 due to an awareness that pandemic lockdown would exacerbate heat risk issues for vulnerable populations, is designed to

> convene stakeholder organizations from around Arizona in an effort to monitor heat forecasts/warnings from the National Weather Service, share best practices relating to heat response and relief, and to encourage collaboration, coordination, and development of novel responses to preparedness and resilience to extreme heat. (Sustainable Cities Network, 2024)

This is a richly varied community that seeks out many voices to share best practices and updates relevant to those working to keep people safe from extreme heat. While participating in these meetings and other heat-related conversations associated with or recommended by the group, several participants shared mapping tools that they were using in their work related to extreme heat. I noticed these tools being shared both in meetings regarding local heat efforts as well as those that had a national or international audience.

Given this trend, I began collecting the mapping tools discussed in the context of these groups to see how each iteration compared to the others. My original goal was to get a sense for what the different capabilities of the tools were, how they discussed or represented extreme heat vulnerability, and how accessible they were to those who might engage with the tools across different contexts. Using an inductive approach, I began comparing these tools, but noticed that they were largely using variations of similar statistics to do the same

thing: map changes in heat over time represented geographically. While most of the tools identified focused on national mapping, there was a smaller subset that focused on heat mapping at the global and local levels. From my list of global, national, and local tools designed to communicate about extreme heat, I selected the tool with the broadest functionality from each of these categories to serve as examples in this research.

The goal in selecting one tool from each category was both to focus the topological analysis described below, and avoid reproducing results—there were neither enough mapping tools available to do a robust review that found stable patterns, nor few enough tools that discussing each of them would not duplicate a discussion of tool functionality without introducing new categories (i.e., while there were two tools that mapped heat at the global scale, they both used primarily the same metrics, so the tool with additional options beyond those they had in common was chosen to discuss here). Choosing one tool from each of the three levels of geographical mapping offered a middle ground approach to sustain the analysis. With that said, should heat mapping become a tool that is used more often to communicate about heat risk, future studies could expand beyond the scope of the present work to enrich the conversation about how these tools are used more broadly.

In the context of the working group from which these heat mapping tools were sourced, there were a large variety of practitioners, emergency managers, community organizers, and researchers connected to and invested in managing risk associated with extreme heat. For this reason, those who use these tools are likely to approach them with a range of different approaches, perspectives, and purposes. Because I am interested in these tools for the role they can play in risk communication, my analysis focused on how heat maps represented visual data about heat risk and how those representations frame extreme heat that impacts communities. Therefore, my research questions were as follows:

1. How do digital mapping tools frame heat risk through their design choices?
2. How can tools be expanded to align heat risk communication with the needs of a greater range of audiences, particularly those who are most vulnerable?

To answer these questions, I needed a method that connected the use of particular heat mapping tools to the impacts that those choices could have on understanding while offering a path forward for how to strengthen this process of communication. Because rhetorical topology is a method that "traces the contours of a discourse and may fold it into a new configuration" (Walsh & Boyle, 2018, p.4), it provided a strong fit for the project. A topological method relies on identifying topologies or "visualizations of the communal beliefs, values, and norms (*topoi*) that connect individual narratives to wider community practices" (Walsh, 2018, p.3). During a topological analysis, texts or other communicative tools generated for a particular purpose—in this case, heat maps designed to represent extreme heat risks—are analyzed for the underlying values or logics on which they are built.

The underlying values that build communication are based on Aristotle's original use of the term *topoi* and they can come in many different forms. For this analysis, I will focus on common topoi which are "used to generate arguments about any material whatsoever" (Walsh & Boyle, 2017, p. 248). In terms of the heat mapping tools assessed here, the alignment issues with transmitting information about heat risk were grounded in how arguments about heat were fundamentally made and represented. For this reason, the common topoi provided sufficient tools to reveal where those tensions in the discourse existed so that they can be re-directed in the future.

To determine which topoi were reflected in the heat mapping tools, I collected information about the functionality of the mapping tools and the language from each digital platform used to describe heat risk. I began with a list of all the features available in terms of map functionality for each of the three examples. I performed every available function of each map and followed each of the resulting outcomes to their conclusion until no additional layers of data could be added or changed based on the options provided. For each of the functions, I noted what kind of information was yielded, the common topos that constituted the interpretive frame for that information, and the specific expression of that topos in terms of data type. For example, a function that allows visitors to select changes in heat over time would be coded as a "Parameter" that makes use of the common topos of "Compare/contrast" and relates to "Time." Coding in this way allowed for an overview of the offerings of each tool in terms of heat communication, a comparison of how the tools differed from each other, and an analysis of how the functions align with the needs of those vulnerable to heat impacts.

OVERVIEW OF HEAT MAPPING TOOLS: GLOBAL TO LOCAL

Extreme heat and climate change are issues that go hand-in-hand. The impacts of both tend to be assessed at the local level; people want to know how vulnerable they are in the current heat landscape, and how much heat they can withstand in the future due to climate change. However localized risk assessments might feel, the impacts of heat present at the global level as well. Because heat is experienced differently depending on the context, it is important to consider heat tools from a range of geographical perspectives.

Global Heat Mapping : ClimateCHIP (Change Health Impact Profiles)

A series of tools that access the global layer of climate and heat risk is being designed by an interdisciplinary team based in New Zealand called Climate CHIP (Change Health Impact Profiles). The goal of the group is to broaden knowledge of risks associated with both heat and climate change, and the intended audience is broad—the website lists scientists, health workers, administrators, industry professionals, teachers, students, and the media (ClimateCHIP, 2023).

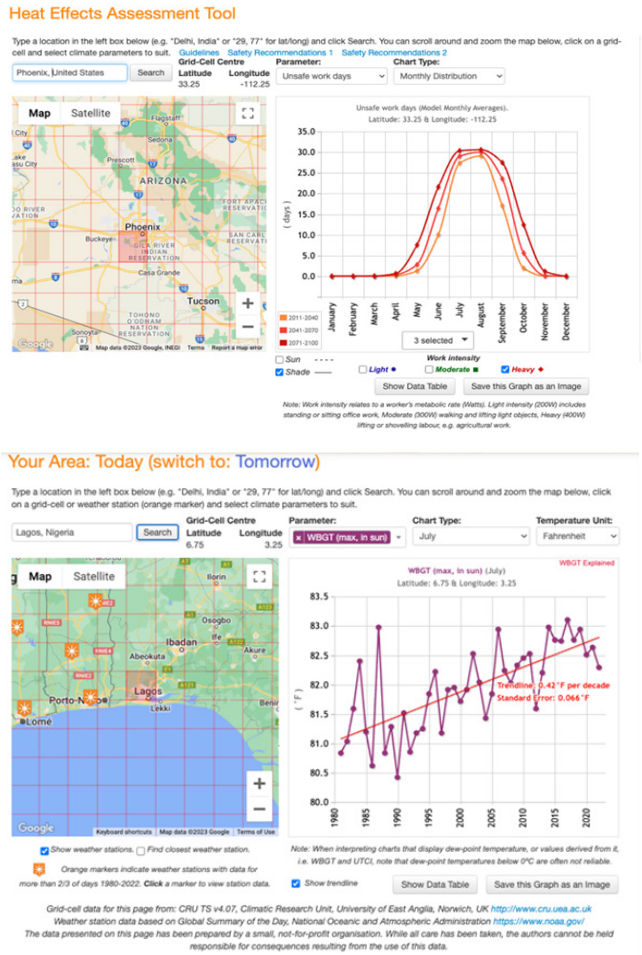

Figure 1. Screenshots of the HEAT and Your Area tool interfaces in Climate CHIP

While the website offers a suite of tools, some of which are readily useable and some of which are under development, this analysis will focus on the Heat Effects Assessment Tool (HEAT) and the "Your Area" function. The HEAT tool communicates "the likely heat stress challenges occurring in a selected location anywhere in the world" while the Your Area tool allows users to "find climate data in any part of the planet from historical data and future models" (ClimateCHIP, 2023). The HEAT tool offers a search by location function, generating a map alongside a graph that can be adjusted to reflect different heat parameters. The "Your Area" tool allows visitors to type in any global location, which auto-generates a map indicating closest weather stations along with a series of data visualizations created by selecting heat parameters, chart type, and temperature unit from drop down menus.

National Heat Mapping: CDC Heat and Health Tracker

While there have been calls for an increase in digital tools that reveal the global impact of heat like ClimateCHIP, many mapping tools that discuss heat vulnerability do so at the national level. The national tool used for this research is the CDC Heat & Health Tracker, which "provides local heat and health information so communities can better prepare for and respond to extreme heat events" (CDC Climate & Health Program, 2023). Though there are a variety of tools available, the CDC tracker offers a range of different mapping options and is linked to a larger "Environmental Public Health Tracking" program that funds state projects that use the data for more localized efforts. The main page offers two levels of mapping features, the first of which focuses on heat health and offers three U.S.-based maps: Daily Heat-Related Illness, Weekly Heat-Related Illness, and Heat and Worker Health. Scrolling down to the second map function associated with "Heat Exposure Data," visitors can toggle between four map choices: Historical, Current, Monthly Forecast, and Projected.

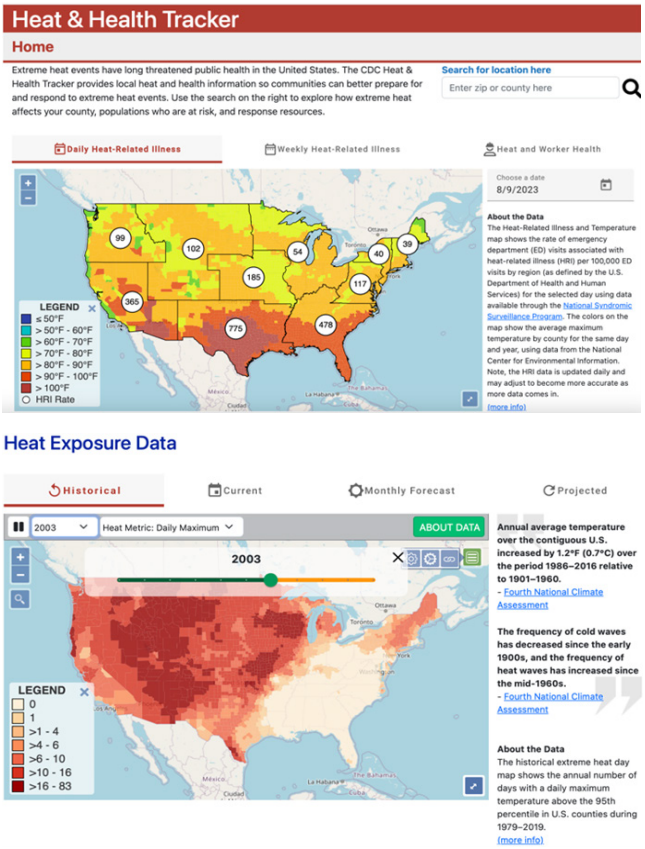

Figure 2. Screenshots of the CDC Heat & Health Tracker mapping tools

The first set of maps present data through two vulnerability lenses: heat-related illness and worker health. There are two map functions that depict heat-related illness on daily and weekly timescales overlaid on the same map of the US, which is divided into 11 regions generated by the Department of Health and Human Services. Each region has a circled number which represents the rate of heat-related emergency room visits per 100,000 visits (CDC Climate & Health Program, 2023) against a backdrop of color-coded temperatures blocks that offers a sense of how hot the region was during the given week or specific day (as of this writing, daily data go back to April 2022, weekly data go back to 2018). Outside of the heat-related illness maps, a third map option is available for "Heat and Worker Health" that is built from data associated with the Bureau of Labor Statistics. While this third map is built around the same US map as the illness maps, it instead "shows the rate of work-related injuries, illnesses, and fatal injuries due to heat per 10,000 full-time workers by state" (CDC Climate & Health Program, 2023). Unlike the previous two maps, the Heat and Worker Health map has a timeline function embedded that shows changes form 2011-2020 when a visitor to the website presses play.

Below this first mapping tool, a second set of maps can be found under the heading "Heat Exposure Data," and they represent heat risk in four timescales: Historical, Current, Monthly Forecast, and Projected. The historical map, which includes data from 1979-2019 has the strongest layering capability, allowing visitors to select from a series of years (every fourth year from 1979 forward), choose color and legend features, and overlay the Daily Maximum temperature data with information including community features like hospitals and nursing homes, meteorological data including surface smoke and radar, and topographical information such as streets or state boundaries. Like the Heat and Worker Health first-level map, the exposure mapping tool offers a "Play Timeline" feature to show how heat exposure has changed (and likely will change) over time.

Local Heat Mapping: Arizona Environmental Public Health Tracker

The most local (wherein "local" is defined as Phoenix, Arizona, where this research was conducted) articulation of the heat mapping tools discussed in this research is the Arizona EPHT (Environmental Public Health Tracker) which is a local extension built using the data from the CDC Heat & Health Tracker. While these tools both have the same focus on tracking and presumably draw from the same data, the interface and functionality of the tools differ significantly. While the Arizona EPHT is an overall environmental data tool, I focused exclusively on the "Heat Stress Illness" content area given the focus of the research (there are, however, many additional options including air quality, drought, infectious diseases, and others). The Arizona EPHT allows visitors to select from a variety of mapping options and health indicators which then populate a map centered on the screen. The geography of the map can be articulated as states or as counties, sub-counties, or water system areas in the state of Arizona.

If users of this tool wanted to look at both a state map of Arizona broken down by counties and a national map broken down by states, they could select the "Add additional map" option and the screen splits in half to accommodate two different geographics or other map queries. Focused primarily on the Arizona Counties map, there were three indicators of heat stress illness to choose from: Heat stress emergency department visits, Heat stress hospitalizations, and Heat-related mortality. Other options include changing the measures related to the indicators (emergency room visits versus age-adjusted rates, for example), adjusting the year (2005-2021), and filtering for gender, age, and month, depending on the indicator options selected.

Once data filters have been selected on the left-hand side of the screen, the map at the center of the screen, as well as a table on the right-hand side of the screen, visualize the data resulting from queries selected. A panel on the bottom-left of the screen allows users to change the color and map type, as well as include layers over the map (hospitals, public schools, American Indian Reservations, etc.). In the center bottom of the screen, data projected on the map are shown in data visualizations including options for a line graph (Trend Chart Over Years), bar chart, and advanced charts. A legend in the bottom-right hand corner keeps track of the changes a user makes that are currently reflected in the map projected.

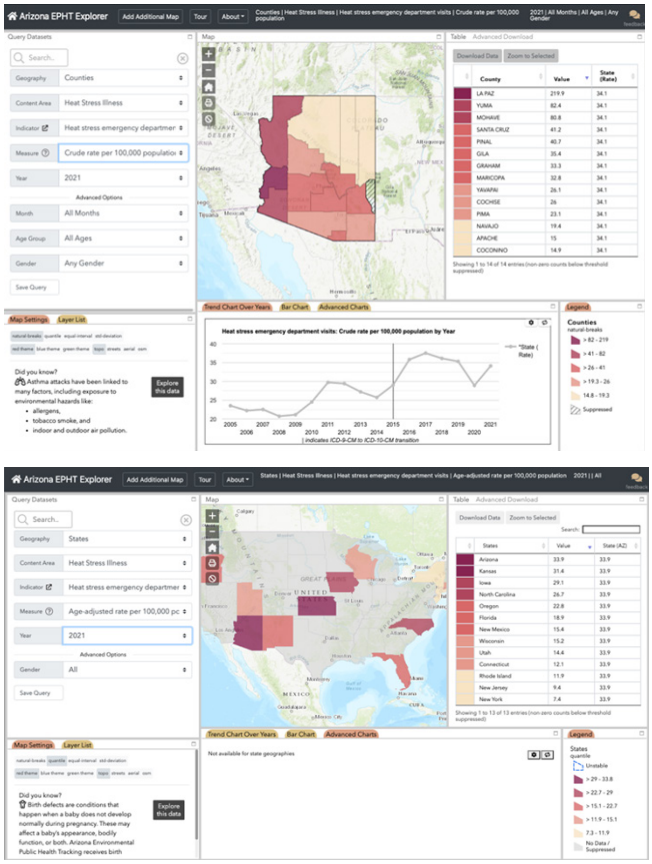

Figure 3. Screenshots of the Arizona EPHT (county and state maps)

Heat Mapping Topologies: Defining and Comparing

The mapping tools described above each offer a way to communicate extreme heat risks using a variety of metrics, functions, and outputs. Like any technology that maps data in a new way, extreme heat mapping tools highlight some values and metrics while downplaying others. A review of the tools and the various functions reveal that these tools primarily rely on two common topoi: definition and comparison. For the most part, the tools highlighted offer the chance to frame the available data around a particular context (topos of definition) and then compare the data yielded to other contexts, both temporal and regional (topos of comparison). Table 1 offers a topological overview of each tool, including the central topos each function represents, as well as how that topos is expressed (time, location, etc.). While these numbers offer a broad overview, each subsection below will discuss primary topoi used in more detail, with examples from the tools described above.

To illustrate what each of these topoi and categories looked like in practice, Table 2 offers an example of each of the topoi/category combinations, as well as where each of the examples comes from. The goal of coding these tools was to provide a general overview of the kind of topoi being used across different interfaces.

In each of the examples, topoi are assigned to a possible action that the person using the heat mapping tools could take to change the output of the heat map. Each case listed in Table 1 represents a function that could be used to modify the output of the heat mapping tool, most often by selecting choices from a drop-down menu.

Central topos	ClimateCHIP	CDC Heat & Health Tracker	AZ EPHT Explorer
Definition	7	9	6
Comparison	27	6	8
Cause and effect	3	0	1
Categories:			
Location	7	5	5
Time	6	10	2
Degree	19	0	3
Environment	2	0	1
Impact	3	0	4

Table 1: Topological overview of heat mapping tools

Central topos	Category	Example	Heat mapping tool
Definition	Location	Selecting longitude/latitude location	ClimateCHIP
Definition	Time	Selecting a particular date	CDC Health Tracker
Definition	Impact	Selecting an impact to health	AZ EPHT Tracker
Comparison	Location	Selecting region for emergency visits	CDC Health Tracker
Comparison	Time	Selecting month of heat-related deaths	AZ EPHT Tracker
Comparison	Degree	Selecting max temperature metric	ClimateCHIP
Comparison	Environment	Selecting shade coverage	ClimateCHIP
Comparison	Impact	Selecting age group	AZ EPHT Tracker
Cause and effect	Impact	Selecting unsafe work days	ClimateCHIP

Table 2: Examples of topoi/category combinations used in heat mapping tools

While each tool has a unique profile associated with the topoi used, in the overall data set, the topoi of definition and comparison were most represented in the functions analyzed. Within both of those topoi, time and location emerged as the most common categories used to compare or define. Other topoi, including cause and effect, and categories, such as impact and environment, were present in the data set, but not extensively used.

Selecting Heat Context: Topos of Definition

Ensuring that users of the digital heat mapping tools can narrow the data included on the map to a particular context was consistent across all three tools. Input options included narrowing by time and location, and sometimes also by type of heat risk (for example, worker safety was an option that could be selected). In this way, the topos of definition—that which describes the context or defines what makes a situation a particular way—was very common throughout all three tools. One underlying argument or role that this topos plays is to communicate that heat risk can only be mapped when the context is clearly defined. The definitional topos is essential to heat communication: heat impacts people and places differently, and because the impacts are so complex, the more a specific heat context can be defined, the better the risk assessment can be.

One example of how the topos of definition makes its way into digital mapping can be found in the ClimateCHIP tool, which allows visitors to select from a range of options to define their context. The "Your Area" tool designed by ClimateCHIP has two versions: Today and Tomorrow. In the "Today" version of the tool, visualizations yielded are based on climate data from 1980 through 2022; in the "Tomorrow" version, the same visual tools map data from 1980 through 2100 based on climatological predictions. There are six heat parameters that appear on the drop down list: Temperature, Dewpoint Temperature, Relative Humidity, Wet Bulb Globe Temperature (WBGT), Universal Thermal Climate Index (UTCI), and Heat Index (HI). Each of the parameters offer a different definitional lens through which to evaluate heat risk, and the less common measures (WBGT, UTCI, and HI) all have explanations with the option of learning more.

Although the topos of definition at play in this tool is important for narrowing the context, the resulting visualizations associated with these metrics change very little in terms of visual risk output—all estimates show rising temperatures for today, and continued increases for tomorrow. While the visual-rhetorical impact of changing the heat metric may not seem like it carries a lot of value, the fact that there are six different statistics used is representative

of a central concern in expressing heat risk: there is no one way to capture risk, and different organizations rely on different definitions and statistics to represent a complex situation. In this way, while the topos of definition is useful for defining the context, finding the right balance of defining too far and not far enough is difficult. At the moment, definitions are based on relatively broad categories that approximate context; location and time were the most common across all three tools. While these do help paint an overall picture about heat risk, the maps rendered make it difficult to assess individual risk, or even community risk, because the numbers alone don't capture levels of vulnerability.

Adding another layer of complexity, the numbers used in ClimateCHIP to communicate vulnerability make assumptions about the human body, condition, and acclimatization. The designers of the tool do a great job of offering definitions and framing how to think about the statistics offered in terms of assumptions and limitations. Designers of these tools have to outline assumptions made by carefully defining their terms because there is no one perfect measure of heat vulnerability. Due to the complexity of heat impacts, there are too many variables to control. This does, however, lead to a question: if statistics cannot capture the complexity of heat risk and vulnerability, to what extent are the statistics helpful to a range of audiences who encounter and respond to heat risk differently? To what degree do these assumptions leave out or fail to account for bodies that are more or less vulnerable than the calculations capture? These are the kinds of questions that should be at the forefront of the design process, and sharing the reality of assumptions made should be publicly available to prevent excluding or passing over the needs of populations more vulnerable than the statistical representations account for. While making these definitions clear is of central importance, designers of heat vulnerability mapping tools should also consider what additional kinds of data might be used to help fill in the definitional gaps left by statistics and numerical estimates of risk. While seeing that a community might be a few degrees hotter in a future month, hearing about the impact that those degrees have on the human body may offer a more compelling reason to seek heat mitigation behaviors.

Juxtaposing Heat Risk: Topos of Comparison

If the topos of definition helps to determine the output of each of the heat mapping tools, the ultimate end game is to use these outputs to compare risk across contexts. While sometimes visitors input information that results in one visual associated with heat risk, each of these tools are designed with overlays, timelines, and multiple displays that allow for direct comparisons across region, time, and impact. One might expect to find the topos of comparison for the same reason that the topos of definition is so prevalent: heat is a context-based risk. The underlying argument about heat risk associated with the topos of comparison is that one primarily identifies the degree of their heat risk by comparing that risk to others. Tools that rely on a topos of comparison, particularly given the categories used across these tools (time, location, environment, impact, and degree), make a strong argument that the degree of risk associated with heat is increasing, that it is going to continue to increase, and that different regions are going to be hit harder than others. However, as with the definitional topos, this kind of strategy is useful for some kinds of arguments, but limits others. For example, while comparison over time sets up an argument about long-term climate change, it has less of an impact in terms of capturing experience for individuals living in dangerous heat contexts today.

Perhaps because it is a national tool, the CDC Heat & Health Tracker is deeply grounded in the topos of comparison: each map included in the tool is rendered at the national scale, such that any inputs only change colors and numbers as they appear on the same map of the United States. The CDC tracker goes a bit farther than the ClimateCHIP tool (at least in its current iteration) in its focus on heat impacts: almost every map available highlights a concrete risk associated with heat (health impacts, worker impacts, heat exposure). The benefit of this is that it captures, in a tangible way, the nature of risk assessed at the individual level. The framing of the tool is designed to showcase consequences of extreme heat on the human body through medical data. In terms of the heat metrics themselves, the heat scale used by the CDC goes from 50-100+ degrees, with no differentiation for above 110 degrees. This is an interesting choice because this temperature is a common heat threshold for establishing extreme heat in some of the hottest cities in the U.S. While this differentiation is not included in the map, one functionality that is offered is the ability to scroll over the map to see the average temperature associated with a particular city. In this way, the map shows both regional data and more localized data.

Usefully, the CDC offers written heat information below the maps which focus on heat-related health impacts, trends, and vulnerabilities, describing basic information to ground the mapped data in present realities. While this is very useful information that highlights vulnerability, individuals might not use the data to frame the maps produced using the tool since there is separation between the two. Considering ways to embed this contextualizing information within the map itself might be one way that people could access both numerical data and context-rich data at the same time, expanding the impact that the tool could have on risk assessment.

RECOMMENDATIONS: RELATING IMPACTS AND SHARING STORIES

Unlike weather hazards that damage infrastructure, have a limited timescale, and leave visual markers of destruction, heat risk accrues quietly and unevenly. For this reason, heat escapes our risk detection mechanisms and calculations that we traditionally use to assess weather hazards. To improve our ability to interpret heat risk, we need a way to communicate about extreme heat that treats it as an entirely different kind of risk than the disasters that leave behind destroyed structures and damaged communities. We need a way to talk about heat that a) makes the risks and consequences visible and b) frames extreme heat as a community risk impacting individuals.

The topoi of definition and contrast provide an important base layer to heat communication. Because heat risk varies on so many different scales, comparing across contexts will always be part of how we talk about extreme heat. For this reason, the tools that are analyzed here are a great first step in communicating about heat risk. However, my argument is that these tools can go farther in contextualizing risk for those who may be making decisions about minimizing heat exposure in the current moment. While definition and comparison activate risk visuals that make powerful arguments about climate change because they overwhelmingly show that hot weather is increasing and getting more dangerous, these data can be paired with more specific information grounded in human experience of heat to reach a broader audience and account for greater social complexity.

Building on Success with Cause and Effect

The three tools discussed here primarily focus on numerical data to either show increasing temperatures or increasing impacts from extreme heat across different regions globally, nationally, and locally. However, these strategies don't always capture *why* escalating heat is dangerous, or how heat hazards compound with other dimensions of vulnerability to disproportionately put some more at risk than others. The tool that goes farthest towards this goal is the most local tool: the Arizona Environmental Public Health Tracker (EPHT). Because this tracker allows visitors to choose their Content Area (including heat, but also including other areas like heart disease, air quality and community design, all of which are known metrics impacting heat health) and indicators (including heat health statistics), the depth of vulnerability due to overlapping issues is more accessible than with the other tools. This in part is due to the scale: local tools can capture a depth of data that might not yet be available in global or national contexts. What this tool does well is that it uses the topos of cause and effect, adding a layer to explore impact, rather than context-setting alone (as is often the case with definition and comparison). Building on this topos of cause and effect could make a difference in making these heat vulnerability tools more useful to anyone seeking to understand their own—or their community's—heat risk.

While the Arizona EPHT offers the most options in terms of cause and effect, there are portions of the other tools that incorporate this aspect as well. The ClimateCHIP team, for example, acknowledges that there are variations in locales, circumstances, and environments that impact these tools. Indeed, the global focus of the tool allows for comparison across region, personalized results based on location, and access to further information about where weather stations are located in proximity to different cities. Because climate change impacts different places disproportionately, ClimateCHIP embeds this understanding into its tools, highlighting that context matters and that vulnerability does not impact everyone equally. The CDC Heat & Health Tracker also focuses on cause and effect when it comes to work incidents: while several states do not have these data available, it is possible to scroll over each state to preview the rate of work-related incidents per year. These maps show, numerically, how many people end up in situations where they must pursue treatment due to the heat. To add context and messaging regarding how to stay safe, the CDC (2023) embeds text below the heat-related illness map that discusses how hot weather relates to health impacts, what the current trends indicate, and who is most vulnerable. Sometimes these vulnerabilities are embodied ("some are more vulnerable, including pregnant people, people with heart or lung conditions, young children, older adults, athletes, and outdoor workers") and sometimes based on regional circumstances ("urban heat islands, combined with an aging population and increased urbanization, are projected to increase the vulnerability of urban populations").

In each of the cases discussed above, an effort is made to explore the impacts of heat using a topos of cause and effect. While these uses of cause and effect are powerful, they are not as common as other topoi used in these tools. The strategy of communicating heat risk through cause and effect could be more grounded in the human experience of heat than the numbers and metrics (temperatures, heat indices, etc.). To continue in this direction, building on the topos of cause and effect can offer a helpful framework for making the impacts of heat risk more tangible for a wider range of audiences.

In addition to making heat risk more visible and real for people, focusing more on cause and effect can also add dimension to arguments made about climate change and the differential impacts that it has on vulnerable populations. As mentioned earlier, technologies designed to keep populations cool often exacerbate issues overall. One example of this is the urban heat island effect, which leads to "higher temperatures in dense, downtown, commercial districts" (Kuras et al., 2015 p. 1364). Adding mapping features that incorporate the causal relationship between heat infrastructure and community impact could be a powerful way to make escalating heat and climate risks more meaningful. This kind of information can also provide a link between hearing about increasing heat risks and seeing how those risks play out for more vulnerable populations in the community.

Adding Experiential Risk Narratives

While building on the topos of cause and effect is one way to expand the reach of heat mapping tools, metrics associated with impacts can still be somewhat removed from the lived experience of individuals who are living in high-risk situations. Several previous studies have shown that heat risk is often packaged in a way that is removed from the everyday lives of individuals, making it difficult to understand how, when, or why to pursue heat mitigation behaviors (Chowdhury et al., 2012; VanderMolen et al., 2022). One way to expand the heat mapping tools available is to add grounded experience into the tools via heat narratives. Incorporating narratives is one way to answer Richards' (2018) call for more localization in mapping tools that "integrate the precision brought about by localization technology with the research brought about by localized concerns of actual people" (p. 66). Tools created by Stephens and Richards (2020) and Butts and Jones (2021) offer a great starting place for how the current heat mapping tools could be perhaps made more impactful by incorporating stories from those who know what heat impacts feel like, rather than what defines extreme heat numerically.

Incorporating narratives is important, not just because it helps ground risk communication in lived experience (Baniya & Chen, 2021), but also because it can lay the groundwork for participatory localization, which Agboka (2013) defined as "user involvement, not as isolated user participation but as user-in-community involvement and participation in the design phase of products" (p. 42). While the tools discussed here have already been designed, there is no doubt that new digital tools that rely on heat mapping to visualize risk will be created given the increasing focus on extreme heat. When this happens, people who use these tools, particularly representatives from the communities who are most vulnerable to heat impacts, should be involved in the design of the tools from the outset. In modifying existing tools, this practice is also important, even if designing tools with participants from the ground up is preferred.

Offering community members a voice in the design of these tools is important from an equity and social justice perspective, and in the case of heat communication, it can mean the difference between whether or not individuals adjust their behaviors to stay safe from extreme heat. Combined with building on the topos of cause and effect, designing with a focus on participatory localization strengthens the awareness of how heat impacts are related to infrastructure and political choices that lead to vulnerable populations being put at greater risk. Gradually, this awareness contributes to an understanding of heat as a mechanism of slow violence that accumulates over time. To Nixon's (2011) point, telling the most compelling stories about the impacts of heat

risk is a step forward in revealing the complicated overlap of circumstances that creates vulnerability. Narratives, storytelling, and inviting local voices into the design of heat tools is necessary for communicating risks in a tangible way that speaks to a broader range of risk frameworks that people deploy to understand or make choices about their levels of risk.

CONCLUSION

Heat risk is on the rise, but the tools we have used to communicate this growing danger can continue to grow to keep up with communicating the escalation of impacts. In revising and revisiting heat mapping tools, we have the opportunity to not only make heat risks more tangible to more people, but also to support and strengthen community equity in doing so. To get there, a combination of rhetorical awareness of how arguments are shaped in digital environments and technical skills required to change the technology can help heat mapping tools reach a broader audience. The use of topology in this case reveals that while we have a strong start in helping define and compare heat risks across contexts, we have a long way to go in ensuring that those metrics are meaningful to a range of people who might use them to understand the risk that extreme heat poses to health and wellness.

Strengthening heat risk communication is one challenge of many that are likely to come about as a result of a warming planet. How we talk about and visualize these risks will matter in the short term, but also for many years to come. Ensuring that our communication designs are robust, layered, and draw on multiple types of data that center the human experience is key if we are to help keep our communities safe.

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Are Academia and Industry Listening to Each Other? A Citation Analysis of UX Research Methods Resources

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ABSTRACT
Technical and Professional Communication (TPC) has been facing concerns of viability, in both its relationship with industry and its ability to build a relevant and valid body of research. TPC's disconnection with industry may be reflected in its relationship to UX as well, despite both fields' shared values. To better understand how TPC and User Experience (UX) are relating to each other, we conducted a citation analysis of a sample of SIGDOC papers and a sample of Nielsen Norman Group (NN/g) practitioner articles focused on research methods. The SIGDOC papers tended to cite TPC sources, while the NN/g articles cited no TPC, but did cite disciplines such as HCI and Psychology. The findings point to opportunities for TPC to improve its connection and influence beyond academia.

CCS Concepts
Human-Centered Computing

Keywords
User experience, Industry, Research methods, Citation analysis

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INTRODUCTION
Technical and Professional Communication (TPC) and User Experience (UX) have a long and shared history together, going back to at least the 1970's (Redish, 2010). However, surveying the current landscape, TPC and UX behave more like distant neighbors who only say hello during meetings of chance, rather than family who live under the same roof and speak with each other regularly.

Yet, TPC and UX have much to gain from each other. After all, these are two fields which both place a lot of focus on users, usability, and design. As Lanius et al. (2021) wrote, "Technical communicators, who perennially face new technologies and domains, are better able to adapt to new situations when they are aware of what UX research tools are both available and supported by the larger community" (p. 351). And, a reintegration of these areas could be one step toward mending the heavily documented rift between academia and industry found within TPC, where academics and practitioners, for various reasons, tend to speak primarily to their own respective audiences, leaving little room for collaboration from the other side (Blakeslee & Spilka, 2004).

Recent research has found that, unfortunately, "the notion that UX could be a bridge for TPC is not likely" (Friess & Liles, 2023, p. 349). These scholars' analysis of usability/UX content in the five major TPC journals showed that UX is not a core part of TPC's identity. However, there is still hope: we argue that UX is an avenue for TPC to gain relevancy to other disciplines and to industry—we just have to look in the right places.

As authors of this article, we (a TPC professor and a UX specialist/product analyst) have a common interest in sharing insights across academia and industry, TPC and UX. We began this project with the overarching question, "Are academia and industry listening to each other?" We had the anecdotal knowledge that they were not, but wanted more solid data to help quantify and understand the extent to which they were not. We believe zooming in on the academic-industry divide within UX can help bring some new insights to the field of TPC. In this article, we aim to do just that, by taking a closer look at UX articles published in both an academic TPC source and

a practitioner UX source, and analyzing citations to find areas of overlap and disconnect. With stronger ties to UX, academic research in the TPC space can be fortified, while technical communication practitioners can become more effective in their jobs.

LITERATURE REVIEW

Since the early days of the TPC field, there have been concerns about its viability (e.g., Savage, 2003). Though the field is now more established, concerns remain. In this literature review, we will address the larger question of the viability of the TPC field through two academic conversations: 1) the divide between the academy and industry, and 2) the quality of academic research in the field. Then, we will examine each of those two conversations within the specific context of UX. Though UX is an interdisciplinary field in itself, many TPC practitioners and researchers have used UX principles in their work and research, so we focus primarily on where TPC and UX research overlap. Finally, we will explain the questions that remain and how our citation analysis helps to answer some of them.

Viability of the TPC Field

In 2009, Carolyn Rude argued that having a shared identity is important for a field to grow and to demonstrate its value to outsiders. She analyzed books published in TPC to map the research questions of the field. She found significant coherence in questions, despite the seeming diversity of topics that researchers explored. "Practice" was one of four categories of research questions that TPC researchers have taken up. She noted that the relationship between industry and academia, "though sometimes uneasy, is critical because the need to provide useful information on complex processes and technology explains the field's origins and growth" (2009, p. 188). Yet, academics have limited access to workplace sites where they could conduct studies that directly benefit practice. Rude noted that practitioner and academic research both have a place, and TPC research should establish workplace best practices and also contribute value beyond the field. However, "we have not articulated very well to others our contributions to the world's knowledge. A shared sense of our common goals in research could contribute to the field's visibility, identity, status, and sustainability" (p. 207).

Six years later, Rude (2015) reasserted that research helps a field understand itself and convey its value to a wider community. Rude pointed out that the TPC field pursues both exploratory research and practice-based research. Practitioners can define problems that research can answer, and academics can conduct research to find those answers and thereby improve practice. Yet, as early as the 1990s, the TPC field seemed to favor more exploratory or boundary-pushing research rather than research that directly benefited the workplace. While the field needs both exploratory and practice-based research, these types of research "seem to exist in different spheres, as though two conversations are taking place that have little to do with each other" (p. 373). There are several logistical reasons for this gap, including access to workplace research sites and confidentiality of workplace data. Yet, as a field, TPC should work to address these barriers to embody the reciprocity that is so important for a field's identity and value.

Collaborating with practitioners and responding to their needs is a missed opportunity for academic researchers in the field, because, as St.Amant and Melonçon (2016) have argued, practitioners do see value in academic research. The authors conducted 30 asynchronous interviews with practitioners and found that practitioners need research especially to understand human behavior and to support their workplace practices. There is topical common ground here that academic researchers can build upon. Yet, even when the research questions are relevant, there is a lack of collaboration. In the next section, we will describe the larger academic/industry divide in which this research rift is situated.

Academic/industry divide in TPC

The TPC discipline has long been upheld by both academics and practitioners, though the rift between academia and industry is a continuing conversation in the TPC space. This rift requires more evaluation, research, and improvement.

Like Rude, scholars Blakeslee and Spilka (2004) wrote of a strained relationship between academy and industry throughout TPC's decades-long history as a discipline. The authors argue for a reciprocal relationship in which practice informs academic research, and academic research influences practice. However, they observed that practitioners find much academic research irrelevant to the workplace, while academics are overly concerned with the lack of theoretical foundation in industry. Even when academics do produce useful research, it is often published in academic venues inaccessible to practitioners. There are other reasons for this rift: academics may not feel their input or involvement is welcome by practitioners, or practitioners may be concerned about proprietary data or productivity.

The rift between academia and industry had been speculated upon for years, but the full extent of it and its contributing factors had not been empirically assessed. Boettger et al. (2014) conducted a content analysis on a random sample of 348 articles published between 1996 and 2013 in four leading TPC academic journals and one publication for TPC practitioners, *Intercom*. Through this initial attempt at mapping out the divide, they concluded that the rift exists mainly due to differences in audience and focus. Academics primarily target other academics, placing more of a focus on product and education-oriented material, while practitioners primarily target other practitioners, placing more of a focus on process-oriented material. With both sides primarily talking to those in their own camp, this rift developed organically over the years.

Boettger and Friess (2016) built upon these findings in a later study by more thoroughly analyzing the content misalignment between academics and practitioners. TPC academics were found to publish more content around pedagogy, rhetoric, assessment, comprehension, and research design, while TPC practitioners were found to publish more content around professionalization, technology, editing, and style. Friess & Boettger (2021) furthered these findings in an academic journal/trade journal comparison, concluding that academics focus more on rhetorical theory, whereas practitioners focus more on process and professionalization. Across these studies, some content overlap was found between academia and industry in topics revolving around process, communication strategies, and collaboration, though on the whole, academics and practitioners diverge in their interests and areas of focus.

To better understand this divergence from a systematic perspective, we must also look at some of the publishing channels of both academics and practitioners. Hannah and Lam (2016) found that TPC practitioners tend to disseminate information to their audience differently than academics do. While academics rely heavily on publishing in academic journals and conferences, practitioners conduct much of their conversation with their peers informally through blogs. Additionally, practitioners tend to post mainly non-research styled blogs, almost exclusively citing themselves and other practitioner sources within these blogs. From these findings, one would presume that practitioners are more interested in engaging in

informal conversation and discussion about TPC, whereas academics are more interested in analyzing and building upon the body of TPC research itself. This is unsurprising, since practitioners are often evaluated based on results in the time-crunched workplace, while academics' tenure and promotion is often contingent on formal publication in peer-reviewed outlets. It is clear that we can add these systemic factors to the list of reasons for the rift, along with differences in audience, perception, and content focus.

Another contributor to the rift is the way that academics communicate research implications. Echoing Blakeslee and Spilka's (2004) observations regarding the perception of practitioners towards academics, practitioners in St.Amant and Melonçon's (2016) interview study wanted academic researchers to better understand practitioners' constraints and needs as an audience. Practitioners have little time to glean applications from long or "esoteric" research studies. The authors proposed preparing "parallel reports" for each audience in different venues and calling out practitioner takeaways more explicitly, as the journals *Technical Communication* and *IEEE Transactions on Professional Communication* do.[1]

Andersen and Hackos (2021) add more nuance to the topic of academic and industry perceptions of one another. While Blakeslee and Spilka suggested in 2004 that some practitioners think academic articles lack utility and application for them in the workplace, Andersen and Hackos here provide evidence of the contrary. Through their research, they conclude that practitioners do in fact find academic research article topics relevant to them; however, the implications of these articles aren't communicated clearly enough to be useful to them. Perhaps, if workplace implications of academic articles were made clearer, much like St.Amant and Melonçon's (2016) study proposes, practitioners would seek out academic articles more.

With differing audiences, foci, perceptions, publishing needs, distribution channels, and preferred ways of communicating, the academic-industry divide in TPC is understandable, but requires resolution to boost the validity of the TPC field as a whole. Yet another threat to the field's validity is the quality of its research.

Quality of research in TPC

Research, according to St.Amant and Melonçon (2016), "can serve as a mechanism through which the two sides [academics and practitioners] can come together, share ideas, and collaborate" (p. 347). It stands to reason, then, that lack of common research questions and consistent methods further disunifies the field.

One way to define a discipline is by its research—the questions that motivate the research (Rude, 2009), as well as the methods, or "approach used to gather research data," that answer those questions (Melonçon & St.Amant, 2018, p. 4). TPC research approaches are eclectic, often borrowed and adapted from other fields. While this flexibility and variety can be a strength, it could also suggest a lack of common vision of what TPC research should accomplish.

Several researchers have noted, in TPC research, disconnects between method and findings, inconsistent definitions of research terminology, and vague articulation of procedures. Rickly and Cargile Cook (2017) helped explain why writing up research can be so challenging, especially for novice researchers:

> Our language must be precise, accurate, situated, appropriate, and considered, whether it be about our theory, our methods, our participants, or our findings. Yet, because our work is embedded in a multiplicity of places, times, and contexts, clear articulation of research methods and goals is challenging. Even arriving at specific definitions for research concepts is difficult (p. 120).

There seems to be an inherent paradox that research methods are written up neatly and linearly in published articles, while real research contexts are messy and unpredictable. Nevertheless, without transparency and detail, future researchers are left unable to plan their own studies and build meaningfully on prior work.

Lam and Boettger (2017) analyzed 118 studies across five major TPC journals over five years, and found that 43.4% of these methods are not RAD (replicable, aggregable, and data-driven), making them essentially "one-off" studies. Similarly, Melonçon and St.Amant (2018), also examining TPC studies from five journals over five years, found that only 37% of studies used empirical methods, empirical meaning "research that carefully describes and/or measures observable phenomena in a systematic way that has been planned in advance of the observation'' (Macnealy, as cited in Melonçon & St.Amant 2018, p. 3).

As a result, regardless of the specific method used, non-replicable, loosely-defined research results in less trustworthy findings, limiting the field's ability to build a trusted body of knowledge. While these issues are certainly not unique to TPC, if the field's findings are to be taken up more broadly, it is especially important to be transparent (Rickly & Cargile Cook, 2017), sustainable (Melonçon & St.Amant, 2018) and replicable (Lam & Boettger, 2017).

UX is an especially promising area for the academic field of TPC to strengthen both its connection with industry and the quality of its methods, especially as communication situations grow more complex. As Lanius et al. (2021) noted, "Within the field of TC, more consistent engagement with UX methods would benefit students and professionals as we all adapt to new technologies and complicated situations" (p. 369). In the next section, we will discuss how the academic/industry divide in TPC in general is reflected in UX, and how the quality of UX research methods within TPC poses both a weakness and an opportunity.

UX in TPC

UX in TPC academic/industry relationship

With both TPC and UX placing an emphasis on users, design, and usability, the overlap of knowledge areas, skills, and competencies is clear. Throughout the past couple of decades, there have been many examples of technical communicators influencing UX, as well as UX specialists influencing TPC (Redish, 2010). However, over the years, TPC and UX have increasingly separated, to a point where some doubt that reintegration is possible.

Redish and Barnum (2011) described TPC and UX as living in two different worlds, a relationship akin to "distant cousins, whom we occasionally see at family reunions… but then return to our separate and distinct homes and continue on with our work as before" (p. 100). While the familial history is real between the two disciplines, new challenges make it increasingly difficult for the two disciplines to come together. As the authors describe, one of the main challenges is that "the UX community doesn't present or publish much by or about the work that technical communicators

1 Likewise, *Communication Design Quarterly* has recently added a Field Perspectives and Industry Insights column.

are doing in the UX arena" (p. 100). Even though UX work is being conducted in the TPC space, this research isn't actively sought out or tied back into the UX community, leaving these fields increasingly separate. While Redish and Barnum's article was published over ten years ago, these findings still resonate today, if not more so.

While the UX field could cite more TPC work, TPC could also stand to develop its connections to UX more. Boettger and Friess (2020) conducted a quantitative content analysis on 672 articles from the top five TPC academic journals from 1996-2017, and found that the topics of UX and usability appear significantly less than expected, considering that technical communicators have become increasingly involved throughout all stages of a product or project lifecycle. As discussed above, Friess and Boettger (2021) then investigated the industry side of the equation, conducting a content analysis on the leading TPC industry magazine, *Intercom*, and comparing it to the top five leading academic TPC journals. Here again, they found similar results: UX and usability articles were far less frequently published in both the industry and academic sources compared to other article topics.

Along those lines, through a content analysis of articles from 1996-2022, Friess and Liles (2023) narrowed in on the proportion of usability/UX content in the five major TPC journals. With less than 8% of the total publications being tied to UX, they concluded that UX is not central to the TPC field's identity, nor has it ever been.

The above studies suggest that TPC has ceded its expertise of UX to other disciplines. But which disciplines have staked their claim on the UX body of knowledge? Luther et al.'s (2020) study has provided an answer. Conducting a bibliometric analysis on the body of UX scholarly research from 1983 to 2019 using citation analyses, co-citation analyses, and content analyses, the authors found that the majority of UX publications stem from Psychology and Computer Science. The two journals with the most UX articles are positioned squarely at the intersection of Psychology and Computer Science: *Computers in Human Behavior* and the *International Journal of Human-Computer Studies*.

While this finding confirms that UX is indeed an interdisciplinary field with certain disciplines it has greater connections to, it does raise the question of why TPC isn't one of these main disciplines. These findings become more important when we consider that Psychology and Computer Science tend to have stronger ties to industry than TPC does. There are multiple reasons for this. Technical Communication programs have often been inside of English departments, which are conceptually quite distant from Psychology and Computer Science departments, which is where more applied and technical researchers can be found. Additionally, the tech industry frequently hires professionals trained in human factors and empirical psychological research methods for UX roles (Redish & Barnum, 2011). With the relationship between industry and Psychology/HCI going many years back, people and professional organizations (e.g., SIGCHI or Special Interest Group on Human-Computer Interaction) are far more established with one another, which only further adds to why TPC scholars typically aren't in the same room as the industry professionals.

Another contributor to the TPC/UX divide is that the UX field has begun to mature and develop into a thriving field of its own, complete with its own methods, career paths, and active communities (Rose & Schreiber, 2021). Additionally, Sauer (2018) argued that while the integration of UX and usability into TPC seemed rapid at first, "numerous implications of these paradigms have still not been fully integrated into our field's theory, academic programs, or systems of publishing and assessing digital scholarship" (p. 362). For one, UX projects often involve continuous improvement over time, while scholarly publications tend to prioritize the new.

Nevertheless, Rose and Tenenberg (2017) said that "UX is now seen by many as the future of technical communication" (p. 90), and conscious steps on the part of the TPC community are necessary to fortify and evolve the relationship between the two.

UX research

Just as a field's research is central to its identity and relevance as a field, the TPC field's research on UX is central to our relevance to UX practitioners. The interdisciplinary field of UX is still considered relatively young, even in relation to TPC, and thus has faced many of the same challenges of any newer, less-defined field.

It is useful to examine what general surveys of academic UX research have shown. In 2011 Bargas-Avila and Hornbæk (2011) studied how researchers across disciplines have advanced the UX field through empirical research. They searched the term "user experience" in academic databases and ultimately narrowed to 66 full-text empirical studies that refer to UX as a new movement in contrast to traditional views of usability. They found that UX research drew upon multiple methods (mostly questionnaires, followed by interviews and observations) and multiple methodological approaches (mostly qualitative, followed by quantitative and mixed), though UX research did show an increase in qualitative approaches compared to earlier usability-focused studies. Further, UX studies tended to emphasize either uniqueness (qualitative) or generalizability (quantitative) through their research approach, rather than combining those approaches. Even studies that claimed the importance of rich context tended not to describe the contexts fully.

That being said, Bargas-Avila and Hornbæk's study was from 2011 and didn't examine practitioner methods, so it provides only a partial picture of the state of UX research. Six years later, Robinson et al. (2017) conducted a content analysis of 431 academic articles about UX over 16 years to help TPC researchers understand how UX research has evolved over time and to identify opportunities to strengthen research practices within the field. They tracked methods, artifacts, research questions, and change over time. They found that researchers borrowed methods from multiple fields. Usability was the most commonly used method, followed by surveys and interviews. The use of usability methods in user experience studies could suggest a lingering ambiguity about how UX differs from usability. Furthermore, these methods most used in academic studies did not align with what other research has shown about the methods most used in industry: "observations, think aloud, contextual inquiry, interviews, and experience prototyping" (Alves et al. (2014) as cited in Robinson et al. 2017, p. 19).

Additionally, most of the studies Robinson et al. (2017) analyzed did not have clearly articulated research questions, leading to difficulty in tracking the field's research trajectory. And, past the period Bargas-Avila and Hornbæk (2011) studied, quantitative and mixed methods increased, which could mean that the field is moving past the quantitative/qualitative dichotomy noted in the 2011 study, and/or that multiple methods are needed to capture the complexity of user experience.

Ultimately, the 2017 study pointed to problems in the UX academic field that mirror problems in the TPC academic field more generally:

a lack of reciprocity between academia and industry, and an inability to build a coherent research agenda for the field, whether via unclear reporting of methods or lack of research questions.

Lanius et al. (2021) took up the question again, this time reviewing academic UX studies from 2016-2018 and surveying 52 UX researchers in both academia and industry. Surveys, usability testing, and interviews remained the top three methods used in published UX research, while the survey respondents rated expert review, ethnography, and data capture among their top methods.

The 2021 study focused on academic and practitioner UX research in general, rather than narrowing in on research that the TPC field has published about UX. Melonçon & St.Amant's (2018) analysis of research studies in the TPC field shed light on that subset of research, and found that, concerningly, TPC academic research on UX and usability reflects some of the weaknesses of research in the field as a whole. TPC researchers tended not to describe their methods in replicable ways. The authors note, "TPC researchers seem to make assumptions that when they use the phrase 'usability testing' that all readers and other researchers will know exactly what they are talking about" (p. 143) though the usability studies were quite varied. To be fair, academics in other fields also struggle to provide methodological detail in UX studies (Bargas-Avila & Hornbæk, 2011), so this presents an opportunity for TPC to stand out in terms of the quality of its UX research.

Lanius et al. (2021), citing Chong (2016), pointed out that TPC textbooks and other foundational works also focus little on UX and usability, to say nothing of rigorous and replicable research methods for same. They find this concerning because "TC and UX are allied academic and professional practices where a closer connection, especially due to the shared values of both, would allow more meaningful advocacy for users" (p. 352).

Overall, the literature shows that TPC research is not well represented or referenced in the interdisciplinary field of UX. For TPC's part, academics have not meaningfully engaged UX topics even in their own literature, despite the natural connections between the areas. When they do, they tend not to explain their methods in ways that allow the field to build a sense of identity and a body of knowledge.

We see the UX/TPC rift as a microcosm of the larger industry/academia rift that threatens TPC's validity as a field; yet for that reason, it also represents a promising space to investigate and ultimately mend the rift.

METHODS

Research Questions

As the literature review has shown, TPC academics have used multiple methods to illuminate the industry/academia divide. Fewer studies have focused on the UX/TPC divide, especially as it pertains to research methods. Further, much of the "state of the field" research in TPC has focused on the same major academic journals. While study of these same, established venues allows for better comparison over time, this focus overlooks newer venues that have been intentional about reaching both a practitioner and academic audience, and that have named UX as an important focus, namely: SIGDOC (Special Interest Group on the Design of Communication).[2]

Therefore, we chose to view the industry-academic divide through a citation analysis of both academic (SIGDOC) and practitioner (Nielsen Norman Group, NN/g) resources about UX methods. These are just two repositories and neither is fully representative of the "academic" and "industry" perspective; however, this comparison adds an additional layer to the academic-industry divide echoed in so much prior research. We were interested in just how much each set of resources was referencing the other, or "listening to each other," and from which disciplines they drew from. We asked:

- In general, what content alignment is there between an academic sample of UX papers and a practitioner sample of UX articles?
- How common are citations within research methods materials in the academic and industry samples?
- Are TPC academic sources citing mostly other academic sources or practitioner sources? From which disciplines?
- Are UX practitioner sources citing mostly academic sources or other practitioner sources? From which disciplines?

Ultimately, we wanted to know whether the answers to those questions point to opportunities for the TPC field to increase in validity and relevance.

Data Collection

Because we are interested in how much academic and practitioner sources listen to each other, we collected a sample of articles from each group. The academic sample consists of SIGDOC conference papers about UX, and the practitioner sample consists of NN/g articles about UX research methods.

The samples do not represent a one-to-one match, since SIGDOC is interdisciplinary,[3] and UX is only one of its focuses; meanwhile, NN/g is fully UX. A future study could compare academic-industry samples whose disciplinarity identities are more closely matched, such as UXPA and NN/g, or SIGDOC and techwhirl.com.

That being said, the two samples do allow us to recognize general areas of overlap and difference. We chose a 5-year span (2018-2022) to gather a large enough sample for meaningful trends. We went through 2022, the last full year's worth of publications we had access to at the time of analysis.

We stored the articles or links in a shared folder and used a spreadsheet to track each source and the items that best speak to the research questions (see Data Analysis below for details).

Academic sample

One way to zoom in on how TPC researchers are approaching UX is to study newer forums than the five major journals typically covered in TPC content analyses or "state of the field" studies (e.g., Boettger & Friess, 2020): *Technical Communication, Technical Communication Quarterly, Journal of Technical Writing and Communication, IEEE Transactions on Professional Communication,* and *Journal of Business and Technical Communication*. Though these forums are valuable to study repeatedly in order to make comparisons over time, that approach leaves out newer forums such as SIGDOC's publications: the journal *Communication Design Quarterly* and the annual *Proceedings of the ACM International Conference on the Design of Communication* (or "*Proceedings*").

2 SIGDOC falls under the umbrella organization ACM, the Association for Computing Machinery.

3 Despite its interdisciplinary label, most SIGDOC authors are academics from English Departments, based on an informal analysis of authorship of the 2021 and 2022 papers.

A focus on conference papers rather than journal articles allows us to capture some of the more in-process and forward-looking research that scholars are doing. Indeed, as Turner (2022) noted, conference presentations tend to be studied less formally, though "investigating a corpus of conference programs [likewise, conference proceedings] could provide a baseline to … identify patterns of scholarship within these organizational conversations" (p. 404).

Another reason to analyze SIGDOC publications is because SIGDOC, in its mission as stated on its homepage (S*IGDOC,* 2023), directly names TPC and UX as relevant fields. If we see these two as "allied fields" (Lanius et al., 2021), then it makes sense to deeply analyze a forum that acknowledges their relationship, going so far as to publish a special issue on "rethinking usability and UX" in 2017. Meanwhile, as Friess and Liles' (2023) analysis of articles published in the aforementioned five TPC journals over 20+ years showed, only 7.1% of them dealt with usability/UX as their primary topic.

According to its website, SIGDOC provides a forum for "researchers, teachers, and practitioners" of relevant fields (*SIGDOC*, 2023), which shows that the organization sees practitioners as part of its audience. The organization was created to focus on documentation in 1975 and published its first *Proceedings* in 1982. In 2003, it broadened to focus on design of communication more generally (Potts, 2013) and in 2013 published the first issue of *Communication Design Quarterly*. The *Proceedings* publish research papers as well as other genres including Industry Insights, and *CDQ* recently added a "Field Insights and Industry Perspectives" column, showing a commitment to including practitioners in the conversation.

To locate the SIGDOC papers about User Experience, we searched the *Proceedings* for the terms "user experience" or "UX" and, out of a total 255 papers from 2018-2022, found 123 papers that included either term anywhere in the paper (or 48%). We narrowed those to the most UX-focused papers by selecting only those that included "user experience" or "UX" in the title, abstract, or keywords. This resulted in a final sample of 77/255 papers, or 30%.[4]

Practitioner sample

For the practitioner sample, we chose a leading source in the UX practitioner community. There have been several TPC content analyses that use *Intercom* magazine (e.g., Boettger et al., 2014; Friess & Boettger, 2021) or TPC practitioner blogs (e.g., Hannah & Lam, 2016) as the primary practitioner source. However, those practitioner resources addressed mainly TPC, while we wanted to investigate a mainly UX resource, regardless of originating discipline. This would allow us to see what other fields' research, including TPC, influences UX practitioners. Additionally, examining the content published by a mainly UX-centered source should in theory provide a clearer idea of what topics and methods the UX industry is most interested in.

For these reasons, we decided to analyze articles published by Nielsen Norman Group (NN/g), one of the leading UX research and consulting firms that publishes mainly UX design and usability articles for practitioners. NN/g was started in 1998 by Don Norman and Jakob Nielsen, two of the main founders of the principles that have helped shape and define the field of UX today. Since the agency's inception, "NN/g principles [have] pioneered many of the UX research methods which have now become the standard best practices" (*Nielsen Norman Group*, n.d.). Today, NN/g continues to conduct research with practical applications, often reporting their findings in articles published on their website. With its strong reputation in the field and large following of UX specialists, NN/g provides a great representation of current UX methods, topics, and future of the field.

Examining only NN/g does limit us from gaining a full picture of UX practitioner sources, especially since NN/g may be an outlier in its connection to academia. Indeed, its namesakes both hold PhDs, Nielsen in HCI and Norman in Psychology. Future studies should aim to analyze other UX practitioner sources and mediums, such as reputable blogs (UX Collective, XD Ideas, etc.), as well as magazines (*Smashing Magazine*, *UX Magazine*, etc.), podcasts, and videos.

NN/g utilizes a categorized and searchable archival system of articles on its website, lending itself well to data collection for content analysis. The NN/g resource library is extensive, so, to filter our search, we only collected articles under the "Research Methods" category on the NN/g website, given that one of our concerns as mentioned in the literature review is quality of research methods. This filtering resulted in 76 NN/g articles for analysis. To better match the samples topically, initially, we searched for SIGDOC papers that addressed both UX/user experience AND research methods as key topics; however, there were so few that it would not make for a meaningful analysis.[5] Therefore, we kept our academic analysis focused on the methods sections of the UX papers, under the assumption that a reader looking for research methods guidance would look to the methods section.

Data Analysis

Because we are interested in the extent to which academic and industry sources reference each other, a content analysis was best suited for our study. To answer our first question about general content alignment between the samples, we ran a basic word frequency analysis of paper titles.

Then, we conducted a citation analysis, which we consider a type of content analysis because it involves inductively categorizing content, in our case, citations. Following Smith's (Smith, 2000a, 2000b) citation analyses of TPC journals, we listed out the relevant citations within each paper or article.

Again, because we are interested in research quality in particular, we selected citations based on relevance to research methods. The NN/g articles were already focused on research methods, but for the SIGDOC papers, we considered where an academic or practitioner may look for methods guidance: the methods section. This filtering yielded 177 citations from the SIGDOC sample and 105 citations from the NN/g sample, for a total of 282 citations to be coded. We defined "citation" as any reference to another source, whether via a formal in-text citation (as with the SIGDOC papers) or a hyperlink embedded within the article (as with the NN/g articles). It should be noted that these samples are not perfectly parallel, and are not meant to be. The citation analysis does reveal general areas of overlap and difference in terms of the types and disciplines of sources referenced, thereby helping to address our overarching concern of whether academic sources and practitioner sources are "listening" to each other, and to what extent.

4 Interestingly, we did note a steady decline in the percentage of UX-focused papers in each year of the *Proceedings*, from 34% in 2018 down to 21% in 2022, but the significance and reasons for that trend, if any, are best explored in a different project.

5 The lack of papers intersecting these topics points to a gap in content for SIGDOC; the 2023 conference helped to address that gap with its theme of research methods.

We coded each citation in two main ways: by "Source Type" or whether it was a scholarly, practitioner, or "other" source (such as a website or government source) that was being cited; and by "Discipline." Additionally, we tracked the years of each article, and in the academic sample we tracked the type of SIGDOC submission (poster abstract, research paper, etc.) in case these features correlated with citation frequency, type, or discipline. Submission type did not require a coding process because this was self-evident in the Table of Contents of each year of the *Proceedings*.

For intercoder reliability, we independently conducted three rounds of coding on approximately 20% of the citations per round. After each round, we discussed discrepancies and refined the codebook, and ultimately achieved 89% agreement on Source Type and 82% agreement on Discipline. The Discipline coding was harder to reach agreement on given there were at least 10 codes to select from versus 3 for the Source Type (see Figure 4 for the codes). We then used the refined codebook to individually code the remaining citations within either the academic or the practitioner sample.

As an example of how we refined our codebook, we had to clarify the definition of an "academic" citation. While peer-reviewed journals are relatively simple to identify as academic sources, books were often more ambiguous. In those cases, we looked to a number of criteria to make the final determination, such as whether an academic audience is explicitly stated in introductory or summary material for the source, or whether the authors are academics. Similarly, we coded something as a practitioner source if its stated audience was practitioners such as technical communicators or UX specialists. For the Source Type codebook, see Appendix A.

Likewise, identifying the discipline of each academic citation was not always clear-cut and required an inductive approach. For example, for a journal article, we defined discipline by looking at the journal's overarching domain, rather than the article content. We started by using each journal's own terminology for its discipline, but the length of the resulting list required us to group similar disciplines to make meaningful comparisons. For example, disciplines like "HCI," "ergonomics," and "human factors" we grouped under the code "HCI." "User experience," "usability," and "user-centered design" we grouped under "UX." We used TPC as a category because we are specifically interested in the TPC/UX relationship. We coded as "interdisciplinary" any journal that explicitly identified itself as interdisciplinary around a specific topic (such as big data or Indigenous studies). We also used "Qualitative Research" as a category, because several works specifically named qualitative researchers, regardless of discipline, as their audience. For an excerpt of the Discipline codebook, see Appendix B.

RESULTS

In this section, we will first provide general description of the papers in both the academic sample and practitioner sample to provide more context for the citation analysis. Then, we share the results of the citation analysis by each sample, starting with the breakdown of citation type.

Content Analysis

In general, what content alignment is there between an academic sample of UX papers and a practitioner sample of articles?

As mentioned above, these samples are not to be considered a one-to-one match of each other, given the inherent differences in audience and purpose. For instance, a methods section portrays "what we did" while a practitioner article generally portrays "what you do." In fact, the differences in each sample will provide some preliminary insight into why academic sources are not taken up more by practitioners, and vice versa. While each venue is valuable in its own right for its own audience, if the TPC academic field is committed to connecting with industry, these discrepancies could point to opportunities to broaden their reach.

To get a general sense of the topics each set of papers addressed, we ran a basic word frequency analysis of the titles using the WordItOut platform. See Figure 1 for the word cloud of SIGDOC paper titles and Figure 2 for the NN/g article titles. The word clouds display all phrases that appeared 3 or more times across the titles (minus stop words), with the size of the phrase correlating with the frequency. "UX" and "user experience" were the most frequent in both samples, so they were excluded from the word clouds to better display distinctions between other phrases.

Figure 1: Frequencies of words in SIGDOC paper titles

Figure 2: Frequencies of words in NN/g article titles

How common are citations within research methods materials in the SIGDOC and NN/g samples?

The literature review established that clearly-described, research-backed methods are essential for building a trustworthy body of knowledge; therefore, we gathered a general picture of how common methods sections were in the SIGDOC papers. Of the 77 total UX-focused papers published in the *Proceedings* from 2018-

2022, 17 of the papers had no methods sections (these tended to be experience reports, case studies, or panel abstracts). Of the 59 remaining papers with methods sections, 19 included no citations in the methods section at all as seen in Figure 3. By format, 6 of the 19 were classified as research papers, with the rest being classed largely as poster abstracts or experience reports.

The papers that did include methods section cited 177 sources total within their methods sections, averaging 3.0 methods section citations per paper.

The 76 NN/g articles in our sample collectively cited 1,096 citations. However, 991 of them were "self-references," or links to other NN/g articles published on the same website, which we excluded. That left 105 citations to external resources.

Half of the NN/g articles (38/76) included at least one external reference. Those 38 papers collectively cited an average of 2.8 external resources per article.

Citation Analysis

Now we will describe the results of the citation analysis, broken down by sample.

Are TPC academic sources (SIGDOC papers) citing mostly other academic sources or practitioner sources? From which disciplines?

Of the 177 total citations in the SIGDOC papers (see Figure 4), 112 (63%) were to academic sources, 30 (17%) were to practitioner sources, and 35 (20%) were to other sources, largely webpages. For the 112 academic sources cited, 40 (36%) fell within the TPC discipline, 17 (15%) were published in interdisciplinary venues, 16 were to HCI sources, 10 to Writing Studies, and 9 to Qualitative Research. The disciplines of Education, UX, Sociology, and Psychology yielded 2-4 citations each and the remaining disciplines ("Other") totaled 8 citations.

Are UX practitioner sources (NN/g articles) citing mostly academic sources or other practitioner sources? From which disciplines?

Of the 105 total external citations in the NN/g articles, 40 (38%) were to academic sources, 33 (31%) were to practitioner sources, and 32 were to other sources (31%). For the 40 academic sources cited, 10 (25%) fell within the HCI category, 10 (25%) in Psychology, 5 (13%) in Qualitative Research, and 4 (10%) were interdisciplinary. There were 11 disciplines with only 1 citation each, such as Medicine, Anthropology, and Business. These we grouped into the "Other" category (28%) (see Figure 5).

DISCUSSION AND RECOMMENDATIONS

General distinctions between samples

The results of the general content analysis point to several notable contrasts. We went into the analysis recognizing that the samples were quite distinct to begin with, given the inherent differences in audience and purpose. SIGDOC names researchers, teachers, and practitioners as its audience. The *Proceedings* and back issues of *CDQ* are housed within the ACM digital library. Many academics will have access through their university library's subscriptions, but many practitioners will not. Peer-reviewed publication is a requirement for tenure and promotion for academics, which will drive academics to publish in venues that are likely paywalled.

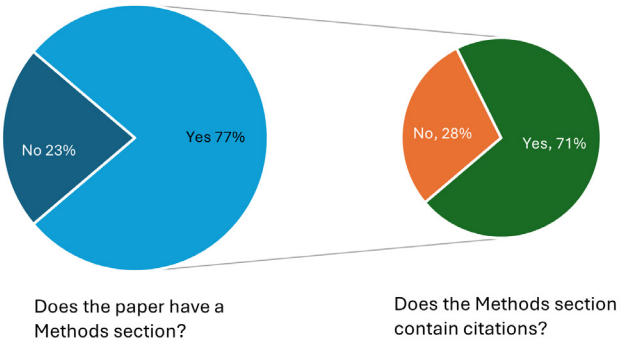

Figure 3: Methods sections in SIGDOC papers

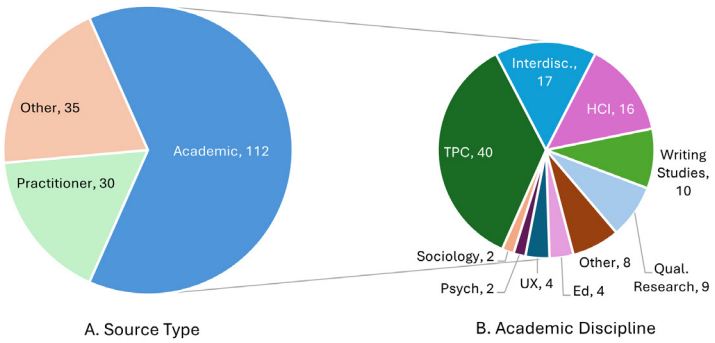

Figure 4: Academic sample citation breakdown

NN/g articles, meanwhile, are fully accessible on the web. NN/g is ultimately a corporation that makes its money through UX consulting and training. Their extensive free resource library helps cement the brand's reputation and draws in new customers. Their self-promotional approach is made clear in our finding that 90% of its citations were to itself. This does not mean that NN/g is not still a quality resource, but it does mean that the topics and content are driven to some extent by commercial interests. Anecdotally, many TPC instructors agree NN/g is a valuable classroom resource, so both current and future practitioners are likely to encounter it due to its accessibility and convenience.

The word clouds reveal contrasts in topic. For one, the SIGDOC word cloud features more words than the NN/g word cloud, suggesting that SIGDOC articles range more broadly topic-wise. The most-frequent words in both word clouds were rather general, but going down the list, the least frequent words in the SIGDOC word cloud were quite specific, such as "older adults," "queer," and "games," as compared to more generic words like "projects," "tasks," and "questions" in the NN/G word cloud. This is understandable, given that SIGDOC articles are reports of specific studies or cases, while the NN/g articles are presented as advice that readers can use across a wide range of contexts.

SIGDOC is just one example of an academic publication, and NN/g is just one example of a practitioner resource. Our limited analysis does not allow us to generalize to "academia" and "industry," and indeed no analysis could. However, in combination with what we know about expectations of academic and practitioner sources from the literature review, our analysis allows us to make some recommendations for TPC academics.

Rigorously designed and reported research is valuable to academics building a body of knowledge within their field. However, it is not in and of itself valuable or applicable to practitioners who need to quickly adapt methods to their own contexts. Academic articles, with their "what we did" approach, are more descriptive in terms of methods, while the practitioner articles, with their "what to do" approach, are more prescriptive. Prescriptive advice is appealing to students and practitioners who need quick guidance on designing a UX project. The nature of academic research does not allow much room for prescriptive advice, since findings and recommendations must stay closely linked to the data. Academic research in TPC can be made more applicable to practitioners, but it will require more intention on the part of academics, if they truly care about their relevance beyond their academic silos. Further, TPC academics can help fulfill a need for accessible, advice-oriented content that is not corporately biased in the way that NN/g and similar sources are.

The results also suggest that SIGDOC as an organization values research methods, given that the vast majority of the papers in our sample contained methods sections. (Those that didn't were largely formats other than research article.) And then, the majority of methods sections contained citations, showing researchers' effort to build upon previous research designs and/or to justify methodological decisions with prior research. Most of the papers that did not cite within the methods sections were, again, not research papers but other *Proceedings* formats; the lack of citation in poster abstracts and experience reports makes sense, given the idiosyncrasies of case studies and the limited space in poster abstracts. A future analysis on whether these studies are RAD (replicable, aggregable, and data-driven) would provide better insight into whether SIGDOC stands out in its emphasis on quality methods compared to other TPC journals. The 2023 conference theme of research methods further underscores the organization's value of methods.

For this study, we focused quantitatively on citations, but a future study could analyze the rhetorical functions of citations in academic and practitioner works. That could help show how and why each group engages outside sources. Content analysis of the types of methods addressed in each sample could further reveal alignments or misalignments.

Differences in source types

Expectedly, SIGDOC papers cite mostly academic sources. With 17% of methods sections citations going to practitioner sources, though, it is clear that researchers are making connections to industry work to inform their methodological choices. Opportunity exists to connect even more. Academic researchers can learn practical advice and procedures from practitioner sources and help to test them in their studies.

Less expectedly, the NN/g articles (excluding self-citations) cited more academic than practitioner or other source types, showing a more even split overall between source types. This indicates that

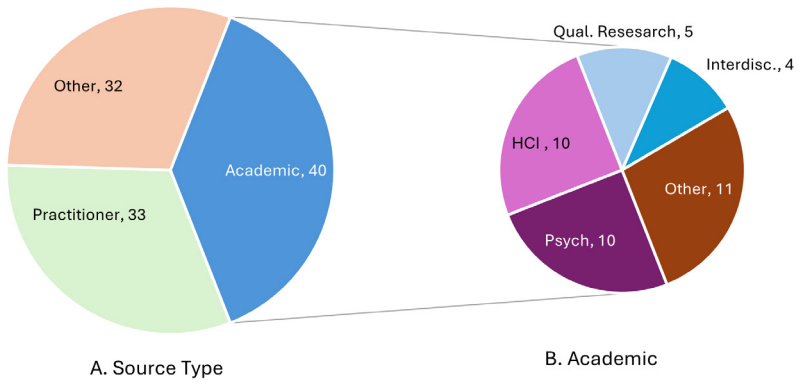

Figure 5: Practitioner sample citation breakdown

NN/g authors do rely upon academic research to support their advice to practitioners, and that practitioners may value seeing those academic foundations. As mentioned above, however, NN/g is likely unusual in its use of academic research, given its founders' academic origins. Future research should expand to a broader sample of practitioner resources. Consequently, to answer our overarching question, "Are academia and industry listening to each other?" Yes, somewhat. But industry is not listening to TPC.

Differences in academic disciplines

When we narrowed our analysis to the disciplines the academic citations were coming out of, more contrasts appeared. SIGDOC, understandably, cites most from TPC. After TPC, the SIGDOC papers most referenced Interdisciplinary, HCI, Writing Studies, and Qualitative Research sources.

For NN/g, the most cited disciplines were HCI and Psychology, suggesting where UX may feel its "home" is (or at the very least, where Nielsen's and Norman's respective homes are). HCI, Qualitative Research and Interdisciplinary all appeared with some frequency in the SIGDOC samples as well. The in-common disciplines are potential shared foundations for TPC and UX. The HCI connection to UX is already well established (Luther et al., 2020), so that may be a valuable body of research for TPC researchers to engage.

Meanwhile, the contrasts show areas for growth. The SIGDOC papers cite relatively little from Psychology, though Psychology research underlies many of the UX practitioner articles. Therefore, Psychology is another promising context in which TPC researchers may situate their UX work. Considering HCI and Psychology tend to have stronger ties with UX and industry (Luther et al., 2020), future research into why this is the case may shed light on TPC's relative absence and what opportunity may exist for the field to become a presence in the conversation.

Perhaps one of the more unfortunate findings of our study is that the NN/g articles reference no TPC sources. Indeed, TPC is a smaller discipline, but it does offer a uniquely rhetorical and contextual perspective on research methods that could benefit UX practitioners. The inherently descriptive nature of academic research means that practitioners must "read between the lines" to glean actionable advice for their own contexts. Yet, that close attunement to local context, especially that TPC values, can offer great value to practitioners. Practitioner advice is often general, leaving gaps for practitioners needing to adapt to their local contexts. Academics' specific and highly-detailed case studies could serve as examples for how and why to adapt generalized advice.

While TPC academics have long argued that TPC offers value to UX, does industry share this value? Would UX practitioners find TPC scholarship valuable if they knew more about it, or could more easily access it? Further qualitative research (surveys, interviews, etc.) should be done with UX practitioners to help determine what value they find in TPC perspectives and what steps can help close the gap. Those steps might include more academic-practitioner research collaborations, as we have modeled in the present study, and more intentional recruitment of industry authors/presenters on the part of academic organizations.

Academic publications might encourage researchers to add methodological takeaways with a practitioner audience in mind (similar to IEEE's "Practitioner Takeaways" section but with a focus on methods). Academic publications might also publish a greater range of genres that allow more flexibility and practitioner-orientation, but these genres must be open-access so that broader audiences can actually use them.

TPC researchers should also stay current with major UX resources such as NN/g, *UX Collective*, and *Smashing Magazine* and reach out to these venues when they have something to offer. Granted, that will require academic institutions to place greater value on industry outreach than many currently do.

CONCLUSION

This study's conclusions build on the work of others who have studied the academic-industry divide in TPC, such as St.Amant and Melonçon (2016) and Boettger and Friess (2016). Such studies have used interviewing and content analysis of full articles to illustrate the divide; our focus on citations as the unit of analysis points to another area where that divide can be strengthened—through the citation of others' work. As Smith (2000b) has reminded us, citations are rhetorically significant: They can reveal what authors find important, the "intertextual" conversations authors are joining, and the basis for methods. Therefore, citing represents another means for TPC researchers to connect to others beyond their own silos.

Our study shows which other disciplines may be most promising for making links to industry and where our field may be lacking. While it has been established that the UX industry has its strongest ties with Computer Science/HCI and Psychology (and our NN/g citation analysis findings support this), our citation analysis findings with SIGDOC only show TPC's connections to HCI, with very little references to Psychology. Further research into Psychology's relationship (or lack of relationship) with both UX and TPC could reveal potential avenues for TPC to broaden its presence.

Furthermore, our study, along with Friess and Liles' (2023) study, contributes a specific focus on UX within TPC publications. Friess and Liles' findings challenged the view that UX serves as a bridge between TPC academics and practitioners. Our own study finds that there is still promise for UX to serve as that bridge if in the right venue. As described in the Methods, nearly half (48%) of *Proceedings* papers mentioned UX/user experience, and 30% used UX/user experience in the title, abstract, or keywords. These figures are notably higher than the 7.1% found in the top five TPC journals (Friess & Liles, 2023).

That said, the links both between TPC and UX and between academics and practitioners should be further strengthened. As recommended above, academic TPC journals can publish new genres/formats that provide accessible advice with a busy practitioner audience in mind. Academic authors can incorporate methodological takeaways within their studies. Authors can also be mindful to draw from practitioner and non-TPC sources to inform their work, while remaining grounded in TPC's own body of knowledge and detailing methods in replicable and specific ways.

Academia needs valid, credible, detailed research to build a body of knowledge that is trustworthy and valuable beyond our own field. Yet, inaccessible publishing practices, inapplicable writing practices, and nebulous methods threaten our validity as a field in another way—by furthering the industry/academia rift. Our findings suggest that this rift persists, and that TPC could make better use of UX as a bridge to industry. There are structural reasons for the rifts that cannot be solved easily, but our study does point to some practical and concrete ways TPC academics can improve their outreach to

practitioners and expand practitioners' access to TPC scholarship. While the major TPC journals seem to have pulled up the drawbridge on UX content, SIGDOC and other venues are ripe for rebuilding these relationships.

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APPENDIX A: SOURCE TYPE CODEBOOK

Code	Guiding Criteria	Example
Academic	Primary academic audience named in introductory or summary material; written by academic; has academic publisher; reports original research or makes original contribution to the field; will typically show up in Google scholar	Flanagan, J.C. (1954). The critical incident technique. *Psychological Bulletin*, *51*(4), 327–357.
Practitioner	Primary practitioner audience (e.g., web developers, engineers, technical communicators) named in introductory or summary material; written by practitioner; can typically be found on Amazon	Barnum, C. M. (2010). *Usability Testing Essentials: Ready, Set...Test!* (1st ed.). Morgan Kaufmann.
Other	Aimed at a general audience or is otherwise not aimed primarily at an academic or practitioner audience; may be a site for news, government, social media, nonprofit org., blog, corporate website	Rocco, M. (2015, March 26). Florida's The Villages is the fastest-growing city in America. *Fox Business*. https://www.foxbusiness.com/features/floridas-the-villages-is-the-fastest-growing-city-in-america

APPENDIX B: EXCERPT FROM DISCIPLINE CODEBOOK

Code (selected)	Guiding Criteria	Example
TPC	Publication name includes technical writing, technical communication, or professional communication in title; names TPC scholars as primary audience on website or in introductory or summary material	Brumberger, E. & Lauer, C. (2015). The evolution of technical communication: An analysis of industry job postings. *Technical Communication 62*(4), 224–243.
Qualitative Research	Publication names qualitative researchers, regardless of discipline, as audience on website or in introductory or summary material	Saldaña, J. (2016.) *The Coding Manual for Qualitative Researchers*. Sage, Thousand Oaks, CA.
Interdisciplinary	Publication title, website or introductory/ summary material indicates the publication is "interdisciplinary" around a specific topic. Does not place one discipline as primary	Kennedy, H., Poell, T., & van Dijck, J. (2015). Data and agency. *Big Data & Society, 2*(2).

Commemoration and Context: The Death Counter Graphics of COVID-19

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ABSTRACT

During the first year of the COVID-19 pandemic, designers produced a number of novel data visualizations about the effects of the virus. Though many of these visualizations conveyed the current risks or actionable steps for mitigating risk, a subset of visualizations focused narrowly on depictions of total mortality. This article analyzes a set of 45 data graphics that fall into this latter group in order to unpack their rhetorical goals and to identify common design patterns. The article demonstrates that while these "death counter graphics" were rapidly produced and spread, they may have had limited value for conveying the immense scale of death during the start of the pandemic.

CCS Concepts

Human-centered computing

Keywords

Data visualization, Visual design, Scale, Emotion, Mortality, Anthropographics, COVID-19

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INTRODUCTION

> "Visualize a pizza…now imagine taking that pizza and cutting it into 8 slices. Then cut each of those slices into 8 slices. Then keep doing that once per second for 400 years. Now double that. That's approximately the number of stars in the sky"-*Comedy Bang Bang*, episode 768

The scale of large figures is notoriously challenging to communicate. Though we encounter large figures about millions of people or billions of dollars with relative frequency, most people associate these references with only a vague sense of magnitude relative to the context. We understand that a million dollars is a lot for an individual and not a lot for the U.S. deficit, but the magnitude differences between a million, a billion, and a trillion dollars is incredibly hard to conceptualize for the average person (Landy et al., 2013). It's simply too big to imagine.

This cognitive challenge became a particularly pertinent issue during the first year of the COVID-19 pandemic, as health professionals noted widespread public apathy and detachment from the grim impact of the virus (Wan & Shammas, 2020). Responding to this widespread public apathy, news publications and designers began to deploy a genre of data graphics aimed at communicating the gravity of the virus by focusing on the total death count. This subclass of mortality visualizations, which I term here as "death-counter graphics" or briefly "death-counters," is characterized by their attempts to provide some additional meaning or context to a "raw" number of deaths. The form and presentation of these graphics shifted wildly from situation to situation. Some publications produced one enormous, scrollable graphic to convey the death toll (popularly referred to as "scrollytelling"), while others peppered a standard news story with a variety of smaller tables, charts, and graphics.

A key feature of death-counter graphics is, as the name suggests, a focus on the *count*, on the "raw" number of total deaths from a particular event. The use of *total deaths* also distinguishes death-counters from other mortality visualizations that break down mortality by deaths per capita or by percentage change over time

(i.e., the "mortality rate"). In turn, death counters are not designed to help viewers track the real-time changes in the data or project acute trends into the future as we would expect to find on a public health dashboard. Instead, death counters attempt to capture tragedy from a distance, aiming to mark and illuminate an abstract sense of loss.

The function of death counter graphics—this memorializing, epideictic potential of mortality visualization—is not unique to this specific tragedy. From Florence Nightingale's use of polar-area diagrams (Brasseur, 2005) to Neil Halloran's animated histograms (2016), we can see a long historical precedent for novel mortality visualizations. But the death counter graphics produced in response to the COVID-19 pandemic offer a significant new chapter in the production of these memorial visualizations. Unlike one-off graphics produced in the past, COVID-19 death counters reflect both the rapid speed at which visualizations are now produced and the broad range of designers who produce them. Novel graphics that were carefully designed were often quickly consumed, leaving publications to create ever more novel graphics every few months to mark the next milestone of death. Additionally, COVID-19 death graphics were published not only by publications like *The New York Times* and *Reuters*, but by amateur designers armed with basic data from public dashboards and access to increasingly powerful and relatively cheap design programs.

Much like the genre of public health dashboards, death counter graphics have become a common genre of disaster visualization, but the differences in their designs have not been fully explored. By examining these graphics as a group, we can start to see trends and unique cases. In this paper, I model one way to group and analyze these graphics: their approach to comparison. Whether visually, textually, or temporally, death counter graphics almost always provide some outside reference to compare to deaths in order to make the total more tangible to a public audience. I argue that in grouping these graphics by comparison-type, we can better understand how death counter graphics leverage mortality toward different audiences and purposes. By noting these comparison types, rather than the visual design alone, designers may be able to make better choices in how to reach their intended audiences.

This article begins with a review of previous studies in technical communication that have focused on data visualizations in public health, particularly the depiction of mortality statistics in public health graphics. I also draw connections between the rhetorical function of death counter graphics and the rhetorical function of other famous memorials, given that many death counter graphics frame themselves as a kind of temporary digital memorial. I then turn to an analysis of 45 death counter graphics collected over a little over the first full year of the COVID-19 pandemic (March 2020 - November 2021). I first describe the core rhetorical functions of death counter graphics and then identify 5 different comparison-types that I found in the sample. To conclude, I point to a specific case to show how the rapid production of death counter graphics can lead to a senseless reduction of the genre to trendy disaster content.

COVID VISUALIZATION RESEARCH IN TPC

As Melonçon and Warner (2017) have argued, technical communicators can play a valuable role in the area of data visualization, particularly in relation to audience analysis and user experience. Researchers in TPC frame data graphics as essentially ideological artifacts (Barton & Barton, 1993) designed within a particular worldview to convey a message or persuade a specific audience, rather than as objective windows into the "raw" data. This ideological potential begins with the collecting and sorting of the data (Wolfe, 2015) and is expressed through the visual design itself (Kostelnick, 2008) as well as user perceptions of visualizations (Peck et al., 2019; Stephens & Richards, 2020). Researchers have also argued for a humanistic ethics of care in graphics about physical suffering and distress, including accident reports (Dragga & Voss, 2003), disease maps (Welhausen, 2015), and statistical atlases (Li, 2020).

Scholars in TPC have begun to extend these research threads and associated arguments to visualizations produced during the COVID-19 pandemic. Doan (2021) made the case that even major news publications published inaccurate and misleading visualizations that tended to downplay the seriousness of the pandemic. Lambrecht (2021) found a similar overall tendency to downplay the risk in CDC messages, suggesting that the organization was trying to avoid overly alarmist messaging in the face of ambiguous and uncertain data. TPC analyses also illuminate the ways that standard visualization processes excluded marginalized users, whether in the collection of case data (Atherton, 2021) or the lack of focus on communities that were being hit the hardest (Carlson & Gouge, 2020).

One normally generative lens for examining COVID-19 graphics is to ask whether they are actionable; that is, whether graphics are tied to specific actions that the user could take to stem the pandemic and/or avoid risk. Verhulsdonck and Shah (2021) addressed this thread by looking for actionable metrics: data that "use specific and repeatable actions that are matched to a measurable outcome" (p. 59). A visualization that uses actionable metrics would not only include data about the rise and fall of COVID infections, for example, but would pair infection rates with data about masking or social distancing. Investigating users' perceptions of COVID-19 dashboards, Sorapure (2023) found that users often defined actionability in relation to their individual needs, and many preferred a combination of composite metrics (e.g., a general risk level) along with disaggregated location and demographic data (p. 12).

But while actionability is a useful lens for many disaster visualizations, it is less applicable to death counter graphics. Death counters rarely, if ever, offer a call to action or even casually mention preventative measures such as masking or social distancing. And while some death counter graphics used dynamic datasets that were updated in real time, most focused on a specific threshold of mortality such as 100,000, 400,000, or 1 million deaths. Although death counter graphics could certainly influence public risk perceptions in an implicit, distributed way (i.e., whether COVID-19 is generally deadly or not deadly), it was not the explicit goal of these graphics. Death counter graphics are engaged in a separate rhetorical project focused on commemorating and contextualizing the singular data point of total mortality.

The unique rhetorical function of death counter graphics is raised in Zhang et al.'s (2021) analysis of 668 COVID-19 visualizations produced in the first 6 months of the pandemic. They noted that while many visualizations were designed for risk communication, there was a clear division between graphics that "mapped the trajectory of the crisis over time or the geospatial spread of the crisis" and a second, smaller group that "compared COVID-19 with historical events" (p. 6). They note that this secondary group had the unique potential to "[carry] an important message that the death

toll was not only a number—it reflected an indescribable loss of valued human life" (p. 9). It is this secondary group that constitute what I term "death counter graphics," characterized by their focus on comparisons of death totals for the purpose of providing some form of deeper context for those deaths.

DEATH COUNTER GRAPHICS AS COMMEMORATIVE RHETORIC

The emphasis on marking tragic events rather than tracking them in situ ultimately bears a strong similarity to the rhetorical strategies used by physical and virtual sites of commemoration such as memorials, monuments, and public art. The Vietnam Veterans Memorial, to take one example, illustrates the scale of death by presenting each name individually, implicitly encouraging viewers to sense the enormity of loss in the visual comparison between reading individual names and viewing the monument as a whole. Likewise, the NAMES Project AIDS Memorial Quilt allows for a physical, tangible scale for those lost to HIV/AIDS by juxtaposing a widely known physical referent (the quilt square) with wide expanses, most famously the National Mall in Washington D.C. As Blair and Michel (2007) argued, these scale-based memorials belong to a particular trend in the culture of commemoration in the United States, where designers shifted away from representational sculptures of heroes or events toward more abstract designs, attempting to call more attention to the role of individual deaths as a part of a massive total.

As Smith and Trimbur (2003) have outlined, memorials are closely associated with epideictic or ceremonial rhetoric in that they are not explicitly marked as persuasive discourse, but rather as responses to a broadly conceived public ethic of commemoration. This public desire to commemorate is a direct response to the destabilizing forces of grief and loss. By honoring the dead, memorial practices aim to provide a means of "re-establishing order and bringing a disrupted community back together as one" (Smith & Trimbur, 2003). This logic is reflected in the brief introductions to death-counter visualizations, whether in the name of "envisioning," (National Geographic) "reckoning with" (The New York Times) or more generally "understanding" (NBC News) the death toll. In each case the visualization is posed in response to an implicit public need to commemorate, avoiding explicit reference to particular risk behaviors or to preventative actions.

This is not to say that death-counter graphics are completely removed from the political and cultural debates surrounding COVID-19 or that these visualizations do not contribute to a distributed understanding of risk. Framing the death toll as unfathomably large inherently positions the pandemic as something that should be feared and addressed. Moreover, the choice to memorialize in any capacity presents the pandemic as a notable, tragic event rather than a normalized aspect of public life. And as Dickinson et al. (2013) outlined, memorials "talk about some events of their histories more than others, glamorize some individuals more than others, and present some actions but not others as "instructive" for the future" (7). Like all memorials, death counter graphics contribute to specific cultural narratives about the dangers of the COVID-19 virus and therefore affect the public understanding of risk.

Additionally, though death-counter graphics rarely point toward deliberative actions within their own texts, they can be easily wielded toward such causes as they are distributed and remediated on social media. Woven into tweet-threads and Facebook posts, users are able to add their own commentary to death-counters and argue for specific risk prevention methods or the other courses of action. The potential for slippage between epideictic and deliberative messaging, as well as the problems that may emerge from the blurring designation, reflects the core tension identified by Amidon et al. (2021) with respect to Flatten The Curve (FTC) graphics deployed in the early stages of the pandemic. As Amidon et al. argued, the visual simplicity of FTC graphics made them easy to share and wield by public health officials, politicians, and individual stakeholders, but this simplicity also eschewed important complexities of the data such as the relative risk for specific populations and the overall uncertainty of the data.

We should apply this same lesson to death-counter graphics; they can be used toward deliberative ends as they are shared and recirculated, even though it is not their original purpose. My analysis here, however, focuses primarily on death-counters as a form of epideictic rhetoric aimed at the broad public imagination of COVID-19 in the spirit of other commemorative mediation such as physical and virtual memorials.

DATA-DRIVEN COMMEMORATION

Hess's (2007) analysis of web memorials dedicated to September 11th provides a useful example to explain how death counter graphics build on practices of virtual memorials in a novel way. Hess considered a sample of four websites that were published quickly after the 9/11 attacks, many of which relied on extensive multimedia as the focus of commemoration. Hess found that the sites often blurred epideictic and deliberative rhetorics, as different sites used memorial practices to make implicit arguments about how the U.S. should respond to the terrorist attack (p. 817). Like death counter graphics, each of these websites is constructed with limited participatory potential. There are few spaces for commentary or interaction with the website creators or for memorializing specific victims of the attacks. However, Hess had found evidence of how the images and videos found on these sites were repurposed for other online spaces (p. 823), signaling the participatory potential of recirculation.

However, despite the fact that Hess specifically chose sites that were rich with multimedia, he made no mention of data, data visualization, or information graphics. The most pungent and shareable media element, according to Hess, were the Flash videos that created a montage of text, still, image, and video to make their point. One of those videos, "Remember the Blood of Heroes…" (2ndarymotion, 2009) still survives on YouTube today, reflecting how still images—even as a part of a montage—were the central visual component of memorial practice during the early 2000s.

My point here is not only that the media production of online memorials has amplified over the past 20 years (though it certainly has), but that the addition of data visualization specifically leads to a critical merger of the logics of memorialization and the logics of data visualization. By analyzing their design practices, we can start to understand how data visualization is leveraged during times of crisis beyond the lens of pure actionability.

METHODS

I began my research with the question: what are death counter graphics trying to achieve? If the goal is not to communicate risk or to promote a particular course of action, what are these designers trying to accomplish in their graphics? What is the rhetorical value

of visualizing the scale of total mortality? In the course of answering these questions, I realized that it is necessary to understand the heterogeneity within death counter graphics, as different designs lead to small but significant variation in the audience and purpose.

To conduct this study, I followed a framework of qualitative content analysis. I collected a sample of death counter graphics, created a protocol for coding those graphics into separate categories, and then analyzed the salient features within those categories. These methods allowed me to distinguish between different approaches to death counter graphics and offer clearer takeaways for technical communicators and designers who might create them in the future.

DATA COLLECTION

I collected visualizations about the COVID death count in April 2021, but continued to collect additional samples through the end of the year. I found visualizations using a Google search of the keywords "covid19 deaths," "death visualization," and "Covid19 visualizations." I looked through the first 10 pages of search results using both Google search and Google Images. I opened each article to determine if the total mortality (and not the more common mortality-rate) was visualized as a major or minor part of the article/graphic.

My definition of "visualized" included a wide range of graphic applications, including basic charts, scrollable visualizations, interactive maps, YouTube videos, looping gifs, photos, and drawn images. In some cases, the graphic was the central focus of the page/article/video and in other cases it was included as one of several graphics within the source. There were some sources that were primarily focused on text-based descriptions of the total mortality, some of which focused on individual narratives of what it was like to live through the disaster. I only included these kinds of text-driven sources if they included photos or illustrations to augment their point, tying the focus back to visual design. These visualizations were produced by local news sources, national news sources, and amateur designers, making it impossible to collect anywhere near a complete set of every single visualization.

Though my sample included some sources published outside the U.S., most of the instances I found were published by U.S. sources. Accordingly, the narratives of death and rhythm publication followed the dominant COVID-19 news stories in the United States. In March 2020, for example, visualizations represented a global scope, focusing on the rising death toll in China and Italy to foreshadow the catastrophe to come. In the summer and fall of 2020, visualizations began to focus only on the deaths in the U.S., especially as the U.S. hit specific death "milestones" in the hundreds of thousands. After vaccines were widely released in the U.S. and death rates began to decline nationally, the focus of death news stories (and therefore death graphics) expanded once again to an international and occasionally global perspective, noting how countries like India and Brazil continued to face dire circumstances even as the U.S. "re-opened."

This process did exclude most COVID-19 dashboards, which were more likely to focus on the rise and fall of the mortality rate, as well as graphics that disaggregated the data into smaller groups of mortality such as deaths by neighborhood or median age (Dobkin & Gottehrer-Cohen, 2020). Additionally, I excluded photos of physical art installations that were constructed to represent the death count. These art installations included quilt squares (covidquilt, 2020), painted wooden panels (Lofholm, 2020), and red flags (Firstenberg, 2021; Wright, 2020). News articles occasionally used photos of these installations as a visual marker of total mortality, blurring the line between the physical installation and its digital circulation. Still, my analysis here focuses only on born-digital visualizations.

With these caveats in mind, my analysis here covers 40 separate articles/videos that included death counter graphics, the earliest published March 9th, 2020 (McCandless et al.) and the latest published December 20th, 2021 (Financial Times Data Journalism Team). Though one article contained 5 different death counter graphics (The Pace of Death, 2020) and one contained two separate graphics (Wu et al., 2020), all others included only one graphic per publication that fell within the definition of a death counter graphic. Therefore, across all publications, the corpus includes a total of 45 death counter graphics.

DATA ANALYSIS

To detect design patterns in death counter graphics, I conducted two stages of qualitative content analysis of all 45 instances in the sample, following best practices in the field (Boettger & Palmer, 2010; Thayer et al., 2007). This analysis followed an inductive coding approach, identifying and refining categories as themes emerged rather than by applying a previous coding schema. I hand-coded these instances, as the number of instances was not so massive as to require a data-driven approach (Lauer et al., 2018).

In the first stage of analysis, I focused on the stated or implied purpose of the death counter graphics: what did they hope to achieve? How did this differ from the framework of actionability that has been thoroughly applied to other COVID-19 visualizations at this point (Sorapure, 2023)? To track this question, I searched for a purpose statement or blurb in each source that would articulate the overall goal of the graphic(s). I noted whether there was a statement at all and developed categories for how they described the purpose of visualizing the death count.

In the second stage of analysis, I wanted to understand the different types of death counter graphics and how designers used these designs to communicate different messages about the meaning of the total mortality. At first, I thought it would be useful to apply a more deductive coding scheme based on pre-existing genres of data visualization, such as Kostelnick's overview of emotional appeals (2016). But I realized that this schema would not adequately show many of the similarities and differences between specific graphics. Therefore, I decided to again work inductively, developing categories without a pre-existing model or schema. After starting to sort the graphics into different groups, I started to focus on each graphic's use of comparison between the total mortality and an outside referent. I found that the different types of comparison provided a useful framework for explaining the purpose and audience of each graphic in a way that accounted for the overlap and divergence between other categories in data visualization.

THE RHETORIC OF "PROVIDING CONTEXT"

My sample of death counter visualizations included 45 separate graphics, all published within the first year of the COVID-19 pandemic. Some provided vague statements about "grasping" or providing "context" for the death toll, though most included no explicit purpose statement at all.

Even without direct purpose statements, I found that death counter graphics aim to achieve two broad rhetorical goals. The first is to provide an emotional context for the death toll using well-worn strategies for pathetic appeals in visual rhetoric. While the "raw" number does carry some emotional force on its own, designers use visual techniques to amplify this force and offer a deliberate frame for how the audience should react. The second purpose is to help readers understand the magnitude of the death count more specifically than as a generally large number. As researchers have shown, most people struggle to recognize the relative difference between large numbers (Landy et al., 2013). Death counter graphics, in turn, are offered as a way to shore up this cognitive difficulty.

Adding Emotional Emphasis

It is true that, for much of the 20th century, data graphics were considered to be emotionless, functional communication, and that any turn to emotional appeal could be seen as the kind of "chart junk" critiqued by Tufte. But as Kostelnick has repeatedly argued (2016; 2019), contemporary approaches to data visualization have largely departed from "stark functionalism" and embraced the tactical use of emotional appeals once again.

In turn, it is not particularly surprising that death counter graphics deploy emotional appeals, though it is important to note that there is a range in the type and intensity of emotions represented. Some graphics use color to mark the emotional tenor of the data — some with gloomy earth tones, some with bright red and orange alerts, and many in a solemn black and white. There are graphics that represent each death as a dot or a symbol in order to respectfully detach the data from its embodied origins. Other graphics attempt the opposite tactic, representing deaths as human icons, or occasionally, human faces. All of these strategies are intended to communicate the emotional resonance of the data.

In the introduction to the *New York Times* graphic "An Incalculable Loss," the authors provide a general articulation for the role of these emotional appeals.

> America has reached a grim milestone in the coronavirus outbreak—each figure here represents one of the 100,000 lives lost so far. But a count only reveals so much. Memories, gathered from obituaries across the country, help us to reckon with what was lost.

Through this notion of "reckoning with" the deaths, the authors position their graphic as a form of commemoration. As with other memorials, the authors hope that the emotional features of the graphic (both visual and textual) will provide the audience with an avenue for remembering and honoring the dead. Indeed, the authors suggest that the total number alone cannot do this rhetorical work, so it must be revised into a form that better fits the emotional register of the situation. In the language of Dragga and Voss (2001), these graphics attempt to reduce the cruelty of mortality graphics by directly signaling that the immense loss of life deserves solemnity, seriousness, and gravity.

This is not to say every death counter graphic directly includes emotional appeals or that these emotion-driven design strategies were always effective. As I will discuss in the concluding sections of this article, the rapid publication of these visualizations inevitably led to some perfunctory graphics created as a way to drive traffic to their sites. But even with this potential for poor designs, the emotional potential of death counter graphics remains their most enduring rhetorical power. When death counters claim to provide "context" for the death toll, part of what they're adding is an emotional context for the lives lost. At their best, death counter graphics offer a striking complement to the precise (but often emotionless) designs of COVID-19 dashboards that were the primary source of risk communication throughout the pandemic.

Clarifying Magnitude

The second common goal for death counter graphics is that they aim to help the public better understand the magnitude of total deaths. As a cognitive issue, humans often struggle to understand the scale of extremely large and extremely small numbers. This is especially true in the case of tasks comparing multiple large numbers, such as estimating the relationship between one thousand, one million, and one billion (Landy et al., 2013). Unfortunately, this cognitive issue presents a major obstacle for communicating data in science and public health, particularly when it comes to environmental phenomena such as geologic time (Trend, 1998, 2000) and global population issues (Dunning, 1997; Meffe, 1994).

As the death toll from COVID-19 soared from the hundreds to thousands to millions over the span of a few months, news publications ran into this same cognitive obstacle. What is the best way to communicate grim milestones of 100,000 deaths, 400,000 deaths, and 1 million deaths if these sorts of large numbers are so often interpreted as the same general magnitude of "many deaths" by the public? Some purpose statements for death counter graphics focused far more on this definition of "understanding" the death toll, such as this example from the site *Visual Capitalist*:

> As the COVID-19 pandemic rages on, the media continues to rattle off statistics at full force. However, without a frame of reference, numbers such as the death toll can be difficult to interpret. Mortalities attributed to the virus, for example, are often measured in the thousands of people per day globally—but is this number a little or a lot, relative to typical causes of death? Today's graphic uses data from Our World in Data to provide context with the total number of worldwide daily deaths.

This focus on understanding the numerical value itself as either "a little" or "a lot" epitomizes the goal of clarifying magnitude found throughout the graphics in my sample. It positions the enormity of the death toll not as an emotional problem, but a rational one, framing the purpose of death counter graphics as a mechanism for interpreting the raw figure of total mortality. And while some death counters focus more on this issue of magnitude than others, the purpose statement above also draws attention to the comparative logic that fueled all of the graphics in the sample. Each of the graphics demonstrate an attempt to find just the right "frame of reference" to reveal some insight about total mortality from COVID-19. Obviously, each graphic takes a different approach to choosing the reference for comparison and in displaying that comparison in a specific style and format. But in the end, their visual argument can still be tracked back to this comparative logic.

In my analysis of various death counter graphics, I argue that the type of comparison used to make sense of mortality has rhetorical value. That is, different types of comparison are designed to fit specific purposes and within specific constraints. Some comparisons are easier to visualize or aim to create a specific emotional resonance. Other comparisons attempt to reflect an audience's assumed spatial or geographic knowledge. In the next section, I break down these various types and the specific design constraints that they intend.

APPROACHES TO COMPARISON

In *Visual Explanations*, Tufte (1997) argued that a key narrative component of data visualization is the point of comparison (p. 30). A single data point on its own does nothing to contextualize or communicate that data to a given audience. Tufte highlighted the importance of comparison in his analysis of the 1986 Challenger space shuttle accident. Engineers cited that the day of the launch would be very cold, but they did not show that the forecast was 20-30 degrees colder than any of their previous tests (p. 39). In other words, they did not offer a tangible comparison for managers to understand the data, the temperature alone was not enough.

Similarly, the key choice that designers make when working on death counter graphics is choosing which reference to use. What do they compare to total mortality to make it visible, emotional, or tangible in a way that the number alone cannot achieve? In my study, the choice in comparative reference led to marked differences in the visual rhetoric of the graphic.

Comparisons to Historic Events

One of the common design strategies of death counter graphics is to compare the death total with other mass-casualty events such as deadly pandemics from the past. The logic of this comparison-type is fairly straightforward. COVID-19 is a pandemic. There have been pandemics in the past. Is the amount of death similar to what readers have experienced or heard about?

The site *Visual Capitalist* was a notable source of these types of graphics. Their first graphic, "Visualizing the History of Pandemics" illustrated the death tolls of epidemics as spiked spheres, with the size of the diameter representing the number of deaths. The graphic displays these spheres in two ways, first as a three-dimensional timeline and then in order from the largest pandemic (The Bubonic Plague) to the smallest (The SARS virus) (see Figure 1). First published on March 14th, 2020, the graphic was widely distributed on twitter and was picked up by at least one *CBS* news broadcast ("How Does Covid19 Compare…", 2021) to explain the significance of the number of deaths.

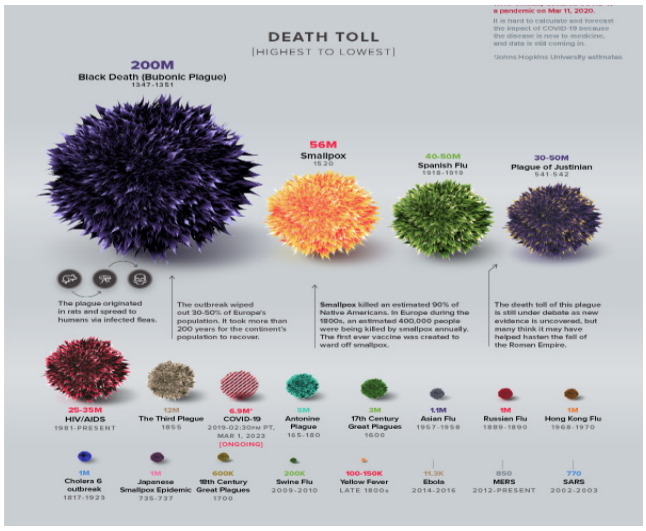

Figure 1: ***COVID-19 Compared to Plagues, Diseases, and Pandemics.*** Note: This infographic communicates the scale of COVID-19 deaths through comparison to other diseases. Source: "Visualizing the history of pandemics," by Nicholas LePan, Nick Routley, and Harrison Schell, 2023, *Visual Capitalist*, https://www.visualcapitalist.com/history-of-pandemics-deadliest/.

In a similar move, several death counter graphics compared deaths caused by COVID-19 to U.S. casualties in military conflicts. Most often these graphics took the form of a simple bar chart and were published to accompany the written text in publications like CNBC (Morgan et al., 2020) and Fortune Magazine (Lambert, 2020). But we can also see these types of comparisons in longer, stylized pieces that blended the text and visuals, such as the Washington Post's scroll-based "One Million of Us" (see Figure 2). As the user scrolls through a range of different graphics about the increasing death toll, text boxes appear periodically to convey the scale of deaths. When the death toll reaches 7,000, for example, the corresponding text reads "By early April 2020, COVID19 had already killed more Americans than all the service members killed in the wars in Iraq and Afghanistan combined" (Peçanha & Wu, 2022).

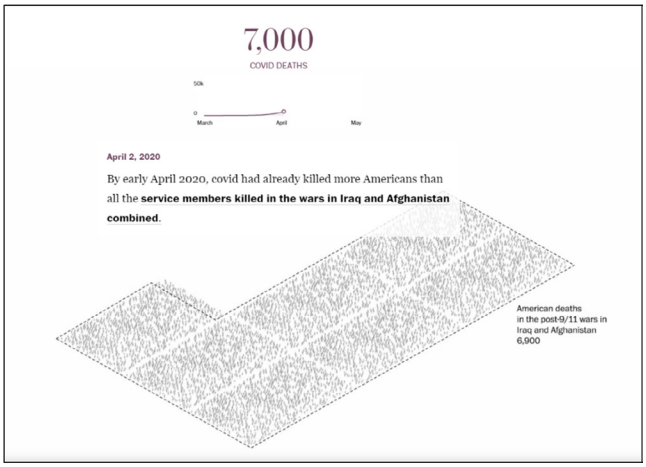

Figure 2: ***COVID-19 Compared to U.S. Conflict.*** Note: As the user scrolls through this data story the number at the top of the page increases and accompanying graphics shift to provide context for particular thresholds. This particular moment demonstrates how designers applied the spatial indication of human icons as well as the narrative comparison to American deaths in recent U.S. conflicts. Source: "One million of us," by Sergio Peçanha and Yan Wu, 2022, *Washington Post*, https://www.washingtonpost.com/opinions/interactive/2022/how-many-people-died-covid-united-states-1-million-graphic/.

With respect to both previous pandemics and past military conflicts, the effectiveness of the comparison depends on the user's prior knowledge of and emotional connection to that event. In the case of graphics that only include past pandemics, this presents several design challenges for communicating either the scale or the emotional weight of COVID-19. Many pandemics happened centuries ago, or, in the case of smallpox, occurred over the course of several centuries. Even for those users that have heard of famous pandemics like the bubonic plague, these events happened so long ago that it would likely be hard to conceptualize their magnitude or emotional/cultural significance beyond a generalized catastrophe. In turn, while comparisons to other pandemics may seem like the simplest comparison, few Americans have experienced a pandemic with a commensurate total mortality, leading most comparisons to function through the public's limited historical awareness of events.

Comparisons to military conflict, or including both disease and military conflict together, offer references that are more recent, recognizable, and emotionally salient than pandemics on their own. In the United States, a sizable chunk of history education

tends to focus on the major wars. The average American might not understand the significance of the 1918 Spanish Flu epidemic, but they will likely have a range of cultural scripts for understanding the comparison to the American Civil War. Moreover, the United States has engaged in multiple military conflicts over the past 25 years alone, and so comparisons to military fatalities may connect with a reader's personal experience. However, these comparisons do contribute to the general trend of militaristic framing toward the pandemic, a framing which can be directed toward problematic representations of the virus (Panzeri et al., 2021). Positioning the pandemic as a war can contribute to division between communities, can imagine health professionals as a form of "soldier," and can support authoritarian solutions by those in power (Wicke & Bolognesi, 2020). When death counter graphics compare mortality to military, conflict it makes them more engaging, but it also contributes to this deeper metaphorical struggle.

Regardless of which group of historical events are included and whether or not the audience can compare the death toll from one event to another, these graphics still do rhetorical work by labeling COVID-19 as a historical event. Many significant historical events—assassinations, workplace accidents, environmental catastrophes—have involved few fatalities but have a massive impact on society. Categorizing COVID-19 along with other historical events therefore functions as an implicit acknowledgement of the power of the pandemic to disrupt the social and cultural norms of public life.

Comparisons to Populations

Rather than comparing the death total to a specific event, other designers chose to compare COVID deaths to population groups, primarily groups in the United States. A data story in National Geographic made several of these comparisons to try to visualize the scale of 500,000 deaths in the United States. Some comparisons in the article focus specifically on geographic populations, such as the framing of the deaths as "like losing all the inhabitants of Atlanta, Georgia" (Conant et al., 2021). This potentially allows Americans to draw on their knowledge of Atlanta as a frame of reference, conveying both magnitude (the relative size of the city) as well as emotion (imagining that population being lost).

The benefit of population-based comparisons, broadly, is that they offer a form of immediacy that is more likely to connect with users' actual experiences than we should expect from comparisons to historical touch points. Even if "the population of Atlanta" is still unfathomably large in a numerical sense, this framing could connect to an array of social and cultural relationships. The user might understand Atlanta as one of the largest cities in the United States or simply as a city large enough to cultivate nationally relevant cultural products in music, television, and sports. In the process, the audience may be able to better imagine the loss-of-life as an issue of scale, but it also might allow the audience to better connect to those who were lost as the *cultural equivalent* of losing a major city. These connections are potentially more personal and immediate than comparisons to pandemics or military battles.

This same logic is heightened in an interactive visualization by the *Washington Post* titled, "What If All Covid-19 Deaths In The World Happened In Your Neighborhood" (2020). After asking users to input their zip codes, the story shows a top-down map with the user's community in the center. Starting with the very first death in the United States, the visualization would then progressively zoom out to show the population radius at notable intervals, providing text descriptions of how many people would have died to fill a specific region. The obvious benefit of this style of death counter graphic is that it allows for the user to interact with the data, relying less on the user's familiarity with a predetermined city or geographic region. As Sorapure found when studying dashboard actionability (2023), users also like to connect risk as closely as they can with their local circumstances.

It is important to highlight that though most population-focused graphics rendered the population as a *geographic* total, not all did. Some graphics compared the death to population groups marked by a particular interest or occupation. For example, after the National Geographic article compares the mortality to the population of Atlanta, the article makes comparisons to "all the fast-food cooks in the country," "the number of Americans flocked to the Woodstock music festival," "all the school bus drivers in the U.S.," and "all the public-school teachers in Indiana, Illinois, Wisconsin, Minnesota, Iowa, Missouri, Nebraska, Kansas, and Oregon" (Conant et al., 2021) (see Figure 3).

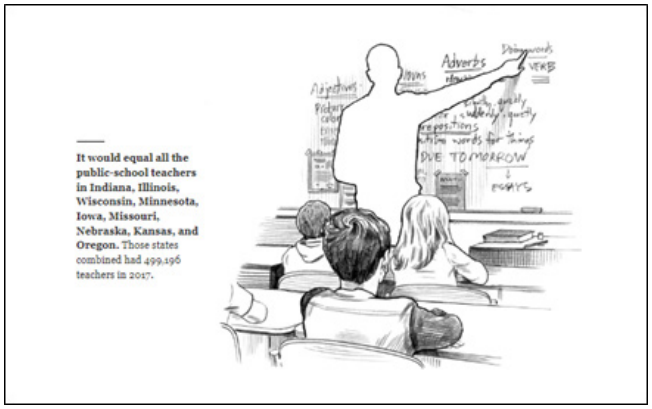

Figure 3: Comparing COVID-19 Deaths to Groups of Teachers. Note: This screenshot depicts the use of illustration to compare COVID-19 to a specific population group: public-school teachers from specific U.S. States. Source: "What 500000 United States Covid deaths look like," by Eve Conant, and Kelsey Nowakowski, illustrated by Joe McKendry, 2021, *National Geographic,* https://www.nationalgeographic.com/science/graphics/what-500000-united-states-covid-deaths-look-like.

Here, we should be skeptical of whether these comparisons provide any benefit in understanding the magnitude of mortality beyond the vague sense of enormity provided by the number itself. It is laughable to imagine that the average person might have a mental reference for the relative size of populations by occupation, much less the conglomeration of teachers across 9 assorted states. However, these comparisons may provide ground for emotional impact. These groups are (at least theoretically) represented in the user's immediate community, and users may be struck by the idea of losing known members of their communities like bus drivers or teachers.

In sum, the value of this comparison is that it does compare COVID deaths to a human scale, and depending on the user's connection with different population groups, these comparisons can offer a sense of immediacy in the connection to actual people in the user's life. However, no matter the reference used in this group, understanding this magnitude of lives lost would still be a challenge given that we are rarely forced to consider the difference between large groups of people at the scale of hundreds of thousands.

Comparisons to Real Objects

To make it easier to imagine the magnitude of mortality, some death counter graphics compared individual deaths to tangible objects that the audience might more easily apply to a scale of tens or hundreds of thousands. For example, one Washington Post visualization focuses on the buses it would take to hold the 500,000 people who had died by that point (see Figure 4). The visualization goes through great lengths to visualize small, measurable distances that add up to the whole, positing that if one bus can hold 50 people and is on average 45 feet long, (and accounting for 6 feet between each bus) then the caravan of busses required to carry all of those who died would "require a caravan of 9,804 buses that would stretch 94.7 miles" (Galocha & Berkowitz, 2021).

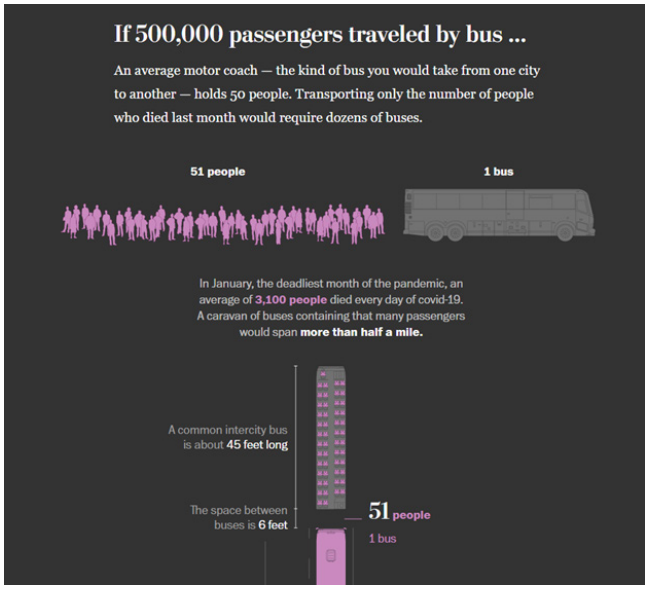

Figure 4: ***Comparison of U.S. Deaths to the Length of Buses.*** Note: This screenshot of a scroll-based graphic captures the start of a visualization offering a comparison between U.S. deaths and length of passenger buses. The graphic goes to great lengths to capture the accuracy of the comparison, demonstrating the length of each bus and the space between buses before prompting the user to scroll down the page. Source: "500,000 dead, a number almost too large to grasp," by Artur Galocha and Bonnie Berkowitz, 2021, *Washington Post*, https://www.washingtonpost.com/nation/interactive/2021/500000-covid-deaths-visualized/.

This style of comparison is deeply interested in the problem of conveying the numerical magnitude, trying to draw on small objects and distances that can be understood in the scale of hundreds of thousands. In turn, these graphics often include a long progression of tangible measurements, starting by asking the user to imagine a single object and then slowly scaling up until the total mortality has been reached. This same approach has been used in a variety of scale-based visualizations on social media, such as the use of individual grains of rice to show the difference between 100,000 dollars and 1 billion dollars (Scher, 2020). In this category, visualizations focus on real objects that the user can imagine individually in the world, whether grains of rice, pennies, or the height of a single Toblerone (Chalabi, 2022) with the hope that, once scaled up, the viewer will have a tangible way to imagine the scale of death in relation to their everyday experience.

The downside of this logic is that describing these scale comparisons forces the user to apply layers of mathematical reasoning to consider the magnitude. To take the Washington Post bus example, the user must first imagine a certain number of people on a single bus, then the length of the bus, the distance between buses, and also the length of all the buses in a single caravan. All of these layers of mathematical reasoning leave room for confusion and disorientation, so that by the end of these mental gymnastics, the user may once again be left with an understanding of the mortality total as generally enormous.

By adding a layer of abstraction from real people to objects, this approach to death counter graphics also has the potential to devalue the emotional resonance of total mortality. Without the cultural importance of historical comparisons or the immediacy of population comparisons, comparisons to objects reduce individuals to "the count," so that one death always equals one abstract seat on a bus or other similar tangible object in the world. That object may be tangible, but it likely carries less emotional weight than an individual human life.

The rare example that does add emotional context through object-based comparisons is Reuter's "The Scale of Coronavirus Deaths" (Hernandez & Scarr, 2020), which illustrates the total mortality by visualizing stacks of coffins. Unlike other objects, coffins do provide a standardized unit that still carries the grim weight of human life. Starting with one coffin, the visualization continues to expand until it shows an enormous imaginary warehouse with a stack of caskets 13 meters high and thousands of meters wide. However, as the visualization expands to the final birds-eye view, it still becomes increasingly difficult to keep hold of either the emotional or numerical logic at hand. This is not to say that these graphics are inherently cruel or unethical, but that they may offer a rhetorical model better suited to imagining the magnitude of Jeff Bezos' wealth than the magnitude of mortality during a pandemic.

Comparisons to Digital Icons/Graphics

Another method of demonstrating the scale of mortality is by representing each death as a single digital icon or graphic, removing the connection to a physical reference altogether. The narrative progression of these graphics is similar to the real objects discussed in the previous section: the graphic establishes that each sphere or dot or icon represents a certain number of deaths and then increases the scale to communicate the extreme total. The *New York Times'* "How 450,000 Deaths Add Up" (Gaimo & Leatherby, 2021) (Figure 5) is a model example of this approach, representing each death as a single black pixel. At the start of the graphic the single death/pixel is almost imperceptible, but as the user scrolls down the vertical timeline on the page these individual black pixels fully fill in the allotted vertical column to demonstrate the exponential rise in mortality.

The difference between these graphics and those focused on real objects is that, with real objects, the user is meant to compare the death toll to their tangible physical experience. The graphic takes the user's knowledge of the *actual* space taken up by an object (e.g., a single coffin) and extrapolates that experience to a larger array. When graphics compare deaths to pixels or spheres or dots, they are not drawing on the user's past experience. Instead, the scale mechanism is fully self-contained within the graphic itself. 1 death = 1 digital object .[1]The force of the graphic comes from the viewer's ability to connect the objects back to human lives, so there

1 Or some other amount of deaths per object.

is a real sense of loss as the screen fills with black pixels, icons, or other abstract markers.

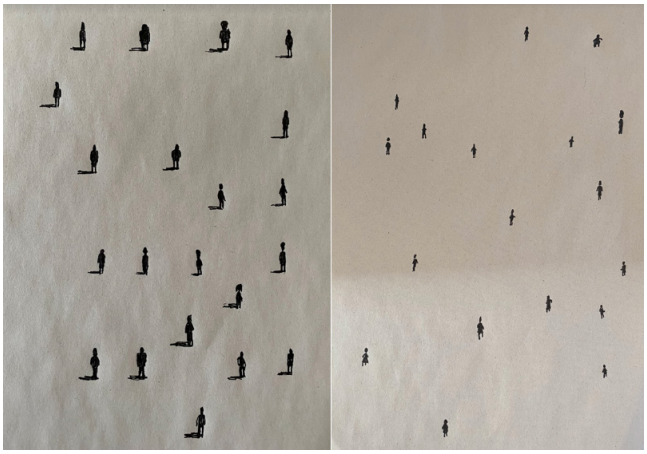

Figure 5: ***Human Icons Developed for Death Counter Graphic.*** Note: Though the *New York Times* declined to permit images from their graphics, these drawings from artist Larry Buchanan were the created for the data story "An Incalculable Loss," published on May 27, 2020. The icon's demonstrate Buchanan's clear effort to present the icons as individual human shapes rather than as a single repeated human icon. Images used via permission of Larry Buchanan, January, 24, 2024.

The graphics within this approach fall squarely into the category of what data scientists have termed "anthropographics," referencing the attempt to anthropomorphize data points as humans for various purposes. Morais et al. (2020) identify 7 dimensions of the anthropographic design space in order to articulate differences across anthropographic practices, but in the COVID-19 dataset the graphics varied the most in terms of realism, i.e., how explicitly each mark was used to represent a specific person. Some graphics presented each individual death as a single dot, while others used generic or stylized human icons (Figure 5). One particularly uncanny example even attempted to present each death as an actual human face.[2]

Even though readers obviously have a general sense of the physical scale of an individual human body and could potentially apply that understanding to one of these graphics, this use of human icons is still rhetorically distinct from those that use real-world objects. In using human-*icons* (rather than images of actual human *bodies*) these graphics do not ask the reader to imagine the scale of death in terms of the real space that the deceased would have occupied. The icons may stretch across the screen, overwhelming the visual space of the interface, but there is no connection between the virtual area of the screen and the real-world outside of it. Whether represented by pixels or human icons, the user is meant to be overwhelmed within the physical space of the interface itself, struck by the fact that these icons represent lives, not space.

In disconnecting the visuals from real space, this type of comparison offers the weakest attempt at illustrating a sense of magnitude of any of the visuals discussed thus far. As the user scrolls through an overwhelming field of dots or icons, there is little need to understand total mortality other than as a generally overwhelming number. And, other than the function of time (discussed below), there is little mechanism for the user to differentiate between a graphic about 100,000 deaths and 1 million deaths. The experience inevitably reduces to a long, horrific scroll.

For what they sacrifice in numerical clarity, however, these graphics may make up for in emotional impact. Filling the screen with icons, showing more icons than the user can possibly keep track of, establishes a suitable visual metaphor for the overwhelming nature of the death toll. As Sorapure noted in her study of COVID-19 anthropographics (2022), this approach also commonly includes intermittent textboxes with information about individuals who have passed away. These textual elements not only break up the monotony of the scroll, but also remind the user to connect these icons back to actual human lives.

Still, the extent that these graphics can actually elicit empathy—the "anthropographic assumption"—remains an open question. Empirical studies have been conducted to test a range of design practices, but the results have been relatively weak in proving that anthropographic design practices have a meaningful effect. Boy et al. (2017) conducted 7 separate tests showing users anthropographic data about Syrian refugees, only to find that the style of the graphic had a minimal impact on self-reported empathy or interest in donating money to related charities. Morais et al. (2021) found a similar lack of meaningful impact on the user's emotional arousal, emotional valence, and the willingness to allocate resources to victims. As Sorapure (2022) pointed out, this area of research is still in the early stages, and more empirical research is necessary to expand the types of designs and rhetorical purposes that are being tested. But in the face of these tests, we should acknowledge that the rhetorical purposes of these designs may not provide as much of an effect as the designers may hope, and empirical testing of the effects on audiences may deliver similarly meager benefits.

Comparisons to Time

The final approach to comparison is to leverage the viewer's sense of time to illustrate the scale of death. One graphic presented the viewer with a digital timer with the label "Since you opened this page, [x number] people have died of Covid-19" (Bump, 2021). For some graphics, the rate of the timer was tied to the actual rate of deaths worldwide. For example, Reuters' "The Pace of Death" (2020) (see Figure 6) features a countdown clock where one new death-icon appears every 16 seconds, corresponding to the average worldwide rate of deaths at the time.[3] The goal of this comparison is not to illustrate the total number of deaths but to provide a sense of scale for the rate of death. If the reader has had the page open for a minute or two to read the article, they may be struck by the fact that in that real time 11 or 12 people (on average) had died of COVID-19. Since this graphic focuses on the mortality rate rather than total mortality it stretches the definition of death counters I've established so far, most of which focus exclusively on the total.

2 Notably, in order to limit the emotional trauma of these faces-of-death the authors first used AI-generated headshots. But after significant public concern, these faces were ultimately blurred to create even less traumatic impact. These blurry faces were randomly generated each time the user opened the page, leading to extreme problems with loading times for the single page. Only a few months after publication, the code behind the graphic was completely broken.

3 This was calculated by averaging daily mortality from September 1, 2020 to September 27, 2020.

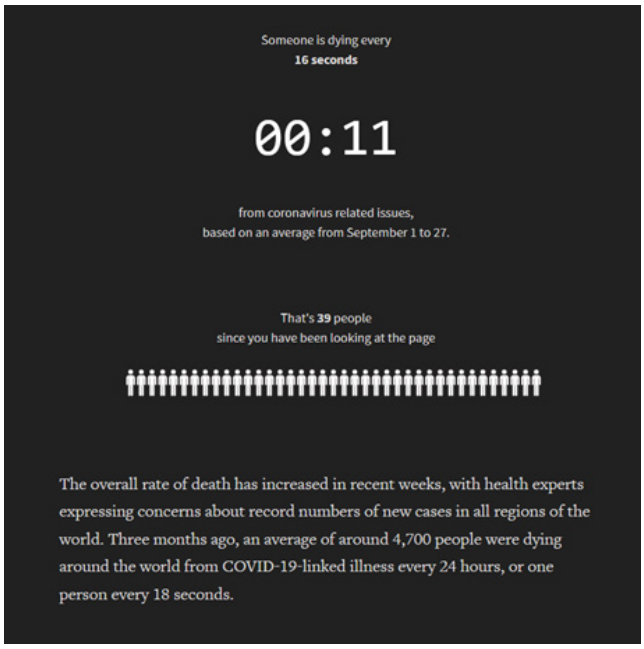

Figure 6: ***COVID Death Every 16 Seconds.*** Note: This screenshot shows one method using time to show the scale of COVID deaths. Every 16 seconds a human icon is added to the rows below and the countdown timer starts again. From "The Pace of Death," by Manas Sharma, Simon Scarr and Gurman Bhatia, *Reuters*, Sept 19, 2020. https://www.reuters.com/graphics/HEALTH-CORONAVIRUS/DEATHS/xlbpgobgapq/index.html

Some time-based comparisons do take the opposite approach—illustrating total deaths rather than the rate. This style of visualization first establishes time as a discrete object (most commonly one death per second) and then tells the reader how much time it would take to add up to the current total deaths. The Washington Post's "Putting 500,000 covid-19 deaths into perspective" (Bump, 2020) (see Figure 7) uses this method, allowing the reader to select a rate from anywhere between one death per-second to one death per-minute. Once the rate-of-time is selected, the article provides a running counter of how many people would have died since opening the article, but crucially also forecasts how long it would take to add up to the current total.

Figure 7: ***Showing COVID Deaths at a Specific Rate.*** Note: This data display attempts to convey the scale of COVID deaths by counting up at a set rate. The text updates both the total number of deaths since opening the page as well as a percentage comparison to the actual number of deaths from COVID-19. Source: "Putting 500,000 Covid-19 deaths into perspective," by Philip Bump, February 3 2021, *Washington Post* https://www.washingtonpost.com/politics/2021/02/23/putting-500000-covid-19-deaths-into-perspective/

Initially, this alternate approach can seem to skew the reader's perspective. By providing a counter at 1 death per second, the *Washington Post* counter increases sixteen times faster than the Reuters counter. It's possible that the casual reader mistakes this for the actual mortality rate and walks away from the article thinking that deaths are more frequent than they are.

However, this approach makes more sense when we see how the authors use this arbitrary rate of 1 death/second to shift the reader's focus back to total deaths:

> One way to consider what 500,000 deaths mean is to put it in a scale we're familiar with: time. As I write, it is about 11 a.m. on Feb. 23, 2021. If each of those deaths were to occur at one-second intervals beginning right now, the 500,000th death wouldn't occur for more than a week. It takes hours simply to tally the deaths that occurred through the spring of last year. Put in seconds, the toll is agonizingly slow.

Though this disconnects the visualization's counter from the actual worldwide rate, the author is trying to provide context for the magnitude of 500,000 deaths. Even if we imagine 1 death/second, it would still take a long time to add to the total. This type of rhetorical shift to total deaths would be much more difficult with a counter based on the actual mortality rate, as the average reader would struggle to multiply the segments of 16 second intervals (the actual rate per second) all the way to 500,000.

Time also plays a role in the scroll-based visualizations discussed in the previous section. Though the primary rhetorical force comes from the overwhelming array of icons/objects filling the screen, the impact of these graphics is reinforced by a temporal appeal. When the graphic asks users to scroll through a long field of the same icons or images, the user experiences not only the overwhelming visual field of icons, but also the time it takes to scroll through those icons. The seemingly endless scroll indicates the immense scale of lives that were lost.

The rhetorical potential of all of these time-based comparisons depends on whether the user is presented with a running counter, with a mathematical operation, or with the experience of the scroll itself. The mathematical operation (i.e., the length of the total if each death was 1 second), provides a potentially potent tool for conveying magnitude, given that even a scale of 100,000 seconds fits into an easy reference to the time-span of a little more than a day. On the other hand, the temporal experience of time-based graphics does not indicate much in the way of magnitude, but could amplify the emotional force of icon-based comparisons and similar anthropographics.

In noting this additional type of temporal comparison, we can start to see how the comparison-types I've discussed here are not mutually exclusive or necessarily complete. In my sample, there were several visualizations that could be classified as more than one of the comparative approaches described above. In turn, my goal in identifying these categories is not to create an exhaustive

taxonomy or accounting tool, but to demonstrate how despite the range of multimodal designs, each of these death counter graphics depends on the logic of comparison to establish the scale of loss.

THE LIMITATIONS OF DEATH COUNTER GRAPHICS

The five types of comparison described above offer a descriptive view of the underlying logics of death counter graphics. As I hope I have shown, there are some designs that make more and less sense when applied to the circumstances of COVID-19. However, it is worth considering the project of death counter graphics as a whole to note key limitations in the attempt to communicate total mortality through these visualizations.

The Inherent Complexities of Scale

One glaring issue for death counter graphics is that they offer a basic solution to a problem that has been worked across time and academic discipline, always resisting easy solutions. Humanistic analyses, like those found in Clarke and Wittenberg's (2017) collection *Scale in Literature and Culture*, critique the way that trans-scalar comparisons often depend on what Haraway (2016) has called the "view from nowhere," the notion of an objective, placeless vantage-point for understanding phenomena. Attempts to compare human-scale quantities across magnitudes require designers to avoid important factors in scale variance. A solar system offers a useful model for the shape of an atom only insofar as we overlook how these two bodies operate within a dissimilar physics, time, and space. In the words of Latour, "levels of reality do not nestle one within the other like Russian dolls" (2017, p. 94).

Accounting for differences across magnitude is challenging rhetorical work, as exemplified by scholars in rhetoric who have addressed the issue in terms of ecological literacy and the magnitude of climate change. Jones (2019) argued for carefully locating trans-scalar arguments within a local political, social, and ecological space, reaching for texts that are less distant and fleeting than most death counter graphics. Pilsch (2017) offered a more theoretical lens for addressing the problem, underlining the fact that a human-centered perspective will always be insufficient for understanding systems that operate at a dramatically inhuman scale. Both of these approaches require more complex tactics than provided by death counter graphics alone.

Praise for death counter graphics (or really any scalar comparison graphic) should also be tempered by empirical studies in cognitive science, education, and psychology that have focused intently on how to address cognitive challenges of scale in educational settings. Research has shown that it may be possible to curtail our natural cognitive biases toward large numbers though the careful use of educational programs like progressively establishing a hierarchy of scale (Resnick et al., 2017) or applying worked problems (Fitzsimmons et al., 2023). But if these experimental pedagogical measures can achieve only modest gains in understanding large magnitudes, it is unlikely that death counter graphics can provide radical insight to the relative magnitudes in the hundreds of thousands or millions.

Death Counters as Disaster Content

In large part, my analysis here positions death counters as individual graphics designed for human audiences, but in looking across the sample, it was impossible to escape the way the graphics functioned as perfunctory disaster content, intended to drive online traffic by riding the waves of algorithmic emphasis on COVID-19. The epitome of this reduction of death counter to an algorithmic traffic-grab is exemplified in the Forbes article "Visualizing Covid Deaths in the US'' published November 20 of 2020 and written by professor of epidemiology John Drake. The author visualizes 250,000 U.S. lives lost using only periods—the punctuation mark. "This post consists entirely of periods" wrote Drake "one tiny dot for every ten people in America that have died of COVID-19" (2020). Indeed, the rest of the article consists only of periods, 25,000 periods extending out in a puzzlingly horizontal scroll out of the right side of the screen.[4] Drake encourages the reader to "scroll slowly across" and offers the categorical reference that each dot would represent a "family, a soccer team, or a business office." Despite Drake's caring introduction, this procession of periods offers little to convey the emotional weight or relative magnitude of total mortality.

Drake does earnestly appear to be attempting to visualize the death toll in a comprehensible way for the average reader. And as we've seen in the case of the NYT and Reuters, this is an extremely difficult task to accomplish. And yet, I find this particular attempt tragically absurd, indicative of how the drive to publish death counter graphics can be reduced by the notion that *any* comparison will illuminate the data.

The most obvious issue with the graphic is that there is no broad public consensus on the size of the period. Yes, it is small. Yes, we do encounter them constantly in daily life. But we do not encounter the period as a unit of length. Even in the form of an ellipsis, periods are automatically reformatted with extra space in order to provide more space to signal the intended pause. Therefore in slowly scrolling, as Drake would have us do, it is painfully easy to lose track of the number of periods on the screen at once. After I've scrolled past the text of the article and I'm left with only the long, horizontal row of periods, am I looking at 100,000 deaths? 50,000? Other than acknowledging "wow, that is a lot of periods," it is hard to track the scale periods and think of them as lives lost, which, we would imagine, is Drake's central goal. Drake's scale of 1 period for every 10 deaths exacerbates the issue. Not only is the reader asked to mentally comprehend a line of periods, but to multiply that experience by a factor of 10. If there was cognitive strain before, adding multiplication would likely lead readers ever closer to a blank stare and lack of thought towards these dots, rather than invoking any sense of actual care or consideration for these people.

As much as the period-graphic offers a uniquely impractical model for death counter graphics, it may be more important to consider how this simplistic attempt emerges from an algorithmic environment that elevated a constant flow of news related to COVID-19. Even if death counter graphics do not instill emotions in the viewer or provide a better sense of the magnitude of total morality, they still generate clicks, views, and shares. This algorithmic incentive helps explain some of the cruder design patterns that emerged in my sample. These designs still claimed to contextualize the total mortality from COVID-19, and levied some form of comparison described in earlier sections of this article, but did so using a design that offered limited hope of providing any analytical or emotional context for the scale of the tragedy. The potential harm of these kinds of visualizations is to further entrench public apathy surrounding COVID-19 mortality (or really any form of large-

4 It is possible that the visualization is formatted differently if published in the print version of the magazine if it was published there.

scale issue). The more we look at visualizations and blankly agree, "well that *is* a lot of periods," the more we treat COVID deaths as inevitable, unfathomable, and immovable.

CONCLUSION

Novel forms of data visualization provided (and continue to provide) ongoing information about COVID-19 to a wide public audience, and we will likely continue to process the strengths and limitations of COVID graphics for years to come. Actionability is no doubt a critical lens for understanding how well graphics inspired the public to take preventative measures like wearing a mask and social distancing. But death counter graphics attempt to solve a different set of problems in pursuit of commemorating and contextualizing lives lost — goals that will likely apply to disasters in the future. For technical communicators working toward these goals, I submit two takeaways to synthesize my overall arguments here.

First, designers working on death counter graphics should carefully consider the design patterns used for mortality graphics in relation to their specific goals and context. Even though many death counter graphics claim the unified goal of providing context for lives lost, the range of different designs demonstrates a wider range of purposes and tactics for achieving them. Some designs appear better aimed at contextualizing the relative magnitude of death, while others allow for a deeper emotional engagement with the loss. By outlining the types of comparison used by death counter graphics, I hope to have made it easier for technical communicators to work with this genre of data visualization in the future.

My second point is that though scale-comparison graphics like death counters represent a captivating genre of data visualization, they are, at best, temporary salves to long term problems in the public understanding of large-scale disasters. In time, monuments and memorials will likely be constructed to commemorate the lives lost in the COVID-19 pandemic. And over the years educators will hopefully develop better strategies for teaching the numerical literacies necessary for understanding arguments based on large values. But each of these are long term efforts. They will take years to construct and apply, while death counters may take only a matter of hours to prepare and publish. Nevertheless, even if they are ultimately a contextual blip in memorial practices, death counter graphics require further study to test both the emotional and cognitive potential they provide.

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APPENDIX A: LIST OF DEATH COUNTER VISUALIZATIONS

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Between the Lines: Visual Euphemism in Technical and Professional Communication Visuals

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ABSTRACT
This article explores visual euphemism in the realm of technical and professional communication (TPC) visuals. I argue that euphemism is a mostly unexplored topic in TPC scholarship and deserving of further inquiry. Due to its equal capacity to inform or deceive, visual euphemism has particular value for scholars concerned with the efficacy and ethicality of TPC visuals. To support this argument, I identify the unique features of visual euphemism, as well as outline a basic critical framework for its identification and analysis. I conclude by briefly examining prominent TPC visuals and advocating for further research of visual euphemism.

CCS Concepts
Social Computing

Keywords
Euphemism, Visual euphemism, Visual tropes

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INTRODUCTION
Essential for discussing sensitive subjects like bodies, sex, death, and disease, euphemism appears in practically every language. Functioning by way of abstraction, euphemism is encoded by countless layers of context, culture, and power. It also possesses an incredible—almost paradoxical—duality, in that it has equal capacity to comfort as well as deceive. Likewise, whether a euphemism is successful or interpreted the way the user intended depends a great deal upon various circumstantial factors. Due to its multifaceted nature, my comprehensive definition of euphemism is rather wordy: an abstracted and ideologically encoded substitution of one sign for another, often employed to circumvent taboo content and provide psychological comfort, but also frequently used to obscure the truth and manipulate, and whose usage and comprehension relies highly on context.

Despite euphemism being this multifaceted rhetorical trope, widely used, and intertwined with human experience, it is often dismissed as merely decorative or mendacious language and rarely given serious scholarly consideration. This is particularly true in technical and professional communication (TPC), where vague and indirect language like euphemism is often viewed as antithetical to the clarity and directness typically sought after.

In the case of visual euphemism, a trope for which there is virtually no consequential scholarship, the imbalance between significance and inquiry is even greater. Visual euphemism is ubiquitous. Blue liquid for blood; eggplant and peach emojis for sexualized body parts; road signs featuring sanitized isotypes warning of horrific dangers are just a few of the pervasive visual euphemisms we regularly encounter. As these examples suggest, visual euphemism enables the depiction of things that, because they are taboo, graphic or unsightly, would otherwise be difficult to show. Through this affordance, visual euphemism proves not just a useful rhetorical trope, but an essential one for contemporary visual communication. Yet, despite visual euphemism's frequency and utility, we know very little about it.

The same proficiency for showing the unsightly explains why many visuals used in TPC could also be characterized as operating euphemistically. Consider the following instructional diagram's use of colorful, cross-sectional illustration to demonstrate the proper application of a hemorrhoid treatment cream (Figure 1).

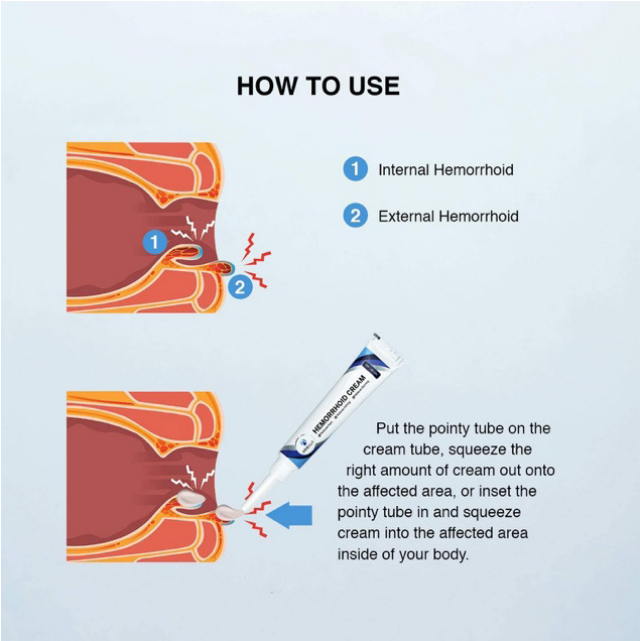

Figure 1: How to Use Ariella Hemorrhoid Treatment Cream Illustration

Cross-sectional drawings like the ones in Figure 1 are conventional to the point of naturalization in TPC visuals. By empowering "readers to see the apparatus contextually, both in its detailed parts and as a wholly functioning entity," cutaways are more effective at conveying technical information than a photorealistic image would be (Kostelnick & Hassett, 2003, p. 36). The cross-sectional drawings in the instructional diagram for Ariella Hemorrhoid Treatment Cream perform this explanatory function; however, given the taboo nature of the content—content most would prefer not to see in a photorealistic way—the cross-sectional illustrations also provide a visually sanitized depiction of how to apply the cream, one that shouldn't cause viewers discomfort, consequently enhancing the diagram's overall rhetorical efficacy.

Alternatively, TPC visual euphemisms can also be used to mislead. Consider the following line graph (Figure 2) (Chan, 2014) depicting the number of murders committed with firearms in Florida from the 1990s to the 2010s, with an emphasis on 2005, when Florida enacted its "Stand Your Ground" law.

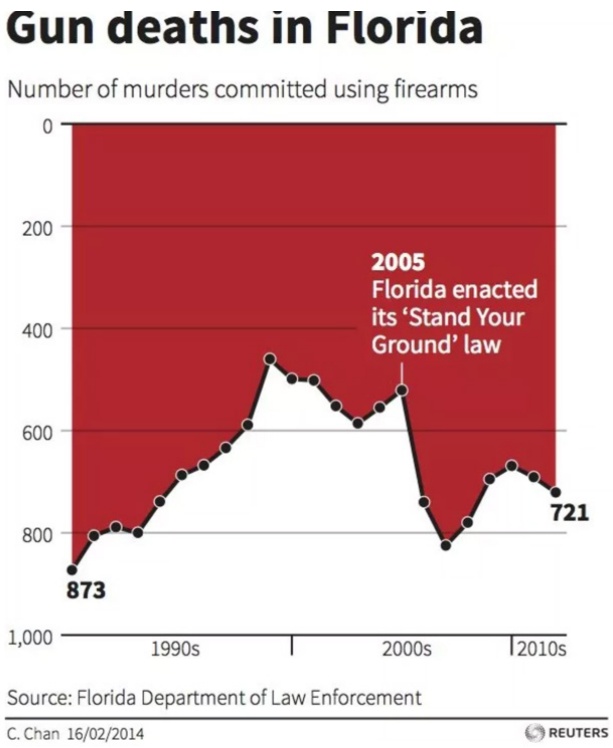

Figure 2: Gun Deaths in Florida Graph

Starting x and y axes with the lowest number and increasing horizontally and vertically from their intersection is a well-established convention of line graphs. In fact, it is so stable and recurring that it establishes what Kostelnick and Hassett (2003) have labeled a "quasi-social contract between designers and readers" (p. 180). By inverting the y-axis so that it starts with the highest number and tops out at zero, the designer of the Gun Deaths in Florida graph has clearly broken this contract. The unconventional placement of axes, coupled with the use of red to highlight the area above the line, suggests an intention to mislead viewers into believing that Florida's Stand Your Ground law effectively reduced gun deaths, when in fact it did not. While the designer's actions appear unethical, it is important to note that they have not lied or otherwise falsified the data represented in the graph. It is accurate. And the data's source is even cited in the graph itself. The designer has subverted convention to obscure meaning but done so in a way that remains essentially accurate. This is the same way that many verbal euphemisms operate.

Given visual euphemism's ubiquity, potency, and power to both inform and mislead, it is beneficial for scholars of TPC to add the concept of visual euphemism to their analytical toolboxes. To

bolster this argument, in the following sections I connect visual euphemism with other relevant TPC scholarship. This is followed by discussion of what makes euphemism such a complicated and consequential trope, one worthy of serious inquiry. I then go on to outline an analytical framework adapted from Brown and Levinson's (1987) politeness theory to explain how visual euphemism can be forensically identified and analyzed. Before concluding, I review some prominent TPC visuals to recommend how visual euphemism and the proposed framework can enhance our understanding of visual rhetoric within the context of technical and professional commmunication.

RHETORICAL TROPES AND TECHNICAL COMMUNICATION VISUALS

Although there has been limited examination of euphemism—both verbal and visual—the current exploration aligns with two larger research trends in TPC scholarship. Each is relative to euphemism's duality, serving to improve persuasive and informative communication while also possessing the capability to mislead and manipulate. The first connection lies in euphemism's association with metaphor and the two tropes' shared ability to aid effective communication of complex TPC-related content. The second connection emerges in the realm of TPC visuals, where scholars have sought to better understand their potential for deception and advocate for more humane visualization design practices.

Metaphors and TPC Scholarship

Since Aristotle, rhetoricians have recognized metaphor's incredible capacity to make complex information accessible. Thus, it's no surprise that numerous studies have centered on the use of metaphor in TPC. Scholars have explored how metaphors shape discourse and thought in technical handbooks (Graves & Graves, 1998), descriptions of the natural world (Adkins, 2003), the solar system (Giles, 2008), genetics (Journet, 2010), interdisciplinary discussions between scientists and engineers (Baake, 2003), and even the discipline itself (Beck, 1991).

Likewise, visual metaphor is the prevailing focus of researchers analyzing visual tropes in TPC. Kaplan (1990), for instance, examined the ways visual metaphors provide interpretative frameworks for understanding and discussing societal values and policies regarding communication technology. Yu's (2011) comparative analysis of brochures used by American and Chinese financial companies showed the value of visual metaphors for professional intercultural communication. Kostelnick (2019) explained how icons, color, and shading are used metaphorically in data visualizations to represent humans and to humanize—or not—data. And, recently, Moore et al. (2021) confirmed the important role visual metaphor plays in engineers' design education.

Provided its fundamental generative power (Lakoff & Johnson, 1980), the ubiquity of metaphor in TPC scholarship is no surprise. Nonetheless, Fahnestock (2002) has challenged the notion that this power is exclusive to it. Characterizing figures of speech as ways of cognition, she has argued that scholarly focus "needs to be extended to the other figures so that they are no longer seen as decoration on the plain cloth of language but as the fabric itself" (p. xii). While she does not specifically identify euphemism, from her reasoning, it is as consequential a trope and equally worthy of study as metaphor. Both are analogous in their metonymic functioning and utility for human communication and understanding. Arguably, euphemism might be even more worthy of study, given that its use is additionally conditioned by a host of tacit cultural and societal mores and infused with power dynamics that go above and beyond metaphor's usual aim to enhance understanding.

Visuals and TPC Scholarship

The other connection the current exploration of visual euphemism shares with previous TPC scholarship is in the way it challenges the common notion that visuals merely serve as transparent and objective channels of information. Much of the work on TPC visuals has emphasized the importance of analyzing TPC visuals to understand better their potential to deceive, accomplished in order to foster more truthful and humane design practices. This emphasis is evident in mainstream works like Jones' (1995) *How to Lie with Charts*, Monmonier's (1991) *How to Lie with Maps*, and Cairo's (2019) *How Charts Lie*. It is also evident in Barton and Barton's (1993) investigation of maps, showing how they are embedded with ideology and can be used for dissimulation. Similarly, Bryan (1995) and Allen (1996) outlined the ways graphs can distort meaning and manipulate audience perception. And Dragga and Voss (2001) showed how TPC visuals can obscure the humanity of those they are intended to represent, while Dombrowski (2009) and Ward (2009) both explored the misleading visuals and unethical information design practices used by Nazis to validate their pseudo-scientific views on race.

Recently, in an issue of the *Journal of Business and Technical Communication* dedicated to addressing the role of TPC in disseminating COVID-19-related content, several articles studied the function of misleading visuals (Amidon et al., 2021; Atherton, 2021; Batova, 2021; Carlson & Gouge, 2021; Doan, 2021; Lindgren, 2021; Verhulsdonck & Shah, 2021; Wolfe, 2021). At the same time, other TPC scholars have collected empirical data via eye-tracking studies to understand better how viewers perceive misleading TPC visuals (Lauer & O'Brien, 2022; Lauer & Sanchez, 2023).

The current work on visual euphemism also aligns very closely with Kostelnick's (2016) previous investigation of the function of emotional appeals in TPC visuals, in the way that both seek to promote more effective and human-centered design. Referencing a multitude of examples, he has pointed out that recent innovations in technology combined with contemporary aesthetics have created conditions and expectations for new user experiences. These experiences, like visual euphemism, are actually made more effective because of their personal, human-centered and humane intentionality.

Although Kostelnick's work and the other research discussed here don't specifically delve into euphemism, they do highlight the broader trends of scholars examining how TPC visuals can contribute to successful, humane communication, as well as their potential for misuse. Viewing TPC visuals through the lens of euphemism extends these trends and contributes to the effective and ethical visual communication all of the above scholarship aims for.

THE COMPLEX VERBAL EUPHEMISM

Understanding visual euphemism requires understanding verbal euphemism. Fowler (1957) characterized the trope as "the use of

a mild or vague or periphrastic expression as a substitute for blunt precision or disagreeable use" (p. 171). Lanham (1991) defined euphemism as the act of using "circumlocution to palliate something unpleasant" (p. 72). Both definitions draw from the Greek word *euphemismos*, essentially meaning to use favorable words. They also represent mainstream characterization of euphemism.

While certainly requiring word substitution, describing euphemism as merely linguistic exchange fails to represent the intricacy and power euphemism actually possesses. More than just polite language, the trope is a rhetorical manifestation arising from a complicated network of social norms, superstition and taboo, one that represents a profoundly elaborate tapestry of culture, class, and power. Moreover, because sometimes we expect and prefer euphemism and other times it can be offensively deceptive, euphemism has a unique, almost contradictory, duality. Put simply, euphemism is complex.

Protective Euphemism

Notwithstanding this complexity, most euphemisms can be divided into one of two types: protective and underhanded (Burridge, 2012). Protective euphemisms are commonly used to avoid discussing offensive subjects explicitly. Although the level of severity for offensiveness varies from one culture to the next, what most consider unmentionable is remarkably consistent. In their comprehensive cross-cultural study of euphemism, linguists Allan and Burridge (1991) found:

> Attitudes to bodily effluvia, body parts, to notions of social status and the like, to death, disease, to dangerous animals, and to the supernatural, vary tremendously between cultures; but essentially these same parameters recur in every culture (and subculture) to motivate euphemism. (p. 8)

Across cultures then, euphemism allows interlocuters to navigate conversations without offense, providing a cushioning effect on mental and emotional discomfort. This type of linguistic protection is most evident in discourse surrounding death. Common phrases such as "in a better place," "no longer with us," or the clinical "expired" provide a veil of comfort, shielding the psyche from the finality of words like "dead" and "died." In this way, protective euphemisms act as psychological coping mechanisms, lessening the anxiety caused by life's greatest mystery—its end.

For the same purpose of protection against death, euphemism plays a crucial role in diminishing our corporeality and thereby concealing the ephemeral nature of our existence. To this end, there is a seemingly infinite number of euphemisms that obscure various aspects of the human body—its functions, parts, pains, and pleasures. Terms like "bathroom" and "restroom" are used instead of explicit reference to what these spaces are really intended for. "Private parts" and "nether regions" supplant specific denotation of actual human genitalia. Phrases like "health condition" and "senior moments" make devastating illnesses seem much less severe, and therefore more manageable than they may actually be. And circumlocutions like "intimate," "doing it," and "Netflix and chill" allude to carnal activities without bodily reference. By downplaying physicality, these types of protective euphemisms provide psychological distance from the inherent vulnerability and mortality that comes with being human.

Euphemism also ostensibly protects against cultural and societal insecurities and anxieties as well. Nowhere is this more evident than in the euphemisms associated with women's bodies. These euphemisms reflect cultural sensitivities at the same time they perpetuate sexist societal taboos and stigmas. They also reveal the complex interplay between language, gender, and power, where the effort to mask female embodied experiences is manifest. Phrases like "in a family way" and "bun in the oven" diminish female embodiment while simultaneously reflecting patriarchal apprehensions and sexist beliefs around pregnancy. The pervasive euphemizing of menstruation also demonstrates this phenomenon. Expressions such as "a visit from Aunt Flo" and "time of the month," along with the antiquated "flowers," represent just a fraction of the countless ways cultures have evaded direct conversation about menstruation. Indeed, the number of words and phrases created to *not* talk about menstruation surpasses irony to the point of paradox.

Underhanded Euphemism

The second category of common euphemism is underhanded. Intended to create linguistic loopholes that can mislead, confuse, and permit plausible deniability, underhanded euphemisms are potent tools for shaping perception and controlling narrative. They enable the transformation of "mass murder" into "collateral damage," concealing the true nature of violent war-time acts and their devastating consequences. By replacing a word like "torture" with "enhanced interrogation" or transforming "slavery" into "a peculiar institution," underhanded euphemisms sanitize morally reprehensible practices. To paraphrase Orwell (1946), underhanded euphemism is often used to defend the indefensible.

The complexity of euphemism created by its Janus face of protection and underhandedness is heightened by another often overlooked feature of the trope. Although euphemisms are intended to obscure and redirect, they somehow must still convey the thing they are meant to obscure. Certainly, some euphemisms like the preceding push the boundaries of credulity and can even be offensive in their attempts to sanitize abhorrent concepts and actions; however, while not exactly truthful, neither are they lies. Euphemisms can diminish atrocity, fostering detachment and ignorance to an amoral degree, but they do so in a linguistic liminal space.

Another feature of euphemism's complexity is its perpetual reliance on context. Relative to time, place, and circumstance, the same word can transform from being euphemistic in one scenario to neutral or even dysphemistic in another. Take the words "queer" and "fat." Within the realms of "queer theory" and "fat studies," these terms are a form of transgressive reappropriation and therefore carry positive connotations for their users; however, in other contexts, these same terms would likely be considered derogatory.

Similar to its contextual reliance is euphemism's unending mutability, what Allan and Burridge (2006) referred to as "contamination" and Pinker (1994) has called the "euphemism treadmill." These terms refer to the linguistic phenomenon of a word's positive or neutral connotations being supplanted by negative or offensive ones. The word "retarded" is a prime example. Originally coined as a neutral term to replace derogatory terms like "moron" and "feeble-minded," "retarded" has evolved to become highly offensive itself. Even when used non-pejoratively, it is now often recommended to substitute it with "R-word" or "R-slur" to avoid causing offense.

Obviously, euphemism is much more than mere word swapping. It is instead a complex rhetorical trope that can be used equally to protect and comfort as it can be to underhandedly manipulate and deceive. Moreover, its usage depends upon immeasurable, always-evolving tacit contextual and cultural knowledge. Given all this, and in light of its frequency of use, it would be advantageous to achieve a deeper understanding of euphemism.

THE (EVEN MORE) COMPLEX VISUAL EUPHEMISM

Visual euphemism shares all of the complexity and features of verbal euphemism, but it also has some of its own unique features that make it even more complex than its verbal counterpart. This heightened complexity is evident in what is arguably the most ubiquitous example of visual euphemism in contemporary culture: the blue liquid visual substitute for blood. This visual trope first appeared in the late 70s, after the National Broadcaster's Association ended its prohibition on advertisements for menstruation-related products. This move allowed Johnson & Johnson to promote their tampons and pads directly to consumers. In addition to ease of use and comfortability, their marketing strategy emphasized their products' absorbency. In 1979, similar ads depicting a tampon inserted into the middle of an hourglass-shaped vial appeared in popular women's magazines. In the before picture, the bottom half of the vial contains a bright blue liquid. When turned upside down in the after picture, none of the blue liquid drains into the bottom, thereby demonstrating the product's effectiveness at preventing leaks. Subsequently, the blue liquid visual euphemism became a mainstay of advertisements for tampons and pads, as well as other products that proclaimed to be effective at absorbing bodily fluids, such as diapers.

Mimesis and Visual Euphemism

Given the immensity of verbal euphemisms for menstruation and the pervasiveness of provincial anxiety toward female bodies, it's not surprising that one of the most well-recognized visual euphemisms would be related to menstruation. And, unsurprisingly, the visual euphemism operates for many of the same reasons and in many of the same ways as its verbal counterpart. The blue liquid enables communication while protecting against the taboo; it is a manifestation of the societal and cultural fears of the times; it relies a great deal on context and tacit understanding; and it even seems to reflect a susceptibility to contamination and the euphemism treadmill, as the blue liquid has been updated to purple in recent years.

What the blue liquid visual euphemism doesn't share with verbal euphemism, though, is the arbitrary relationship between form and meaning that all verbal language participates in. The blue liquid is still a liquid—just as the blood it visually stands in for is. This potential for an analogous relationship between form and meaning makes visual euphemism a much more complex trope than verbal euphemism. With verbal euphemism, there aren't pleasant or polite words per se, just words that signify in ways that are perceived as pleasant or polite. True, visual signs have the potential to construct meaning through an arbitrary correlation between signifier and signified (black is the color of mourning in some cultures, white in others), and they often do; however, unlike words, visual signs like the blue liquid can also demonstrate an analogously mimetic correlation between signifier and signified. The image of an apple can connote various signifieds, such as knowledge, health, or a gift for a teacher. At the same time, an image of an apple, such as in a photograph, can and often does denote an actual apple.

Barthes (1977) identified this quasi-tautological aspect of visual communication as a fundamental difference between verbal and visual signs. He explained:

> Given that the relation between thing signified and image signifying in analogical representation is not "arbitrary" (as it is in language), it is no longer necessary to dose the relay with a third term in the guise of the psychic image of the object. (p. 154)

For many images, the quasi-tautological correspondence between signifier and signified is part of the benefit of visual communication. The creator of the visual sign does not have to gamble with the viewer's interpretation; there is no need for them to envision the thing—and perhaps get it wrong—because the thing is already visualized for them.

Abstraction and Visual Euphemism

In the case of visual euphemism, the analogously mimetic relationship between image and thing presents an interesting dilemma, though: how does one show what people don't want to see? The answer is through the process of abstraction. Primarily related to visual communication, abstraction describes how the salient features of a thing are used to convey the meaning or essence of that thing (Arnheim, 1969/2004). When an illustrator draws a smiley face, they emphasize important features—the eyes, mouth and head—through very basic shapes—dots, lines, and a circle—while also deemphasizing detail and excluding other features (McCloud, 1994). This inclusion/exclusion process focuses attention on the essential features of a thing to amplify meaning.

Visual euphemism also relies on the inclusion/exclusion process of abstraction to construct saliency and create meaning. Shape, color, and other visual elements are used to convey meaning but without being visually exact or specific. In the case of the blue liquid, a color change made it possible for advertisers to show what their products can do in a way that mitigated the cultural taboos associated with menstrual blood. Through phallic and callipygian-shaped visual allusion, the eggplant and peach emojis have become widely understood as euphemistic visual substitutes for genitalia. The ubiquitous male/female isotypes outside many public restrooms work by making salient which space a person should use while excluding the unsightly bodily functions that actually occur in those spaces. Road signs use abstract symbols and other simplified visual icons to warn of the danger, damage and potential death caused by slippery roads and falling rocks without actually showing the graphic outcomes of such accidents.

Abstraction can also be used to create underhanded visual euphemisms. This is particularly true of many TPC visuals. Charts and graphs, for instance, rely heavily on abstraction to purposefully highlight trends and enable certain comparisons at the expense of other details. Because of this, data visualizations can easily be designed in ways that misinform. A too-short y-axis can make the disparity between data sets represented by bars in a graph look more significant than they actually are; a too-long y-axis can make the same disparity seem insignificant. A pie chart can make it more challenging to distinguish differences between datasets compared to a bar graph using the same data. These manipulations of abstraction distort meaning without actually being untrue. Likewise, a report that includes photos of individuals who have tragically lost their lives due to a malfunctioning product conveys the reality of human loss much more directly than a euphemized table in which victims

appear as mere numbers in a column. In cases like these, abstraction diminishes the human element to a simple statistic, potentially lessening the emotional impact and moral implications of the actual cause of the suffering, thereby enabling it to continue.

Maps, too, work through abstraction. Their primary purpose is to reduce three dimensions into something that is perceivable on a two-dimensional page. In this way, they are a type of comforting visual euphemism, one that allows for the successful navigation and an understanding of geography that would be impossible otherwise. But maps can also be underhanded in the way they diminish and exclude the humans who exist in a geographical area. This type of exclusion can have serious consequences. For instance, a map that emphasizes geographical features but neglects to include human settlements may make it easier to mine, frack, or bomb the area, facilitating destruction, death, and many other inhumane actions.

Dynamic Visual Euphemisms

Another complicating feature of visual euphemism is their potential to move. Pharmaceutical advertisements can be a striking example, because advertisers and designers often face the challenge of visually representing the unsightly illnesses their products treat. This dilemma has precipitated the creation of what I call animated ailments—intricate anthropomorphic visual euphemisms of disease. Digger the Dermatophyte (Figure 3), an ugly little yellow creature who represents unsightly toe fungus in commercials for Lamisil, and Mr. Mucus (Figure 4), a green, gelatinous blob that stands in for human mucus in commercials for Mucinex, are excellent examples.

Figure 3: Digger the Dermatophyte for Lamisil

Figure 4: Mr. Mucus for Mucinex

There is a long history of these animated ailments in advertising; they have even been created for ailments that cannot be seen. For example, depression is represented by a malfunctioning windup toy in ads for Pristiq (Figure 5); an overactive bladder is made visible by about-to-burst water balloons in ads for Enablex (Figure 6).

Figure 5: Depressed Wind Up Doll for Pristiq

Figure 6: Water Balloons for Enablex

These dynamic visual euphemisms depict bodily ailments and illnesses while also demonstrating how the promoted products remedy illness in ways that don't disturb the audience. In doing so, they are significantly more complex than verbal euphemisms.

A CRITICAL FRAMEWORK FOR VISUAL EUPHEMISM

Despite the complexity outlined above, most people rely on a rather simple method for recognizing euphemism: "I know it when I read/hear/see it." However, for researchers who want to better identify and understand euphemism, Brown and Levinson's (1987) politeness theory provides an adaptable heuristic for doing so formulaically and reliably.

Politeness Theory Explained

Brown and Levinson's (1987) politeness theory centers on Grice's (1967) concept of "face," essentially shorthand for one's self-image.

As long as each party in a communicative act is rational and seeks effective communication, they will work to communicate without damaging face. When a speaker fails to take face into account and says something or makes a request that offends or embarrasses, they have committed a "face-threatening-act" (FTA). What determines the severity of an FTA is a combination of three factors:

- Social distance: the level of familiarity between participants in the communicative act
- Power: the degree to which one participant has power—or not—over the other, either through hierarchical position or the ability to impose their will
- Rank of imposition: the cost or burden (measured in time, money, material goods or mental/emotional labor) associated with participating in the communicative act

Brown and Levinson (1987) called the conflation of these three factors "weightiness." While gaging weightiness is a deliberative tacit process, they provide the following equation to explicate:

$$Wx = D(S,H) + P(H,S) + Rx$$

They explain:

> Wx is the numerical value that measures the weightiness of the FTA x, D(S,H) is the value that measures the social distance between S[peaker] and H[earer], P(H,S) is a measure of the power that H has over S, and Rx is a value that measures the degree to which the FTA x is rated an imposition in that culture. (p. 76)

Depending on the outcome of this equation, a person will use one of four politeness strategies that permit them to communicate what they need to but in a way that avoids or mitigates the FTA. These four strategies are:

- on record: direct, unambiguous and succinct
- positive politeness: somewhat direct, mutually respectful, inclusive and complimentary
- negative politeness: somewhat ambiguous, deferential, wordy
- off record: indirect, ambiguous, and suggestive

When weightiness is low, individuals tend to communicate on record, expressing their intentions directly. In contrast, when weightiness is high, individuals communicate off record, leaving room for multiple interpretations and to create plausible deniability for any face-threatening acts. Euphemism is the quintessential form of off record communication.

Politeness Theory Adapted

While the formula provided by Brown and Levinson (1987) is theoretical, meant to describe an unquantifiable mental process, it is possible to determine the likelihood of off record communication like euphemism by refiguring this formula and calculating for (W)eightiness forensically. One can do this by asking, researching and answering questions like: What is the level of familiarity between the parties? Who has more power? What is the cost or burden created by the communicative act?

Likert scales of social (D)istance, (P)ower, and (R)ank of imposition that range in numerical value from 0 to 5, such that 0 = none; 1 = very low; 2 = low; 3 = moderate; 4 = high; and 5 = very high, can be used to measure the levels of each. External coders can then be employed to ensure reproducibility and reliability, further substantiating the level of directness or indirectness in the communicative act. These scores can then be added to assign a numerical value for (W)eightiness, which in turn can be correlated with Brown and Levinson's (1987) politeness strategies (Table 1):

(W)eightiness Value	Politeness Strategy
0-3	On record
4-7	Negative politeness
8-11	Positive politeness
12-15	Off record (includes euphemism)

Table 1: (W)eightiness-to-politeness-strategy correlation

Because euphemism is the ultimate trope of off record communication, determining (W)eightiness and correlating it with a politeness strategy permits a helpful syllogistic reasoning to identify and subsequently analyze euphemism. If the number is in the 12-15 range for off record communication, and the researcher concludes a euphemism has actually occurred, they can then conduct further interrogation of face relative to the participants in the communicative act to determine motivation and intent. In essence, they answer the question: do the factors of social distance, power and rank of imposition that contextualized the communicative act suggest the euphemism was meant to comfort or mislead?

For identifying visual euphemism, various design theories and numerous heuristics can be integrated to systematically organize and comprehend the design components used, such as color, shape, framing, arrangement, and proportion. Doing so aids in identifying and analyzing the inclusions, exclusions and changes made during the abstraction process that produced the visual euphemism. This process of analysis provides valuable insights into the specific contributions made by individual design elements that engendered the visual euphemism. The result is an enrichment of our overall understanding of how visual euphemisms are crafted and how visual tropes operate more broadly.

Basic Critical Framework

A basic critical framework for visual euphemism that incorporates all this would follow a straightforward step-by-step process:

1. Identify visual artifact(s) for study
2. Determine (D)istance, (P)ower, and (R)ank of imposition
3. Ascertain interrater reliability
4. Calculate for (W)eightiness and correlate with politeness strategy
5. If off record and euphemistic, classify type of euphemism (protective or underhanded)
6. Catalog euphemistic design elements
7. Conclude and contribute to scholarship on visual euphemism/visual tropes

The critical framework established by these analytical steps provide a systematic approach for identifying and studying visual artifacts. It facilitates carefully discerning the nuances of euphemistic visuals to better understand how they function. Although intricate and challenging to disentangle amidst the deliberate ambiguity of euphemism and the innate polysemous nature of visuals, TPC scholars with their knowledge of rhetoric and visual rhetoric are uniquely equipped to do just this.

TPC VISUALS AS VISUAL EUPHEMISMS

The concept of visual euphemism and the critical framework can serve as valuable and effective tools for researchers studying TPC visuals. Briefly revisiting some past scholarly examinations of TPC visuals supports this claim, suggesting visual euphemism's substantial utility for studying other TPC visuals.

Nightingale's Rose Diagrams

Florence Nightingale's rose diagrams showing the rates and causes of British soldiers' deaths in the Crimean War are a well-established entry in the canon of TPC visuals. Brasseur (2005) partly attributed their importance to Nightingale's incredible ability to abstract data in a way that was easily understandable to a general audience. However, an initial reconsideration of the rose diagrams suggests Nightingale might also have been an adept user of visual euphemism. Consider that Nightingale herself characterized the British field hospitals in Crimea as "hell on earth" (Florence Nightingale: Biography); yet her diagrams depict this hellish scene innocuously through shapes, colors and shading. In this sense, the rose diagrams could be visual euphemisms, ones that enabled the audience to comprehend the true reasons for so many soldiers' deaths, but in a way that protected them from their harrowing circumstances.

Booth's Maps of London Poverty

Kimball (2006) analyzed Charles Booth's maps of London poverty and showed them to be a product of the visual culture and aesthetic sensibilities of the time. Through the clever use of color and design, Booth designed maps that allowed the moneyed class to "see" the harsh realities of poverty in the form of darkly colored boxes representing the habitats of impoverished individuals. By visually representing poverty in this anodyne and aesthetically pleasing manner, Booth's maps potentially served as visual euphemisms, enabling the upper class to acknowledge and engage with the issue of poverty without directly confronting its harsh reality.

Minard's Napoleon's March on Moscow

For its combined use of a map, timeline, icons, and various other visual features to depict Napoleon's ill-fated invasion of Russia, Tufte (1983) has said that Joseph Minard's Napoleon's March on Moscow "may well be the best statistical graphic ever drawn" (p. 40). Dragga and Voss (2001), however, have argued—somewhat controversially—that the graph is actually cruel and inhumane. Through the lens of visual euphemism, analysts could assess and determine if Tufte's accolade is justified or if the graph is in fact misleading in the way it obfuscates the true cost of human life and suffering as Dragga and Voss contended.

Du Bois's Data Visualizations

The little-known but important data visualizations of W.E.B Du Bois are also worth reinvestigating as potential examples of visual euphemism. In a previous work (Van Winkle, 2022), I explained how Du Bois created these visualizations and presented them at the 1900 World's Fair in Paris to counter the social Darwinists' racist belief that freed slaves were incapable of self-government and socio-economic progress. Du Bois's visualizations potentially functioned as visual euphemisms in the way they emphasized the remarkable socio-economic achievements made by newly freed slaves and their descendants but visually avoided the extreme adversity and violence they suffered during this same time from the Ku Klux Klan.

The intent of these examples is not to assert that they definitively qualify as visual euphemisms. Convincingly determining them as such requires comprehensive application of the analytical framework outlined earlier. Nonetheless, they suggest the potential value of scrutinizing a range of TPC visuals—whether previously studied, contemporary and unexamined, or yet to be created—as potential instances of visual euphemism.

CONCLUSION

Although an argument for exploring and analyzing vague and indirect communication like visual euphemism may seem at first encounter contradictory to the straightforwardness and clarity expected in technical and professional communication, it is actually the reason why it is such a useful concept. By employing visual euphemism and utilizing the provided critical framework for their identification and analysis, scholars in TPC can enhance our collective understanding of how visuals inform or misinform. This, in turn, facilitates the development of visuals that bridge the gap between specialized knowledge and users in rhetorically effective and ethical ways, thereby supporting the shared goals of TPC scholars, pedagogues, and practitioners.

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Book review: *Data justice and the right to the city*

By Morgan Currie, Jeremy Knox, and Callum McGreggor (Eds.)

Currie, M., Knox, J. & McGregor, C. (Ed). (2022). *Data justice and the right to the city*. Edinburgh University Press.

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Data Justice and the Right to the City consists of a set of case studies each exploring the intersections between urban governance and datafication. This volume, edited by Morgan Currie, Jeremy Knox, and Callum McGregor, situates itself within the critical discourse on how data-driven technologies reshape urban spaces, impacting notions of citizenship, justice, and democracy. Each chapter draws inspiration from Henri Lefebvre's concept of the Right to the City (RTTC) theory by integrating data justice as a complementary framework to address the political ramifications of datafication in urban contexts. RTTC emphasizes participatory parity in urban space by developing spaces and data systems that enable all residents, regardless of their economic status, cultural background, or political power, to have an equal say in how their cities are designed and managed.

The book is divided into four sections—algorithmic government; education; gig, platform, and crowd labour; and art and activism in the datafied city. Each section includes case studies that explicate each theme. This text provides a good basis for scholars and practitioners interested in understanding some of the core ethical issues involved in municipal data use, and it does so by updating RTTC theory to make sense of modern urban spaces saturated with data-intense technologies.

The editors' introduction outlines a theoretical foundation of the book's case studies by describing the RTTC through the principles of data justice. In this section, Editor Currie advocates for the collective design and management of urban spaces, ensuring inclusivity and equity in urban development. Data justice, Curie argues, contributes the economic and political dimensions of datafication to RTTC and challenges the idea of data as a neutral, apolitical tool. In this way, the book contributes to a growing body of scholarship examining and offering tools for social justice in the smart city. The book's strength is in its case examples, which provide heuristics for thinking through many approaches for advocating for data justice.

The first section of the book looks at how data-driven technologies are employed in urban governance and their implications for social justice. Jansen's chapter on predictive policing, for instance, provides a critical analysis of how algorithmic systems are used to forecast crime, often reinforcing existing biases and inequalities. Jansen underscores the paradox of predictive policing: while it aims to enhance efficiency and safety, it often exacerbates social stratification by disproportionately targeting marginalized communities. Similarly, Metcalfe's chapter on hostile data in the UK's immigration policies highlights how data systems perpetuate exclusion and discrimination. By tracing the historical antecedents of these policies, Metcalfe reveals the deeply entrenched biases in data-driven governance, calling for a reorientation towards more inclusive and transparent practices. Redden, Brand, Sander, and Warne end the section by investigating the use and challenges of using predictive analytics in child welfare services. This chapter includes a variety of news stories from AlgorithmWatch, a non-governmental, non-profit organization based in Berlin and Zurich. This section is valuable in that it offers concrete examples of how data collection and analysis affects the lives of residents.

The second section of the book focuses on education and the role of data literacy in fostering democratic engagement. Zehner critiques the university's role in shaping urban space and calls for authentic citizen participation in imagining alternative economic futures. Davies argues for rescuing data literacy from dataism, advocating for a vision of data justice that challenges the dominant narrative of digital literacy that encourages a critical awareness of data's limitations, the power structures behind data collection, and the need for inclusive, participatory data practices. Williamson examines smart city initiatives and their implications for citizenship, highlighting the constraints and possibilities for agency within these frameworks. Williamson's chapter is notable for offering two types of advocacy apprenticeships: one that focuses

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on developing skills for economic growth and industry needs, and one that emphasizes solving social problems and optimizing urban services through citizen participation in coding and data analysis. This section is particularly relevant to classroom pedagogy.

The book's third part details several cases on the complexities of gig and platform labor, examining how data-driven technologies mediate these forms of work. Gallagher's chapter on the historical and contemporary dimensions of gig work in Edinburgh, for example, provides a cultural-historical analysis comparing the eighteenth-century Society of Cadies with modern gig workers. Gallagher underscores the continuity of labor struggles, emphasizing the need for collective agency and local organizing to resist exploitative labor practices. Gregory's chapter on students as gig workers presents a compelling case for understanding the precarious labor conditions faced by students engaged in platform economies. Gregory critiques the neoliberal university's complicity in perpetuating these conditions, advocating for a critical pedagogy that equips students with the skills to navigate and challenge exploitative labor practices. Wood and Lehdonvirta's chapter on remote platform workers further outlines the challenges faced by gig workers. They highlight the spatial fragmentation and isolation inherent in remote work, calling for the development of online communities and collective action to address these issues. The authors argue for a reimagining of platform labor that prioritizes worker rights and agency over corporate profit. This section provides an important touchpoint for making sense of modern labor practices of the data economy.

The final section of the book explores art, activism, and data resistance. Feldman's chapter considers interventional strategies as it describes how urban activists use networked technologies to organize and resist surveillance. Feldman emphasizes the need for alternative communication infrastructures that align with the values of direct democracy and inclusivity, highlighting the creative strategies employed by activists to circumvent state and corporate surveillance. Catanzariti examines the impact of facial recognition software on public assembly politics, advocating for anti-surveillance interventions informed by an understanding of the underlying data infrastructures. Paris, Currie, Pasquetto, and Pierre critique the role of data in police reform and abolition movements, focusing on the epistemological implications of using data as evidence. Last, Thornton's chapter on public art interventions critiques the commodification of language through Google's AdWords system. Thornton's projects, such as {poem}.py, transform poems into visual representations of their economic value, challenging the pervasive influence of linguistic capitalism. These chapters emphasize how artistic interventions serve as a form of data resistance, making visible the often-invisible processes of datafication and economic control.

This book offers a wide-ranging set of cases that bridge theoretical insights with practical application, highlighting the problems inherent in data-driven urban governance. Co-editor McGregor emphasizes the need to balance critique and resistance with the pursuit of democratic data use, warning against both data fetishes and reactionary demands for unmediated urban rights. He calls for a sociological imagination that reclaims data as part of the urban commons to foster more equitable and participatory urban futures. Overall, this book balances seeing municipal data as both an object of critique as a site for revolutionary transformation.

By situating data justice within the broader framework of RTTC, *Data Justice and the Right to the City* provides a compelling argument for reclaiming urban spaces and data infrastructures as sites of democratic engagement and social justice. This volume is important reading for scholars, activists, and policymakers interested in the intersection of urban studies, data ethics, and social justice. It is also a critical resource for communication design scholars and professionals, providing valuable insights into the socio-political implications of datafication and its impact on urban life. The authors emphasize the importance of ethical and inclusive design, urging professionals to create transparent, user-centered documentation and systems that avoid perpetuating societal biases. By developing the concepts of data justice and showcasing innovative uses of multimedia for advocacy, the book offers practical and theoretical guidance fostering democratic engagement and building more socially just futures. *Data Justice and the Right to the City* challenges readers to critically examine the socio-political dimensions of datafication and to envision more just and inclusive urban futures.

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Book review: *Book anatomy: Body politics and materiality of Indigenous book history*

By Amy Gore

Gore, A. (2023). *Book Anatomy: Body politics and materiality of Indigenous book history*. University of Massachusetts Press.

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Have you ever wondered how design matters other than in content, structure, and insightful arrangement? Amy Gore's latest text, *Book Anatomy: Body Politics and the Materiality of Indigenous Book History,* can provide some answers to this question. A single sentence from the concluding chapter in her book— "When we read a book for its narrative content only, we miss half the story" (p.125)—speaks volumes about where lies the book's alternative rhetorical possibility. This alternative rhetoricity rests on paratextuality manifesting a text's layout, cover design, and spatial texture that make up the cornerstone of design-based communicative practices.

What makes Gore's book stand out is her analytical dig into ideologically motivated appropriation of paratextuality by some nineteenth-century publication houses. Paratextuality is a parlance that specifies how a text's thematic potential, socio-cultural orientation, and politico-ideological grounding are bound up with a text's other elements: the text's cover page, title, editorial intervention, introductory note, revised foreword, epigraph, footnote, and endnote, use of blank spaces, the layout of text, thumbprint images, bibliographical moves, textual omissions and elisions, and editorial additions and subtractions. What paratext stands for is subject to change. If an element of the paratext can thus "appear at any moment, it can equally disappear… through the decision of the author or outside intervention…" (Genette & Maclean, 2021, p. 264). Powertextual power—a power to play with design, texture, and layout—has been a part of politicization. That is, who can appropriate paratextual power is a question worth pondering. Not only Genette and Maclean but Gore and anyone working on the rhetoric of paratextuality pose this question.

Paratextuality exerts a great deal of say and sway over information design in a text. Like textuality, paratextuality influences what Allira Hanczakowski (2022) called the formative power over how a narrative is told, built, developed, and ended, how its voice is controlled, and how it is tamed and negotiated to cater to the expectations of the dominant community of readers. The fact that the design of paratextual space is not a passive site but a site of confrontation is explicitly reflected in Gore's remark: "Paratexualized forces impel and complicate textualized confrontation" (2023, p.18). Primarily, when it comes to designing information, our attention automatically drifts toward textual elements: ideas, thoughts, ordered arrangement of ideas, usage of images, symbols, cues, and signposts. Here technical communicators can take advantage of paratextual rhetoric to foster design justice, a practice of inquiring into whose interest a particular design serves. The design of narrative and textual content hardly tells us substantial things about the design of paratextual elements. Thus, Gore's book revisits design from the perspective of paratextuality because it is absence rather than presence in design that triggers suasive impact in a telling effect. This return to design is where the actual relevance of this book is for those who believe design is critical to the suasive conveyance of information.

Divided into five chapters and an introduction, *Book Anatomy* centers around a systematic analysis of paratextuality's rhetorical nexus with ideological practice. The common denominator that binds all these chapters together is the entanglements of paratextual rhetoric with the politics of print capitalism, settler-colonial ideology, and white supremacist proclivity. Having this understanding assists technical and professional communicators with giving a decolonial touch to their design-based communicative practices. The introduction "Making Matters" explains paratextuality as a framework for understanding how meaning-making processes are affected by

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nontextual elements. The introduction overviews how memorable Indigenous narrative accounts were paratextually manipulated and repositioned to meet the expectations of unregulated print capitalism. The most crucial trope in the introduction frames text as a body with diverse anatomies: textual and paratextual. One of the implications of this trope is that text is a living entity imbued with affective forces that are persuasive.

Chapter One, "Dispossessed: Editorial Dismemberments, Copyright, and Property Rights in John Rollin's Ridge's Murieta," explains how a 19th-century popular narrative, *The Life and Adventures of Joaquin* by John Ridge, had to course through a long cycle of dispossessions and violence. Due to a loose copyright law in 19th century America, Ridge's narrative was republished with some changes to the content, along with the insertion of a seemingly unique foreword and introduction. Drawing her readers' attention to how rampant plagiarism was in the nineteenth-century publication process, Gore writes, "It perpetuates the violence or the original plagiarism by showcasing a Nahl illustration from California Police Gazette plagiarism on its cover, invoking the history of Ridge's dismemberment from this text" (p. 39). The fact of the matter is that the meaning-making process became a site in which print capitalism and readership had to negotiate. It is through the manipulation of paratextual elements and entities that publishers sought to take advantage of the manuscript, thereby evading head-on the accusation of a dire form of plagiarism. This chapter's thrust is that even in the design of information lies the possibility of making some rhetorical choices, which is meaningful to technical communicators.

The book's second chapter, "Whiteness, Blank Space, and Gendered Embodiment in Winnemucca's Life among the Paiutes and Callahan's Wynema," discusses how blank space in the narrative comes to play a critical paratextual role. Blank space as a paratexual component serves as a spatial rhetoric. It appeals to technical and professional communicators because space-oriented rhetoric is important in design study and professional communication. Central to this chapter is the fact that the blank space exists in most of the narratives discussed above to play a rhetorical and ideological role. Literacy history demonstrates that writers in the 19th century and the early 20th century had to negotiate with various constraints, such as the editorial design logic of print capitalism in the US. A handful of strategically inserted paratextual elements, such as blank space in the narratives, were employed to amplify the visual impact of narrative constructions reproduced in flat-out defiance of copyright laws that protect writers' right to royalty and reward from the sale of their books. Regarding these appropriations, Gore argued, "I read blank space as a rhetorical strategy as well as a visual and symbolic paratextual element" (p.48). Gore's take on the issue under consideration makes room for "a deft rhetorical negotiation of both speech and silence" (p.48). The byline, copyright, appendix, and strategic narrative omission play their part significantly. Elements like author biographies, endorsements, and reviews can establish the credibility and authority of a work. Technical communicators can leverage these components to build trust and confidence in their materials, particularly when dealing with complex or technical subject matter.

Chapter Three, "Pretty Shield's Thumbprint," accentuates how a thumbprint included in the text *Pretty Shield*—an ethnographic narrative written by Linderman about a crow culture in Montana—serves as evidence of a zone of contestation, a zone in which colonizing forces aiming at the erasure of Indigenous agency met with the native Americans' undying longings for identities native to the soil. For technical and professional communicators interested in examining context-based information design, this chapter does have a great deal of significance.

When it comes to strategic design, Chapter Four, "Citational Relations and the Paratextual Vision of D'Archy McNickle's *The Surrounded," comes to occupy the forefront of the overview.* Here strategically designed paratextual elements such as gaze-oriented photos on the book cover, footnotes, and endnotes turn up as a host of decisive factors in promoting and restricting the visibility of Linderman and D'Archy. Studying paratextual components like tables of contents, indexes, and visuals helps technical communicators organize information clearly and enhance visual appeal. Prefaces and introductions provide audience insights for tailoring content. Author bios and endorsements build credibility. Cover designs and blurbs aid marketing and promotion so that, as claimed by Gore, contextual elements in the narratives of the select native American authors get foiled by paratextual elements.

A fantastic foray into the emerging scope of the rhetoric of paratextuality, the last chapter, "Paratextual Features," uncovers the phenomenon of digitizing archives and digital production of text in the contemporary era. On closer examination, Gore envisions a growing scope of paratextual politics and rhetoric, urging her readers to unpack how paratextual design works hand in glove with an ideological interest. This point appeals to technical and professional communicators because their design-based rhetoric is tethered to context. This work is helpful for communicators involved in technical and professional communication because our rhetorical, pedagogical, and communicative practices have already started taking on instrumentalist, design-oriented, and structured hallmarks (Aakhus, 2007). For example, technical communicators started opting for practices such as writing studios, makerspaces, design thinking, user interface (UI), and user experience (UX). Often, technical communicators overemphasize textuality to the detriment of other elements that fall outside the purview of the textual domain (Selber, 1994). As a result, the immersive impact of paratextual design in learning and teaching space is pushed to the sideline. Previous technical communication research has extended the notion of the rhetorical situation in the wake of new materialist, spatial, and design rhetoric. The rhetoricity of design, including the intentional ordering of information, stems not only from ideas, images, and arguments but also from nontextual components such as layout, texture, cover design, and spaces left blank on pages on purpose (Herman, 2008).

Thus, Gore's *Book Anatomy* is a handbook for those delving deep into how the design of paratextual elements can be leveraged to enrich affordances in technical and professional communication. Her text details how paratextual elements such as tables of contents, indexes, glossaries, and appendices play a crucial role in organizing and presenting information in a structured and accessible manner. Understanding how these elements function can help technical communicators design clear and user-friendly documentation, manuals, and reports.

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Book review: *Amplifying voices in UX: Balancing design and user needs in technical communication*

By Amber L. Lancaster and Carie S.T. King (Eds.)

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In *Amplifying Voices in UX*, a diverse group of scholars and practitioners come together to explore different aspects of user experience (UX) with a focus on inclusivity and social justice. This book moves beyond conventional UX frameworks, presenting innovative pedagogical strategies and methodologies that highlight empathy, accessibility, and the importance of considering marginalized voices in design. The authors delve into areas often overlooked in mainstream UX discourse, offering new perspectives on how to create more inclusive and impactful user experiences.

The first section, "Pedagogical Topics," focuses on innovative pedagogical strategies for teaching UX and technical and professional communication (TPC). The opening chapter, by Tham and Grace, introduces a design thinking method that highlights empathy and addresses complex problems with multiple stakeholders. They integrated this approach into their technical communication (TC) courses through a service-learning model, underscoring the importance of a stakeholder-centered mindset. This approach is particularly "desirable for TC and UX courses" as "students learn to advocate for users and stakeholders in socially just and responsible ways" (p. 44). Lee and Oswal, in chapter 2, address the need to integrate accessibility into UX design early on. They critique late-stage, checklist-based approaches to accessibility for lacking context and a user-centered focus. Their course design highlights the interconnectedness of UX and accessibility concepts and helps students understand the broader context and rhetorical situations of disability access. In chapter 3, Bennett applies disability justice principles to UX practices in digital courses.

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While online classes have historically been praised for removing normative barriers through accessible technologies, ableism still systematically influences digital course design. Through surveys and interviews with students, Bennett emphasizes that "disability justice values should be extended to the design of digital courses" (p. 89), ensuring disabled students are empowered as active participants in their educational experiences.

In chapter 4, Gallagher and Gallagher introduce a pedagogical framework centered on "access-first design," immersing students in essential components of accessible digital visual design such as "tags, alternative texts, and visual content descriptions" (p. 113). This framework trains students to systematically deconstruct and analyze visuals, enabling them to "generate rich visual translations and accessible materials" for users with low vision and blindness (p. 120). In closing Part One, Ilyasova and May emphasize empathy in TC and UX education. They highlight the gap in the literature regarding practical guidance on developing empathy, arguing that "empathy is a teachable set of skills" (p. 137). They propose pedagogical strategies such as emotional vocabulary lists, mapping, and mindfulness exercises to foster students' emotional literacy, preparing them to design more empathetic and inclusive solutions.

The chapters in part one collectively highlight the importance of integrating empathy and accessibility into pedagogical practices, offering diversified, practical approaches such as embedding design thinking within service-learning models, integrating accessibility early in UX education, and applying disability justice principles to challenge ableism in digital course design. These innovations provide clear, actionable guidance on what should be included in UX curriculum, helping educators understand how to train more inclusive, empathetic, and effective design professionals.

Part two, "Rhetoric of Health and Medicine Topics," explores how UX practices can enhance user advocacy and patient experiences in various healthcare contexts. In chapter 6, Acharya highlights the disconnect between mHealth apps developed in the Global North (GN) and the needs of Global South (GS) users, advocating for localization that considers cultural values, behaviors, and local contexts. Acharya advocates for native features to address local challenges, such as improving offline functionality in low-bandwidth environments. In chapter 7, Chong and Rice-Bailey tackle the sensitive and crucial topic of

advance directives (ADs), legal documents for end-of-life care. They highlight the inadequacies in current AD forms, which are often difficult to understand due to complex language and poor design. For instance, the use of double negative language can be very confusing; if patients do not read it carefully, "they may inadvertently select an option they do not want" (p. 206). The authors advocate for improving AD forms to empower patients to make informed decisions about their end-of-life care, ensuring their wishes are clearly communicated and respected.

In chapter 8, Henderson draws on her experience as a former collegiate athlete and employs localized design and patient-experience design (PXD) methodologies to highlight how collaborative design efforts can better address athletes' mental health needs. By emphasizing the contextualized needs of patient-users, Henderson demonstrates how TPC can extend user advocacy beyond academic settings and better support mental health in nonacademic environments. Continuing the theme of accessibility from Lee and Oswal's exploration, in chapter 9, Oppegaard and Rabby explore how audio descriptions can enhance social inclusion for people who are blind or have low vision. Participants noted that fact-based, concise audio descriptions significantly improved users' sense of inclusion. Authors point out that well-crafted audio descriptions can make public spaces more accessible and inclusive, making "people who cannot see or see well feel valued and important to public places" (p. 289). In the last chapter of part two, Wang explores the importance of localization in usability design through a case study of a Chinese pregnancy app named the BabyTree. Wang underscores how the app's localization strategy effectively integrates cultural values and tackles the unique challenges faced by Chinese women. Key features, such as social networking and enabling user opening online stores, "facilitate redistributing medical and material resources on pregnancy and motherhood" (p. 319) for stay-at-home new mothers. The chapters in part two provide valuable insights for researchers in health communication. They emphasize the necessity of localization, inclusivity, and cultural sensitivity in health communication design, highlighting the importance of attending to the specific contexts, challenges, and unique needs of target users.

The final section of the book, "Equality, Access, and Social Justice Topics," focuses on how UX practices can tackle systemic inequities and foster inclusive design in diverse settings. In chapter 11, Hodges and co-authors focus on equity for teaching faculty and graduate student instructors. They highlight the irony that those facilitating knowledge sharing in UX are often "underrepresented and exploited" themselves (p. 327). Using a design justice framework, the authors emphasize the need for incorporating their voices into the design of service TPC courses and creating mentorship networks, flexible training resources, and teaching resource pools to advocate for more collaborative and equitable conditions in higher education. In chapter 12, Harris, Mendoza, and Bowers turn readers' attention to UX design's role in driving institutional change. Through the investigation of Stacey Abrams's campaign for voting rights in Georgia, they show how UX principles can address systemic oppression and empower marginalized communities. This chapter vividly demonstrates the potential of UX design to instigate social and institutional change, positioning it as a powerful tool for equity and justice.

In chapter 13, echoing Wang's exploration of localization and user empowerment, Hopton and co-authors focus on the challenges in localizing climate-smart technology for women beekeepers and explore how participatory design can enhance female users' economic opportunities, autonomy, and digital literacy. For example, Ethiopian beekeepers must inspect apiaries early in remote areas to avoid aggressive bee subspecies. The app's design must consider these risks and ensure the safety of women beekeepers, highlighting the importance of working closely with local users to gain such regional and gender-specific insights. The last chapter by Dong and Topping examines safety vulnerabilities in ridesharing through the lens of feminist UX design. By examining two heinous cases where women were victimized during ridesharing, Dong and Topping illustrate "technology is rarely if ever neutral" (p. 416). The authors critique the marketing materials and app interfaces for perpetuating patriarchal perspectives when they portray women as objects of desire rather than autonomous individuals and encourage interactions that prioritize social and romantic relationships over user safety. Authors advocate for participatory design approaches that incorporate feminist perspectives, emphasizing the importance of considering gender dynamics at all stages of the design process to create safer and more equitable ridesharing experiences for women.

The chapters in Part Three highlight the critical role of UX in addressing systemic inequities and promoting social justice across various contexts, including education, public services, and technology. By integrating the voices of underrepresented and often-exploited groups—such as teaching faculty and graduate student instructors, marginalized communities in voting campaigns, and those exposed to safety vulnerabilities like women beekeepers and female rideshare users—the authors offer actionable strategies for using UX design to promote social justice and equity. They highlight the importance of participatory design practices, providing useful guidance on how to address critical, frequently overlooked populations.

Overall, *Amplifying Voices in UX* is a compelling and thought-provoking collection that underscores the significance of inclusivity and social justice in UX and TPC. By presenting a diverse range of case studies and practical approaches, the authors effectively demonstrate how UX design can be a powerful tool for fostering equity and empowering marginalized communities. This book is an invaluable resource for educators, researchers, and practitioners who are committed to creating more inclusive and socially responsible design practices. Through its comprehensive exploration of empathy, accessibility, and localization, *Amplifying Voices in UX* not only enriches our understanding of UX but also inspires actionable change towards a more equitable digital landscape.

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Yingying Tang, Assistant Professor at Sam Houston State University, specializes in social justice, usability studies, and the digital rhetoric of emerging technologies. Her work has been published in journals such as the *Journal of Technical Writing and Communication, Communication Design Quarterly Review, H-Net Reviews*, and *Springer.*

Book review: *Engineering words: Communicating clearly in the workplace*

By Sharon Burton and Bonni Graham Gonzalez

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Engineering Words: Communicating Clearly in the Workplace by Sharon Burton and Bonni Graham Gonzalez emphasizes that effective communication is essential for engineers to succeed in their careers. The book argues that technical brilliance alone is insufficient, and engineers must also convey their ideas clearly and persuasively to various audiences in business environments. It provides practical guidelines and techniques for various forms of communication that engineers commonly use. These include writing clear business documents, creating compelling presentations, and understanding the business context in which engineering communication occurs. Additionally, the authors integrate concepts of human cognition to explain how people process information and how this understanding can be applied to improve communication. They argue that mastering communication can significantly enhance an engineer's career prospects and influence.

The introductory chapter sets the stage for the book's focus on improving communication skills for engineers. It explains the importance of clear communication in the engineering field and outlines the book's target audience, which includes both college students and practicing engineers. The chapter emphasizes that good communication is crucial for career advancement and successful collaboration in the workplace. It reassures readers that communication skills can be learned and communicative techniques discussed are applicable to real-world situations.

In chapter two, the authors provide fundamental guidelines for clear communication in a business context. They emphasize the importance of writing in an active voice, using present tense, and focusing on clarity and brevity. The chapter discusses the basics of sentence and paragraph construction, the importance of user-focused writing, and practical tips for reducing reading level to enhance comprehension. The goal is to make technical writing straightforward and effective, ensuring that the intended message is easily understood by the audience.

Chapter three explores different contexts within which engineering communication occurs. It covers writing for various audiences, such as professors, bosses, and the public. The chapter delves into the financial aspects of engineering communication, explaining terms like revenue, gross profit, and net profit. It also addresses the historical and technical contexts of problem-solving in engineering and introduces the technology adoption curve. The chapter concludes with practical applications like constructing business cases based on return on investment (ROI) and cost avoidance.

Chapter four will be beneficial to engineering students entering the job market. It delves into writing employment documents, providing instructions on creating effective résumés and cover letters. It explains the structure of a cover letter, including addresses, dates, salutations, and complimentary closes. The chapter offers advice on telling a compelling story through cover letters and tailoring résumés to different job search environments, and highlights the importance of clarity, brevity, and relevance to appeal to potential employers.

Chapter five provides entry-level engineers with valuable information on project flow within a company, helping them contribute more meaningfully. The authors illustrate typical project phases, from initiation to delivery, emphasizing the importance of understanding business requirements and creating functional and technical specifications. The chapter covers development, testing, reality check meetings, and final delivery. It highlights the need for effective documentation and communication throughout the project lifecycle, offering tips for successful project management and communication.

For those seeking to improve their presentation skills, chapters six and seven will be helpful. Chapter six focuses on designing effective presentations, covering key aspects such as title slides, outlines, text formatting, font selection, color usage, and graphs. It provides practical tips for spelling and grammar to ensure professional and polished presentations. The authors highlight the

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importance of contrast, structure, and emphasis in setting the mood and enhancing comprehension. They discuss how to structure presentations to maintain audience interest, avoid common pitfalls in design, and convey key messages effectively.

Following designing effective presentations, Chapter seven offers practical advice on managing the physical and psychological aspects for delivering presentations confidently. The authors discuss techniques for reducing anxiety, maintaining audience attention, handing questions confidently, and navigating the politics of presentations to leave a positive and lasting impression. The chapter emphasizes the importance of managing oneself while speaking, using body language effectively, and engaging with the audience through voice modulation. The chapter also covers preparation steps to take before the presentation, ensuring presenters can deliver their presentations smoothly and effectively.

Chapter eight delves into the principles of human cognition and how they affect communication. The authors introduce cognitive concepts and describe how humans process, store, and retrieve information and how these processes influence comprehension and retention. It highlights the importance of designing communication that aligns with how people think and learn, using visual explanations and clear structures to reduce cognitive load and enhance understanding.

From the perspective of human cognition, chapter nine describes the process of constructing clear, effective, and persuasive explanations in the engineering field. It explores how effective explanations are not merely about presenting information but about shaping it in ways that the human brain can easily process and recall. This involves leveraging principles of design and perception, particularly using visual aids, to create visually appealing and cognitively resonant explanations. The chapter also discusses the transition from documenting technical information to addressing questions through cognitively constructed explanations, ensuring that complex ideas are broken down into manageable chunks that facilitate comprehension and application.

Chapter ten introduces the concepts of personas and scenarios as tools for user-centered design and communication. Personas refer to the target audience for a product, while scenarios describe the audience's lifestyles and needs. The chapter explains the importance of understanding the target audience and tailoring communication to their needs. It provides guidelines for creating and using personas to represent different user types and scenarios to illustrate specific use cases. In addition, it emphasizes the need for accurate and relevant personas and scenarios to ensure effective communication and user-centered design.

With clear personas and scenarios for a product development, chapter eleven focuses on writing functional specifications, which describe a product's "functional behavior and high-level characteristics in terms of features and functions" (p. 121). It provides comprehensive guidance for functional specifications and highlights the importance of understanding user expectations and behavior to ensure documentation meets users' needs. The chapter includes examples to illustrate how to deconstruct functions into multiple technical specifications, prioritize main functions and features, and create clear, concise descriptions for effective communication and implementation.

The final chapter emphasizes the role of testing in the product development process and its impact on communication. It discusses various organizational styles and reasons for testing, highlighting its importance in identifying defects and ensuring quality. The chapter provides guidelines for creating effective test cases and test suites, explaining how to deconstruct test cases and write detailed test plans. It stresses the need for clear communication throughout the testing process, ensuring that all stakeholders, including testers, product developers, and government agencies, understand the testing procedures, results, and their implications for the product's development and release.

Through its twelve chapters, the book addresses the gap between academic writing, characterized by complex sentences and extensive jargon, and engineering communication in business environments, which requires clear, concise, and direct communication. The authors' solutions are highly effective, providing practical and actionable principles that empower engineers to improve their communication skills, enhance collaboration, and drive business success. One of the book's strengths lies in situating engineering communication within business environments and highlighting the critical role of effective communication in problem-solving and in the flow of project and product development. It emphasizes the need for clear, concise, and targeted communication to ensure all stakeholders, from technical team members to non-technical managers, understand project objectives, requirements, and progress. This approach fosters better collaboration, secures necessary resources, and supports project advancement. Additionally, the book frames effective communication from the perspective of human cognition, persuasively offering strategies to minimize cognitive load. By using straightforward language, visual aids, and structured content, it ensures that complex information is presented in a manner that is easy for audiences to understand and retain, thereby enhancing the overall efficacy of communication in professional engineering contexts. However, the book misses addressing ethics in engineering communication, which is crucial for ensuring that engineers can navigate complex professional scenarios responsibly. This omission could limit the book's comprehensiveness in preparing engineers for all aspects of communication in the business world.

The book fits well into the fields of communication design and technical communication. Communication designers and technical communicators will benefit from the book's insights into methods for breaking down complex information into manageable parts, using visual aids, and employing straightforward language. These strategies enhance engagement, comprehension, and the overall effectiveness of technical communication, making the book a valuable resource for professionals looking to improve their ability to create impactful and user-friendly communication artifacts.

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