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The Mechanics of new media (science) writing

Articulation, Design, Hospitality, and Electracy

Electracy Podcast Part 2 Transcript (Kate)

Kate [00:00]: Were a scientist to hear me say, "Science writers participate in the creation of scientific knowledge," they would surely guffaw. Indeed, when I suggested this to my physicist husband, he vehemently disagreed. Specifically, he took issue with the term "creation," for a science writer is not creating anything but a story, a description of a scientific discovery, not discovering something herself. This response also suggests a different understanding of the term "knowledge." For my husband, knowledge is something tangible (a scientific discovery), whereas I consider knowledge as something more nebulous (like cognition). Where he and I differ, as scientist and non-scientist, is in our epistemology of science, in how we define what knowledge of science *is* and how knowledge of science is *acquired*. In the rest of this podcast, I explore these different epistemologies, define how science writers contribute to non-scientists' knowledge about science, and describe some of the tools science writers use in their articulation of scientific knowledge.

Kate [01:08]: To begin, scientists and nonscientists tend to favor subtly different meanings of the term *knowledge*. When scientists consider the word *knowledge*, their tendency is to gravitate toward a fact-based definition, what the *Oxford English Dictionary* described as "the fact or state of having a correct idea or understanding of something; the possession of information about something" ("Knowledge," 2013). For a scientist, knowledge is the product of their work and inextricably connected to the scientific method. In order for something to qualify as knowledge, it must be empirical, measurable, objective, and reproducible. However, non-scientists tend toward a broader and more flexible definition of knowledge as something synonymous with understanding, simply the "fact or condition of knowing something" to any degree, by whatever means ("Knowledge," 2013).

Kate [02:03]: More importantly, scientists and non-scientists differ in their assumptions about how one acquires knowledge about science. Scientists favor what philosopher Bertrand Russell (1998) called "knowledge by acquaintance," in this case, the direct encounter of science "without the intermediary of any process of inference" (p. 25). For example, by conducting his experiments on pea plants, Gregor Mendel obtained direct knowledge of the heritability of traits. The everyday person who obtains knowledge of Mendel's experiments by reading a scientific paper or, even more removed, by reading a science writer's article about Mendel's experiments, does not "directly know" the object, and thus has "knowledge by description" (p. 26). The most accurate and complete knowledge of something comes by acquaintance; knowledge by description is always second-hand and partial.

Kate [02:58]: Perhaps Bruno Latour's (1987) *Science in Action* can be used here to help us work through this distinction. In the first chapter of *Science in Action*, Latour sketched out how science is actually an endless list of decisions, illustrating that scientific discoveries and our understanding of them are shaped by the choices made by scientists. In this way, Latour encouraged us to think about the process of science in order to understand how scientific knowledge is created. Arguably, one way to conceptualize this flow of scientific knowledge through society is to think about it in terms of a process flow diagram. If you are not familiar, a process flow diagram is used to illustrate the flow of a process. Different circles (or nodes) are used to indicate an event or action, while arrows are drawn to illustrate how one event or action leads to a subsequent one.

Kate [03:59]: In our example, we have a scientist named Pete, and his discovery of a new planet. In the process flow diagram for scientific knowledge, a scientific discovery is the initiating node. At the moment of discovery, there is only one circle on a diagram, because Pete has not shared this discovery with anyone else. However, the moment that Pete decides to share this discovery with others, various paths emerge from this node. These paths represent Pete's options for articulating this scientific discovery to the rest of the world.

Kate [04:35]: As I discussed in Part 1 of this podcast, Pete has a vast array of rhetorical means that can shape the way his discovery is presented to his intended audience, and these choices shape his audience's knowledge of this newly discovered planet. For simplicity's sake, let's imagine Pete's options here in terms of two different audiences: other scientists or the American public. Now we have two arrows extending from our initiating node. Each of these paths leads to a different event, in this case a product: Pete's presentation of his discovery for that audience. At the end of the path for the scientific audience is a lengthy scientific paper; at the end of the path for the American public is a brief news article. In reality, it is most likely that Pete will choose to present his discovery to other scientists, so let's follow the pathway originating from this node for the rest of the example. Since Pete has decided he is going to publish his discovery for other scientists, his next step is to determine which journal he would like to publish in. Now, three paths appear off of our scientific paper node on the diagram, leading to nodes representing the three journals Pete considers appropriate to publish his discovery: 1) *Scientific American*, 2) *Advances in Space Science*, or 3) *Annual Review of Astronomy and Astrophysics* (also known as *ARAA*). Although they are each scientific journals, each journal requires a different format or style, creating a different written product. These nodes are the *Scientific American* version of Pete's discovery, the *Advances in Space Science* version of Pete's discovery, and the *ARAA* version of Pete's discovery. In reality, Pete can only choose one journal in which to publish his paper, but each of these products potentially exists at one point in time. Because Pete wants to publish this landmark discovery in a prestigious journal, he chooses to publish in *ARAA*. Assuming Pete's paper is accepted, his scientific paper is published and available to be read by anyone who reads *ARAA*.

Kate [07:00]: Next in our scenario, a science writer named Alice reads Pete's article, and she decides to write about Pete's discovery for a new audience. Leading from Pete's *ARAA* publication is a path to Alice's article describing Pete's discovery, creating a new node on our diagram. Now Alice, like the scientist before her, is faced with multiple paths depending on how she chooses to describe the scientific discovery for her audience of non-scientists, from her choice of medium down to her choice of language. Every decision she makes about describing the discovery creates a different scientific knowledge, ultimately effecting the version of Pete's discovery that Alice's audience of nonscientists receives.

Kate [07:46]: In reality, all of these nodes are not actually realized. Generally, only one version of Pete's paper is ever published, just as typically only one version of Alice's piece is ever distributed. But regardless of what comes to fruition, there was always the *potential* for alternative versions, different articulations of that original discovery.

Kate [08:10]: Taking a step back, then, what this model illustrates is the process by which scientific knowledge is created and disseminated. Any node in this model represents knowledge of the original discovery, but they each represent a different *articulation* of that knowledge. Pete the scientist, by participating in the science and knowing it by acquaintance, necessarily has the most complete type of scientific knowledge. Anything after his initial discovery is not *scientific* knowledge, because it is not vetted by the rigor of the scientific method. Alice the science writer, and every reader of her work, does possess knowledge of the science, but theirs is knowledge by description. In this way, a science writer participates in the creation of a non-scientist's knowledge about science.

Kate [09:02]: Although this knowledge of science that the science writer and layperson possess is a different type from that of a scientist, it is the appropriate type of knowledge for this group. It is not important for non-scientists to be experts in science; they simply need what Benjamin Shen (1975) called "practical science literacy... the type of scientific and technical know-how that can be immediately put to use to help improve living standards" (p. 265). According to the Program for International Student Assessment (or PISA), a branch of the U.S. Department of Education, "scientific literacy" is defined as "the capacity to use scientific knowledge, to identify questions and draw evidence based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity" (as cited in Yore & Treagust, 2006, p. 305). As this definition suggests, it is not important for non-scientists to understand all the intricacies of the science. Rather, non-scientists simply need to comprehend the "big ideas or unifying concepts/themes of science" and to be able to participate in public debate about science and technology issues, as Larry Yore and David Treagust (2006) recommended (p. 293). And this is exactly what science writers help their audiences do.

Kate [10:23]: It all comes back to our notions of articulation, specifically how audience affects how one chooses to articulate. Predominantly, scientists' intended audience is other scientists: technically trained individuals expecting specific genre conventions, such as empirical evidence, a comprehensive record of methodology, and dense, concise language. Generally, a scientist's methods of articulation are more rigid and restricted, and a scientist must include every minute detail so that one's peers can scrutinize the scientist's work. A science writer, on the other hand, addresses a completely different audience and is not subject to the same limitations as a scientist. In fact, a science writer would be a less effective communicator were he or she to communicate in the same way as a scientist. A lengthy account of a scientist's methodology would not only bore a non-scientist, its language may even cause this individual to become confused. Instead, a different articulation of a scientific event is necessary, capturing the broader concepts and themes suggested by Yore and Treagust (2006), creating practical scientific knowledge. Using tools like black boxing, metaphors, new media, and framing, science writers are able to render the difficult and abstract concepts of science into something comprehensible for non-scientists. By rearticulating a scientist's discovery in this way, a science writer creates a new articulation of the scientific event, one that is relevant and usable by an audience of non-scientists.

Kate [12:09]: Part of the challenge in communicating about science is the fact that science is inextricably tied to representations. As Luc Pauwels (2006) noted, "what is known and passed on as *science* is the result of a series of representational practices. Visual, verbal, numeric, and other types of representation are used in all sciences and in various types of scientific discourses" to explain science to one's intended audience (p. vii). In order to be communicated, to share this understanding with another person, a human being (whether a scientist or a science writer) must represent this scientific event using some variety of words, numbers, diagrams, photos, video, or audio. Since one is not doing the science (knowing it by acquaintance), it must be *described* using these tools in order for knowledge of this topic to exist. Moreover, much of science must be represented because it cannot be known by acquaintance. Many aspects of science are "too fast..., too slow..., too big..., too small..., too similar..., or too far away... for the human eye to discern, or they may be hidden... or [they may be] inaccessible unless a destructive course of action is taken," Pauwels (2006) asserted (p. 2). Some form of representation must be used in order to communicate this science, no matter if one is a scientist communicating with other scientists or if one is a science writer communicating with the non-scientists.

Kate [13:56]: It is in their ability to utilize these representational means that scientists and science writers articulate science differently. The scientist, because of her genre and audience, is typically only able to use words, diagrams, charts, and the occasional photograph in order to represent a scientific event. Her language is limited to science's empirical jargon and precise prose. A science writer, on the other hand, often has a more expansive range of tools to articulate a scientific discovery.

Kate [14:32]: First and foremost, the science writer is able to use a broader array of literary techniques than the scientist. Because science writing is more intimate and interactive than scientific writing, a more colorful variety of adjectives are used to articulate the adventure and excitement of a scientific event. Moreover, a reader will often encounter different styles of science writing, as fellow classmate Debra Reilly describes.

Debra [15:01]: Science writing I would expect there to be a lot of ownership by the author: using "I," using their own style, whether that be a lot of flowery language and metaphor or whether they're to the point, choppy-short-sentence kind of person. And I would expect that kind of writing to be more interested in, maybe, metaphysical connections as well, not just literal, this is fact.

Kate [15:32]: Debra's brief description summarizes much of what truly differentiates a science writing style from a scientific writing style. In science writing, the author is allowed to not just relay the facts, but to show their personal storytelling flair through their choices about tone, style, and language. Debra also hints at another dominant characteristic of science writing: the use of metaphor and analogy. Although scientists occasionally employ these literary devices, science writers use them much more frequently. Free from the restrictions of exact scientific observation, a science writer can use less empirical devices such as metaphor to describe what a dense scientific topic is *like* to a non-scientist. And this method of explanation is often the most helpful, as Dorothy Nelkin (1987) asserted that "explaining and popularizing unfamiliar, complex, and frequently technical material can often be done most effectively through analogy and imagery" (p. 10).

Kate [16:40]: Additionally, the science writer has more liberty to choose what details to include or foreground in her articulation of a scientific event. She does not have to present the minute detail of the scientific process. She can choose to black box this information, explaining a complex system by articulating it in terms of its inputs, outputs, and transfer, rather than every step that happens along the way. Similar to the black box, a science writer utilizes frames to help non-scientists interpret a scientific discovery. According to Myra Ferree, William Gamson, Jürgen Gerhards, and Dieter Rucht (2002), "a frame is a thought organizer," specifying "what is relevant and what should be ignored" when considering a topic (pp. 13-14). At the same time, Ferree et al. (2002) suggested, this frame functions to "organize and make coherent an apparently diverse array of symbols, images, and arguments, linking them through an underlying organizing idea that suggests what is at stake on an issue" (p. 14). Thus, framing facilitates science literacy by helping an audience comprehend the big ideas of a scientific event and reveal their relevance to one's life. Indeed, as Matthew Nisbet and Christopher Mooney (2007) described them, "frames allow citizens to rapidly identify why an issue matters, who might be responsible, and what should be done," the very goals of scientific literacy described by PISA (p. 56). Arguably this framing technique is science writers' greatest contribution to the creation of scientific knowledge. Their articulation of science makes it comprehensible and relevant to nonscientists, as my fellow New Media Science Writing classmate Emily Cavaliere describes.

Emily [18:29]: I think science writers contribute to scientific knowledge as we understand it because a lot of our, sort of, understanding of knowledge comes from what we read. That's the way I think I understand and know things. So, um, without the science writer telling me what has happened and telling me, like, what to make of it, it's him or her that has told me this story and told me, like, why I should care. And, I mean, it's difficult to understand something you don't care about so I think that their job of, like, creating human interest in science is really important.

Kate [19:08]: As Emily observed, often the most difficult part of understanding science is that it feels so far removed from one's life, allowing us to ignore or dismiss important science issues. However, by framing the facts and contextualizing science, science writers make science relevant to non-scientists by showing how science impacts our daily lives.

Kate [19:35]: Beyond choices of language, science writers also tend to have a greater variety of media they are able to utilize in their articulation. Because science writing appears in multiple communication channels—from the daily newspaper to television programs to podcasts—science writers have a seemingly endless means by which to represent science. In a magazine feature, a science writer can use multiple pictures, diagrams, and words to describe a scientific event. In a short movie, the science writer can use a video clip of the actual topic being discussed, allowing the audience to have a more direct experience with the science. In fact, this is the exact reason my classmate Kelly McCarthy chose to use video for her New Media Science Writing Project. A written description of the science or a narration of the experiment would not have sufficiently represented her topic.

Kelly [20:30]: After going through the research study I just thought it would be able to resonate the ideas of the research a lot better if people were able to see it. So I think the video really, you know, kept people's attention and helped to really show them what the study was about. With our project they had a few different things like the eTSST test, which, it was really good to have that shown in the video because it's all about people watching other people and seeing, I guess, the empathy resonating between the speaker and the people watching them. So I think that was a really good thing to show, and it probably wouldn't have been able to be as effective if it was just being spoken and the process was just being told to us rather than shown.

Kate [21:28]: As Kelly described, this ability to actually *show* the science rather than tell it not only engages an audience but also allows them to more fully comprehend the topic discussed. New media allows the science writer to put the audience in the scientist's shoes, so to speak, bringing them one step closer to the knowledge by acquaintance scientists possess.

Kate [21:53]: Moreover, this utilization of increasingly digital, multi-media articulations of science allows science writers to have greater access to their intended audience. Indeed, digital formats are the most popular means by which non-scientists receive information about science. A 2008 Pew Research Center survey indicated, "the Internet [...] had now surpassed all other media except television as an outlet for national and international news." When asked where they get their science news, my English 401 classmates unanimously obtained their science information via digital sources like web articles, podcasts, and videos. For example, when I asked classmate Chris Krull, where he got his science writing, every source he listed was digital.

Chris [22:42]: I use Twitter a lot. I follow NASA. I follow Virgin Galactic, Stephen Hawking. You know all those guys. Wired, I follow them. I get a lot of my stuff from Twitter. There's actually this really cool website called Science 2.0 (science20.com). That's more if I really just want to, like, read articles that are kind of over my head, I'll go there. And, podcasts, I listen to This Week in Tech, but that's more tech-focused. Twitter a lot, it's where I get a lot of stuff.

Kate [23:14]: Twitter, websites, and podcasts were Chris' preferred channels to obtain information about science, all of which are decidedly new media formats. The accessibility of new media helps science writers articulate a scientific event most effectively: it enables science writers to use a multitude of representational methods to describe science, and it allows science writers to reach an audience through their preferred information channels.

Kate [23:47]: Thus, literary tools and new media allow science writers to proliferate scientific knowledge. They use a literally style that is descriptive, personal, and engaging to help draw a non-scientist's interest and use metaphors and analogy to explain science in an accessible way. Through framing, they contextualize science and make it relevant to the layman, and they deliver the final product to the audience using the most rhetorically effective medium. All these reasons and more are why science writing is the primary source of science information for everyday people. The science writer's articulation of science is *made* for us.

Kate [24:37]: Reflecting on the conflict between scientists and science writers, perhaps a truce can now be called. As I have shown in this podcast, the cause of the friction between scientists and science writers is in their epistemology of science. For scientists, scientific knowledge is academically vetted, evidence-based, and acquired directly by becoming acquainted with it as one practices science. For the science writer, and most non-scientists, scientific knowledge is any factual information about science one acquires from a credible source, increasing one's understanding of a scientific topic, and is most often obtained through the description of scientific discovery. At the core of each of these descriptions of scientific knowledge is the scientific discovery; where they differ is in its articulation. Both scientist and science writer share the goal of proliferating information about science. Both desire this information to be understood and applied by their audience. But it is this audience that is different between scientist and science writer, necessitating a different rendering of the story, a different articulation of the scientific event. Each author crafts their story in the way that is engaging and persuasive to their audience. Each desires this information to be useful and relevant. And as a result, each author, whether scientist or science writer, participates in the creation of scientific knowledge.

Kate [2]: Before concluding, however, I again return to Bruno Latour (1987), that ever-helpful Frenchman, through whom I have attempted the present diplomatic effort. It turns out that such epistemological diplomacy pays practical dividends in terms of the production of science writing. Rearticulating the relationship between science and science writing opens up new ways of writing about science, new ways of engaging audiences, and new ways of making knowledge.

Kate [2]: In the *Journal for Scientific Communication*, Carlos Fioravanti and Lea Velho (2010), articulated how Latour's work in actor-network-theory (or ANT) might positively impact science journalism. Confronting the same division identified in part one of this podcast, the authors see ANT as both a way around the division and an avenue toward richer, more engaging science writing. "An important lesson of ANT," the authors argue, "is that science advances are not due exclusively to desires of scientists, policymakers, customers or readers, but as a consequence of negotiations and successful alliances between them" (p. 5)

Kate [2]: The mantra of ANT is to follow the actors and the chief admonishment is to never decide, in advance, who or what counts as an actor. Based their reading of ANT as an approach that considers "knowledge production […] as a result of interaction of different groups of actors, not only scientists, with different interests" (p. 2), Fioravanti and Velho (2010) argued, in the context of science writing, that such writing can benefit from moving past the assumption that scientists are the chief actors in any story about scientific research. Their journal articles are, for instance, only one aspect of the possible story. The authors maintain that ANT allows science writers to "widen the focus of science stories, by referencing to other social actors, considering their motivation, interests, and conflicts" (p. 1). Not limiting the production of science to scientists alone allows for "new actors, circumstances and details" to "emerge, enriching the narrative" (p. 3). They go on to argue that "Building a landscape as complete as possible—with actors, machines, institutions, and spaces— may help the reader to better understand how a scientific achievement evolves" (p. 3). This ANT-ish approach to science writing resonates with the use of articulation theory in new media writing. Johndan Johnson-Eilola (2004), wrote:

> Because articulation conceives meaning as a contingent play of existing forces rather than a traditional 'creation' and 'reception,' the perspective can be useful in helping us understanding writing as a process of arrangement and connection rather than simply one of isolated creative utterance. (p. 202)

Kate [2]: Using actor-network-theory, the two authors imagine, as we do, the science writer as a "mini-researcher," and so they see such writers as increasingly akin to the very scientists they write about (p. 6). There are important stakes in how we articulate science and science writing: how will scientists conduct their research and engage the public? How will the public engage science? And how will science writers shape this engagement? In an increasingly complex global, political environment, these articulations matter.

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