Introduction: Knowledge Design – Visual Rhetoric in Science Communication

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The successful interchange of complex information is critical to modern knowledge societies. In recent years, the struggle with COVID-19 and the challenge of climate change have underscored the importance of scientific insights. Yet, society's reliance on—and trust in—science cannot be taken for granted. To play a role in societal decision making, science depends on effective communication. Scientists need to put their insights into perspective, making them comprehensible and plausible to the general public. The rise of research in the field of science communication documents this increasing importance.[1] However, researchers are only beginning to take a distinctly design-oriented perspective on science and (more broadly) knowledge communication.[2] This delayed attention may come as a surprise because when we examine the practices of science communication, we find they are influenced by almost all areas of design: exhibits in science centers, learning games and materials, stages and spaces for science communication events, as well as online platforms and interfaces of all kinds. Moreover, graphic design plays a critical role in almost all areas of science communication—whether professionally executed or created by non-specialists.[3] Science communication is—to our mind—fundamentally interwoven with design, and the two areas would mutually profit from exchange with regard to theory, method, and criticism. Hence, by the term, *knowledge design*, we refer to a general design-oriented approach to the communication of knowledge and, particularly, of scientific insights.

We tend to think that science communication's main job is to get all the facts right and to make science intelligible to non-experts. However, to play a role in societal decision making, effective science communication needs to connect scientific research to non-specialists, making its insights plausible and underscoring its relevance to people's lives. Further, science's authority and credibility—its ethos, so to say—must be regularly re-instantiated through communication. For this reason, this special issue also pursues a rhetorical approach to design and science communication—and by the same token, we take knowledge design to be fundamentally informed by rhetoric.

1 See, e.g., Martin Bauer and Massimiano Bucchi, eds. *Journalism, Science and Society. Science Communication Between News and Public Relations* (New York, London: Routledge, 2007); Dan Kahan, "What Is the 'Science' of Science Communication?" in *Journal of Science Communication* 14, no. 3 (2015): 1–12; and Baruch Fischhoff and Dietram Scheufele, "The Science of Science Communication," *Proceedings of the National Academy of Sciences* 110, Supplement 3 (2013), doi.org/10.1073/pnas.1312080110.

2 Fabiola Rodriguez Estrada and Lloyd Davis, "Improving Visual Communication of Science Through the Incorporation of Graphic Design Theories and Practices into Science Communication," *Science Communication* 37, no. 1 (2015): 140–48.

3 Although this special issue of *Design Issues* focuses on science communication, we must note that—of course—design processes also play a critical role in the actual sciences. Questions of methodology are, to a large extent, also questions of design.

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The relationship between rhetoric and design has been the intermittent subject of debate and theorizing. Gui Bonsiepe was among the first to work on the intersection of the two fields with regard to graphic design.[4] Richard Buchanan famously uncovered rhetoric's potential contributions to design theory.[5] Indeed, both rhetoric and design represent goal-oriented methods of production. Similar to rhetoric, design seems to bear a persuasive dimension, too, in that it often aims to influence people's ideas, beliefs, convictions, and attitudes. Conversely, "design arguments," to borrow Buchanan's terminology, not only follow the rationality of functionality, but also are directed at the emotions of the addressees and follow "doxa"—that is, general beliefs about what is right. Rhetorical theory conversely offers a profound production-oriented set of strategies and techniques that has yet to be transferred, expanded, and reapplied to the field of design. Finally, since its earliest definition by Aristotle, rhetoric is the art of addressing and reaching out to an audience: Rhetors are able to identify what is possibly persuasive in any given case.[6] With this core faculty, rhetoric also may offer valuable insights and strategies to designers dealing with so-called "wicked problems."[7]

This special issue focuses on graphic design in science communication as a subfield of the more general field of knowledge design.[8] Scientists and science communicators alike use graphic design to communicate their insights—whether to other scientists, special interest groups, or the general public. Use of graphs and other visuals, including slides, posters, and the like, has become a staple in science communication. In recent years, the availability of images and visuals, as well as the possibility of creating one's own visualizations, has increased enormously as a result of digitization. Visual elements have thereby emerged as a vital means for conveying information and making knowledge more accessible. Of course, in the specific field of information design, important work has already been done on the representation of facts and data, influenced in large part by the contributions of Otto Neurath and Edward Tufte.[9] With regard to layout, Josef Müller-Brockmann offers conceptual groundwork.[10] In this special issue, however, we pursue a rhetorical approach to graphic design in science communication that ventures into all areas of graphic design.

In its essence, graphic design is a form of visual communication: layout, colors, typography, and visualizations accelerate communication and facilitate the flow of information. Graphic design thus aims at enabling the addressee to create new knowledge structures. The addressee-appropriate and goal-oriented design of visual elements poses a great challenge—one in which design and rhetoric interact. In communicating successfully via visual elements, questions of design play a decisive role, synthesizing aesthetic and

4 Gui Bonsiepe, "Visuell-verbale Rhetorik" [Visual-Verbal Rhetoric], *Journal of the Ulm School for Design* 14/15/16 (1965): 23–40.

5 See Richard Buchanan, "Declaration By Design: Rhetoric, Argument, and Demonstration in Design Practice," in *Design Issues* 2, no. 1 (Spring 1985): 4–22; and Klaus Krippendorff, "Comments on Richard Buchanan's 'Declaration by Design,'" *Design Issues* 2, no. 2 (Spring 1985): 71–72. For further discussion, see Knape "Persuasion by Design? Design Theory Between Aesthetics and Rhetoric" in this special issue. More recent explorations include Gesche Joost and Arne Scheuermann, eds. *Design als Rhetorik* [Design as Rhetoric] (Basel: Birkhäuser, 2008); and Annina Schneller, "Design Rhetoric: Studying the Effects of Designed Objects," *Nature and Culture* 10, no. 3 (2015): 333–56.

6 Aristotle, *The Art of Rhetoric* (Cambridge, MA: Harvard University Press, 2000), lines 1, 2, 1355b26f.

7 See Horst Rittel and Melvin Webber, "Dilemmas in a General Theory of Planning," *Policy Sciences* 4 (1973): 155–69; and Richard Buchanan, "Wicked Problems in Design Thinking," *Design Issues* 8, no. 2 (Spring 1992): 5–21.

8 This work promises to be a productive exploratory venture into the field of knowledge design because graphic design easily partakes of other areas of design (e.g., product design, interface design).

9 See, Otto Neurath, *Isotype (Vienna Method of Pictorial Statistics): International Picture Language* (London: Kegan Paul, 1936); and Edward Tufte, *The Visual Display of Quantitative Information* (Cheshire: Graphics Press, 1983).

10 Josef Müller-Brockmann, *Grid systems – Raster systeme* (Salenstein: Niggli, 2009), 13.

strategic considerations. However, the optimization of communication not only is a central question of design, but also can be framed in a longer tradition as a rhetorical problem—as a theory and practice of successful information and persuasion strategies that take into account the perspective, motivation, and prior knowledge of the addressee. Rhetoric asks how one can communicate in an understandable, clear, and vivid manner, so that aesthetic effect and communicative functionality interact to persuade others.

From a rhetorical perspective, the central questions for knowledge design concern design's role in making information clear (claritas) and comprehensible (perspicuitas), as well as how design strategies can achieve immediate insight and understanding (evidentia). How can graphic design render scientific findings clear and comprehensible? Which devices and techniques of graphic communication persuade the addressees? Finally, in which ways does graphic design become susceptible to manipulation and misinformation?

Graphic design, however, is not only a method of rendering communication more efficient—not merely a tool that we employ for efficient communication, but designing information and knowledge certainly also bears an epistemological dimension: The graphical form determines how we think about concepts and theories (e.g., of different atom models, the wave–particle duality, or the configuration of space through cartographic representations). Because knowledge exists only within the confines of its semiotic representation, graphic design creates meaning as much as it communicates it. Also, graphic design bears a message on its own: a message about the accessibility, relevance, and attractiveness of information and knowledge. Hence, graphic design can act as a central gatekeeper in science communication.

All the articles in this special issue focus on one or more aspects of graphic design in knowledge communication. The first article offers a more fundamental reflection of the relation between rhetoric and design. In doing so, the rhetorician Joachim Knape focuses on the critical question of the persuasiveness of design. Knape revisits the Buchanen/Krippendorff debate and analyzes the controversial relationship between aesthetic and rhetorical (i.e., persuasive) strategies in the design process. He proposes that the design argument results from the combination of aestheticized gestalt and rhetorical appeal of a designed artifact.

Similarly, Timothy Samara offers the perspective of a graphic designer, arguing that data visualizations have functional and narrative aspects that need to be mediated. To make informed decisions, non-specialist audiences depend on the clarity and resonance of data displays. But these visuals, as created by scientists, journalists, and policy researchers, often contradict the principles

that, according to designers, should guide effective and convincing communication of data through visual means. Design education and practice insist that visual forms convey the nature of content, or of data, on both objectively functional and narrative levels. Samara addresses established best practices for creating clear, functional data displays, and for using visual form to clarify data's relevance and reveal its intricacy without distortion. Samara further advocates exploiting the visual form's narrative potential to qualify and contextualize information, thus enhancing how viewers internalize data, accept its veracity, and invest interest in its meaning. He posits balancing this formal duality in data visualizations—the functional and the narratival—to best engage and resonate with non-specialist audiences, thereby catalyzing their participation in the world around them.

Infographics are widely used in print and online newspapers and are regarded as immensely effective in social media. But which kinds of information are best displayed in the form of an infographic? Willem Koetsenruijter investigates whether we can identify certain types of information that are specifically suitable for a visual representation and other types of information that can be better represented verbally. He introduces as the central notion to make this distinction the concept of space in combination with the knowledge of metaphors. Koetsenruijter concludes by proposing three conditions that indicate when a text does a better job than a visualization.

Graphics in scientific communication are not simply a means for elegantly conveying, condensing, or systematizing "facts." As with any form of communication, they are bound to, or registered in, the discursive context of previous uses. Thus, graphics not only visualize information (in an iconic or symbolic way) but also contextualize (i.e., index) the practices, communities, and genres of particular fields, thereby serving as effective emblems of scholarly identity. Jürgen Spitzmüller pursues this argument in his analysis of typography in academic communication. Drawing on a sociolinguistic theory of social positioning and identification, he shows how graphic design is a disciplinary practice in the double sense of the word—both visualizing and contextualizing.

Rhetoric is particularly interested in how communicators establish credibility and authority. Aristotle already maintained that the ethos—that is, the persona of the speaker—constitutes one of the three central means of persuasion. However, the communication of scientific knowledge traditionally has been oriented toward objective truth and facts, building on the authority of science. Annina Schneller's article argues that, besides or even in contrast to these aims, creating authenticity has become a major

factor in successful science communication. Conveying a "personal touch," or giving the audience a feeling of "being real," are crucial promoters of credibility. Schneller explores methods of gaining trust and sympathy on the levels of both textual and visual presentation.

Images and visualizations of all kinds play a considerable role in the communication of scientific knowledge. Simone Heekeren's article deals with the recontextualization of scientific images in multimodal popular science articles. Heekeren presents different types of multimodal, transcriptive procedures necessary for recontextualizing and readdressing images for popular science contexts. Because these procedures may be accompanied by a change in the legibility of visualizations, Heekeren outlines possible implications for the potential of popular science images as evidence.

Conveying information and arguing based on knowledge can be particularly challenging in the opinion-dominated field of political communication. Barack Obama's State of the Union addresses were distributed online as so-called "enhanced" versions, where the television images of Obama delivering the speech were accompanied by pictures, graphs, and tables used to convince the audience about the factual state of affairs in the United States. Jens Kjeldsen explores this combination of the rhetoric and epistemology of visuality and information design, on the one hand, and political oratory, on the other. Kjeldsen demonstrates how the "Enhanced State of the Union" presentation represents a hybrid genre using visuals to create a rhetoric of reification and reality, apparently aiming not to argue but only to establish facts.

With this special issue, we hope to productively unite the perspectives of design and rhetoric under the topic of science communication and offer incentives for further exploration in the field of knowledge design.

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