PERFORMING SCIENCE: SCIENCE COMMUNICATION AS PERFORMATIVE EVENT

Alan Chong and Lydia Wilkinson

University of Toronto

alan.chong@utoronto.ca, lydia.wilkinson@utoronto.ca

Abstract – *A course at the University of Toronto encourages engineering students to analyze how science is conveyed in the popular media through a variety of contexts. An analysis of the language and rhetoric of these communicative acts provides an entry point into how science is framed, while the discipline of performance studies, which identifies and analyzes the mechanisms with which we present our messages and ourselves, provides another useful tool through which to understand the motivations and associated strategies behind scientific communication. This teaching practice paper presents three case studies of scientific press conferences used in the course: NASA's 2010 astrobiology event, the Higgs Boson announcement in 2012, and Virgin Galactic's 2014 SpaceShipTwo crash. These three case studies illustrate how the act of communicating science within public spaces should be navigated with an awareness of the intended message and the way that this message is conveyed and perceived. Each case study includes a summary of observations on the event (generated and shared through class discussions), and prompts that will enable the effective instruction of these and other case studies.*

Keywords: engineering communication, science communication, transdisciplinarity, science outreach

1. INTRODUCTION

As engineering educators, we are highly focused on the importance of equipping our students with the skills that will help them excel as professional engineers; in turn, the communicative artifacts that our students produce, their engineering documentation and presentations, often target an audience of likeminded professionals. In some instances, we may encourage our students to design communication for a non-technical client or for community stakeholders, but in these instances the imagined 'layperson' is often peripherally engaged in the technical project, with access to channels such as client meetings or stakeholder forums through which they can respond to and negotiate the meaning of the communicative object. The orientation of technical communication instruction towards workplace readiness is evident in preeminent textbooks on

the subject [1,2], as well as the limited available programmatic reviews [3,4], and the overarching focus of professional communication conferences, such as IEEE's Professional Communication Society [5]. This orientation is warranted, given the limited imperative of CEAB and ABET's graduate attribute in communication [6,7], and our understanding of engineering employment post-graduation [8-14].

It is also important that we prepare our students to communicate about their engineering work to a broader audience. The preponderance of scientific and pseudo-scientific messaging on social media has created a landscape in which scientific experts, including engineers, can contribute meaningfully to improve public understanding of science through clear and direct messaging. This media landscape is also one in which communication is disseminated to and consumed by more diffuse, heterogenous and ultimately less predictable audiences.

The University of Toronto's Science and Technology in the Popular Media course helps students prepare for this complex environment by giving engineering students an opportunity to consider how science is communicated through the media in a variety of contexts; some of these contexts are mediated by journalists and public officials, for example articles in newspapers and websites, while others see scientists communicate directly to the public through multimedia, as in the case of interviews and press conferences. This last mode of communication is a particularly valuable tool through which to identify and articulate best practices for sharing science with the public. As public events, a range of high-profile science press conferences are easily accessible, and an increasingly important source of information for both journalists and the public. As events that are typically planned and marketed with some advance notice, these communicative acts are often more carefully managed and controlled than ad-hoc science communication via more immediate social media channels like Twitter. As a result, these press conferences provide rich samples of scientific communication in the media, which can be mined for effective communication

strategies, as well as missteps that may complicate or impede public understanding.

The performative aspects of these press conferences further increase their value as source material for case studies. Performance theory brings together the fields of anthropology, sociology and mimetics, to consider both how everyday acts and highly staged events constitute acts of performance [15-17]. These press conferences provide scientists and engineers with a (sometimes literal) stage that is constructed to share their expertise. While the course theory focuses on the analytical frames of language and rhetoric, in-class discussion often moves towards the performative elements of these press conferences; together these complimentary analyses provide valuable insights into the motivations and associated strategies behind these communicative acts, as well as the ways that our students interpret these mediated events.

This teaching practice paper will present three case studies used in the course, highlighting some of the key elements of each case study that can be shared to provoke discussion and deepen student understanding. These three case studies—NASA’s 2010 astrobiology event, the Higgs Boson announcement in 2012, and Virgin Galactic’s 2014 SpaceShipTwo crash—illustrate how the act of communicating science within public spaces should be navigated with an awareness of the intended message and the way that this message is conveyed. Each case study includes a summary of observations on the event (generated and shared through class discussions), and prompts that will enable the effective instruction of these and other case studies.

2. BACKGROUND

Science and Technology in the Popular Media equips students with theories of scientific communication to provide a framework for their analysis of these case studies. The course introduces Nisbet and Mooney’s concept of scientific framing: published in 2008, and seemingly anticipating the recent spread of pseudo-science across today’s media landscape, Nisbet and Mooney’s *Science* letter argues for the importance of pitching science to the values and dominant attitudes of particular audiences. Nisbet and Mooney’s position explicitly responds to partisan antiscientific campaigns, for example climate change denial as a largely Republican or Conservative position, arguing that it is necessary to correct misapprehensions by focusing on stories that will appeal to these special interest groups. “In short” they argue, “as unnatural as it might feel, in many cases, scientists should strategically avoid emphasizing the technical details of science when trying to defend it” [18].

Students are also encouraged to identify the dominant modes of public scientific discourse categorized by Trench and adapted by Bucchi: the deficit, discourse and participatory models [19]. While the deficit model of

science communication relies on the transfer of scientific concepts in simplified form to a largely unfamiliar public, the participatory model acknowledges the importance of engaging with the public as active participants in scientific debate. The interest and championing of particular scientific issues by the public can influence research directions both directly, through research funding, and indirectly through readership and popularization: one study found, for example, that an article published in the *New England Journal of Medicine* is three times more likely to be cited in the scholarly literature if mentioned in the *New York Times* [19]. Rather than funneling science to a passive recipient through increasingly simplified media (scientist to science journalist to easily understood science article), the participatory model actively engages participants in understanding science by providing access to the producers of this science (the scientists themselves) within the spaces in which that science evolves. Nisbet and Mooney’s approach to science communication acknowledges the challenge of harnessing this participatory model within a climate of science skepticism: increased public engagement enables the participatory communication model, while at the same time necessitating a greater awareness and management of how particular framing devices appeal to particular groups.

Press conferences offer an opportunity for viewers to hear directly from the science authority, enabling the type of more immediate dialogue between scientist and public forwarded by the participatory model. As carefully managed events they are also opportunities for these scientists or the institutions they represent to frame their message in particular ways, which is where an acknowledgement of the performative possibilities of these spaces becomes particularly relevant. As a sociological construct framing acknowledges the existence of schemas, stories or interpretive frameworks through which we interpret the world. Performance theory further acknowledges the potential of these frames as guides for and interpretive tools through which to understand human behaviour: as signals of our status, position, values, affinities and identities, our behaviours constitute a performance of self in society. While students are not explicitly instructed in performance theory, they are encouraged to move beyond a content and message analysis, to consider how other elements of the press conference, including human behaviours and physical elements, like setting, stage and costuming, further influence how these stories are interpreted.

3. CASE STUDIES

By design, these case studies make use of certain shared cultural understandings to promote critical awareness: Science and the Popular Media students are active consumers of media who are encouraged to explore how these events meet and defy *their* expectations for a

scientific press conference. In addition, students have been introduced to the concept of scientific framing, which depends on the persistence of culturally constructed schema to mediate our engagement with this science.

3.1. 2010 NASA Astrobiology Event

On November 29th, 2010, NASA published a media advisory of a News Conference scheduled for 2pm on December 2nd “to discuss an Astrobiology finding that will impact the search for evidence of extra-terrestrial life,” linked to an article to be published in *Science* [20]. Details of the publication were embargoed until the scheduled press conference. Unsurprisingly, such an announcement resulted in a great deal of speculation and interest from the media and the public. Various outlets reported a huge range of possibilities, speculating that, among other things, NASA had discovered life on one of Saturn’s Moons or that they were ready to reveal actual alien life found on Earth. The speculation ran so rampant that scientists had to walk back that announcement in response to largely speculative and hopeful questions about the research. Many publications began reporting on the maelstrom of the announcement itself as an excited public anticipated historic news.

Details of the actual scientific paper were leaked prior to the 2pm press conference time and embargo, revealing much less significant – in the eyes of the public at least – findings. The discovery – of a bacteria called GFAJ-1 that substitutes arsenic for phosphorus in its composition – represented, according to NASA and the research team, a huge change to our understanding of the requirements to support life, and they had designed a media conference that certainly reflected their belief in its significance.

The structure, setting, and plan for the press conference deviated from the conventionally staid nature of professional scientific announcements (an example of which is discussed in the next case study) [21]. The conference featured five speakers, in addition to the Director of Communications for NASA, Dwayne Brown, author of the media advisory. The unconventional tone of the event is clear from the get-go: Brown introduces the research and the speakers with the enthusiasm of a boxing announcer, promising that they will “end a week of fiction [because] today begins a day of fact.” The panel, made up of Felisa Wolfe-Simon, the Principal Investigator for the research team, Mary Voytek, the Director of NASA’s Astrobiology Program, Steve Benner, a Chemist, Pamela Conrad, an Astrobiologist, and James Elser, a Professor at Arizona State University (who joined by phone), are seated around a coffee table in front of an elaborate backdrop produced to show Mono Lake, the place where the bacteria was discovered.

The execution of the press conference is also highly unconventional. Both the physical composition of the scene and the structure of the conversation appears designed to most closely resemble a television talk show,

rather than a professional science setting, such as a lecture hall or classroom, that might focus viewer attention on the research team’s explanation of their findings. The talk show format encourages conversation and debate between panel members with varying levels of familiarity, confidence and investment in the project. Felisa Wolfe-Simon, as first speaker, performs her belief in the import of her own discovery: her explanation of the project is obviously carefully planned and rehearsed, and includes highly produced visual aids. The structure of her speech focuses as much on her own journey as a researcher – from her process to her findings to their import – as it does the scientific basis for this research. This narrative schema of personal challenge and discovery obscures a more complex and arguably significant backstory for the discovery of the bacteria.

The other scientists on the panel were seemingly selected to provide additional perspectives on the research and to discuss its significance within each of their respective fields, but function to highlight tensions implicit in the research between the actual results and conclusions drawn from them. Voytek appears to serve as moderator for their insights, but her attempts to engage the other panelists often opens up opportunities for conflict, as when James Elser responds to a quip about needing new textbooks by stating that perhaps new sentences or a paragraph might be required. Most notably, Benner appears to adopt the role of resident crank, openly questioning the nature of the findings, as well as the proof. As Matthew Battles points out, “Benner repeatedly (and entirely correctly) call[s] the results ‘exceptional’ which to scientists means not ‘awesome’ but ‘unlikely to be true.’ ... Several times Benner refer[s] to the ‘different standards of proof’ that apply in microbiology and biochemistry.” [22] Wolfe-Simon’s response, that she is interested in exceptions, not so delicately classifies Benner’s doubts as scientific cantankerousness. Their back and forth sets up an oppositional dynamic where each is representative of a recognizable role: cantankerous skeptic and idealistic dreamer.

Within the heightened performance space participants display an awareness of their audience and their role in shaping the message. In one instance, Benner acknowledges that he is struggling to identify the level of simplicity with which he should explain the findings to a science reporter. The dominant perspectives on audience engagement suggested by Wolfe-Simon and Benner are both problematic: Wolfe-Simon’s public is evidently so naïve that they will embrace the momentousness of the discovery based on buzz alone; Benner’s is so ignorant that they must be schooled on the scientific process. Either perspective is an awkward fit for the participatory model, which is predicated on a conception of audience as active, critical recipients to scientific messaging. In each instance the scientist’s performance works to further complicate

their relationship with the public, as the limiting nature of their assumptions is played out on stage.

This case study exposes students to a highly unconventional scientific press conference that in its atypical scenic elements, players and structure, calls attention to the potential of these performance factors to impact the scientific message. At the same time, it often opens up important conversations about gender, age and authority. This particular issue could arguably provide material for an entirely different paper, but it is worth noting that Wolfe-Simon is a young female researcher whose voice and mannerisms conform to many of the most highly criticized affectations leveled at women of her age and gender—students often remark upon her sometimes breathless tone, her tendency to uptalk and her frequent hair flipping. In contrast, Benner is an older white man who comfortably reclines in his chair, often entering into Voytek's space who is seated next to him. Both parties are obviously performing a heightened version of themselves, but Benner's 'self' more closely resembles stereotypical expectations for what a scientist should look like. As Fahy and Lewenstein argue, "the celebrity scientist is associated with discourses of truth, reason and rationality... Scientists' public images have epistemological dimensions, being aligned with truth and the view that the methods of science make it uniquely positioned to uncover truths about the natural world" [23]. Wolfe-Simon's unabashedly emotional response to the science runs counter to common notions of scientists as reasonable and rational, but arguably the *mise-en-scene* of the event and the opportunities for conflict afforded by its players helped to write Wolfe-Simon's script.

That the press conference had its desired result – publicity – would turn out to be the research's undoing. While peer reviewers missed key problems with the paper, scientist observers, no doubt attracted by the significant public attention that the press conference and its announcement elicited, would go on to examine the research closely, finding significant flaws in the methods that largely invalidated the results. The controversy would play out over Twitter as #arseniclife, leading *Science* to delay the physical printing of the article, which arrived with numerous technical commentaries attached, speaking to the controversy. Months later, two unsuccessful attempts to reproduce the results were also published in *Science*, and although the paper was never retracted, the outcome served to underscore the flurry of controversy that stemmed from this unusual press conference and its fallout.

Students are initially given the above background of the case study, then communally watch the thirty-minute press conference with their peers. Reactions during the viewing help capture the impact of the communicative impact of the presser, and set the tone for small group discussion of the impacts prior to a return to large group discussion. Framing these discussions are a group of questions, but students are free to take their discussions in different directions:

- What were the standout features of this science press conference?
- How did the structure of this specific press conference shape the information delivered?
- Why were there multiple people presenting at the press conference? What communication styles stood out, and for what?
- What techniques did the scientists use to explain the findings and the implications? Which were effective and why?
- How significant did the researchers make it sound? How important was the actual discovery, relative to the press conf. announcement?

Students then share their group's perspectives with the larger class, which allows them to engage with these issues around science, performance, and discourse. Only after this initial discussion of the press conference itself is the fallout explained and discussed, leading to more discussion on the impact and ethics of NASA's communicative choices. With every seminar, we arrive at a unique set of discussion points and conclusions about the case. Students are quick to recognize many of the features and challenges pointed to in the above analysis, and use this opportunity to inform their awareness of communicative acts in science communication.

3.2. 2012 Higgs Boson Announcement

The 2012 CERN press conference announcing the discovery of the Higgs Boson provides a very useful counterpoint to the NASA event [24]. Rather than being delivered in a studio space, the announcement was held after a 2-hour technical seminar as part of a conference at CERN, and as such took place within a large lecture theatre. The structure allowed for just a brief comment by Rolf Heuer, the Director General at CERN, to frame the question and answer. His announcement, delivered verbally without visual aids, focuses on the nature of the science, outlining findings and explaining exactly what was discovered and what remains unanswered, including the limitations of these findings. The focus on engagement in this approach is evident: provided with a 3-minute speech and 57 minutes allocated to the Q&A, the audience has the power to direct the conversation based on their interests. Heuer's tone within this conversation is calm and direct, and like the announcement resists excitement or hyperbole.

Although it may be tempting to interpret the staidness of this press conference as non-performative, it is more accurate to consider how this performance aligns with our expectations of scientific rigour and credibility. As a scenic backdrop the lecture hall emphasizes the educational imperative of the press conference. Heuer and his team are seated behind a wooden table and in front of two CERN

signs; the placement of the group emphasizes the team effort of the various contributors. Heuer's interactions with the audience are direct and professional but also occasionally terse. When one reporter tries to elicit a more emphatic response to the findings, asking Heuer to elaborate on his earlier observation that "as a layman, I think we have it," he responds: "Well, I think I just said it. As a layman I would say we have it. But as a scientist I would have to say, what do we have? We have something, yeah. We have discovered a boson. And now we have to determine what kind of boson it is. That's in the scientist's language so to speak. Does that answer your question?" Heuer's response evades any heightened emotion, but also calls attention to the similarity between a layperson's and a scientist's response: the difference that he identifies is not one of understanding but of depth of investigation. His frustration with the question belies the triviality of the discussion: his job is to investigate the science not frame it.

These scenic elements and the players themselves conform to our expectations for a scientific press conference and a 'serious' scientist. It is notable that the mandate for this press conference seems to differ significantly from the NASA event. The aim of the CERN press conference appears to be connecting with the audience in a way that creates qualitatively different knowledge of the scientific matter, rather than working as a public relations strategy. In order to accomplish this engagement, the CERN team incorporated a more complete discursive model, where the audience could actively participate in directing the conversation.

Around the same time as the Higgs-Boson announcement, CERN had an active PR team, including a group of enthusiastic scientists working to engage the public with different strategies, but this event was clearly designed to *educate*. Few PR campaigns can rival the size and influence of NASA's public impact, or its history of sustained public engagement; perhaps in this case the focus on PR was a mismatch for the comparatively non-news of the bacteria's discovery.

In seminar, this event is juxtaposed sharply against the previous NASA conference and requires minimal context. Typically, the excerpts shown last less than 5 minutes, consisting only of Heuer's brief announcement and the first few questions and answers. Our discussion about the CERN conference is informed by our analysis of the NASA conference, asking largely the same questions of a completely different communicative event housed within the same genre. Students are encouraged to consider how purpose, context, as well as the scope and nature of the research and other differences may influence performance in both examples. While noting the relative success of the CERN presser compared to the NASA, students ask critical questions about professional identity performance, the role of scientist stereotypes and audience expectations, as well as the dangers of both moving too far away from and remaining trapped within these standards.

3.3. 2014 Virgin Galactic SpaceShip Two Crash

This example is a departure from the previously mentioned case studies: in the fallout from Virgin Galactic's SpaceShip Two Crash the National Transportation Safety Board (NTSB) provided up-to-date information about their crash investigation via a series of video briefings [25-28]. In this case, the regulatory body adopted the role of scientific authority, in contrast to the scientist or advocate acting as spokesperson for a particular scientific innovation.

The explosion of SpaceShip Two over the Mojave Desert in October 2014 marked a considerable setback for Richard Branson's space tourism company, which at the time was already combating the negative press of delays in their timeline to democratize space travel and increasing public ire around the environmental implications of this democratization. (Naomi Klein's *This Changes Everything*, released a month before the crash, took direct aim at the environmental impact of flying tourist rockets into space [29].) The crash of SpaceShipTwo, in which the co-pilot was killed, called into serious question the logic and ethics of undertaking inherently dangerous innovation for what amounted to a pleasure voyage. In fact, directly after the crash many media outlets speculated about which celebrity astronaut would be the first to ask for a refund [30-33].

The NTSB's multiple press conferences took place against a backdrop of media coverage and established narratives that worked in counterpoint to their fact-finding investigation. These overriding narratives focused on the most entertaining elements of the SpaceShipTwo story: Branson as flamboyant celebrity millionaire; space exploration as environmentally irresponsible, largely inaccessible and self-indulgent; or, space tourism as the next frontier. This latter frame becomes a central focus of Virgin Galactic's science communication directly after the flight. Following a brief shutdown in the weeks immediately following the crash, the company's website was relaunched with a central focus on the promise of space travel, the rhetoric of discovery and the necessity of sacrifice for the cause of scientific innovation [34-36]. In response to these competing narratives the NTSB's coverage of their own investigation focused on delivering information that was factually accurate and clearly understood.

Captured in press briefings on the agency's website, as well as four video briefings led by acting chairperson Chris Hart, the agency's coverage emphasizes accuracy and objectivity, goals that are articulated in Hart's preamble to the initial conference, but also in his use of intentionally noncommittal language in all four press conferences, as he underscores the importance of maintaining neutrality and avoiding conclusions until completing the investigation. Unlike press conferences designed to excite or engage an

audience, these investigatory updates are designed to educate and inform, and the physical space as well as explanatory aims support these objectives. After the first brief event to announce the investigatory team, held at an ad-hoc outdoor space in the vicinity of the crash site, the briefings move inside against a NTSB backdrop. In the third press briefing Hart uses two handheld shuttles—instructional props—to explain the physics of the flight failure. During each briefing Hart verbally emphasizes the NTSB’s lack of conclusions regarding cause, and in the fourth press briefing he expressly notes the role of the public in interpreting the data provided independently, even encouraging them to share their own recommendations in response to the NTSB’s report. Through this approach Hart encourages the type of participatory science communication that is most productive when it resists overly simplified or unscientific story frames.

In approaching this case study students are encouraged to analyze these elements of the NTSB briefings in relation to the competing narratives forwarded by Virgin Galactic and the popular media. Discussion prompts include:

- What are the narratives forwarded by each party (Galactic, NTSB, popular media) in the wake of the crash?
- What are the storytelling pegs or schema that these narratives appeal to?
- How are these stories enacted/performed? How does text, behaviour and visuals work to underscore the story?
- How do these stories work in relation to one another? How does each influence the other?

These prompts provide a valuable opportunity to explore how media messaging works in concert, and how purpose will influence the choices of each communicative act.

4. STUDENT RECEPTION

Students have typically reacted positively to both the discussion of performance and communication coming out of these case studies. The discussion prompts, juxtaposition of contrasting styles, and ensuing large group discussions have contributed to positive course evaluations and student feedback. Students noted, in particular, that “the incorporation of videos into the seminars were effective at engaging the class,” possibly due to the communal aspect of the viewings and instant shared reactions to the material. Furthermore, students reported finding “that the case studies and seminar-based teaching style match the theme of the course — one about communication — very well.” Importantly, they also found “the case studies to be significant, relevant, and appropriately supplemental of the course material.” More anecdotally, the press conference seminars are the most

engaged of the semester: students really sink their teeth into the performative aspect of these communicative acts, bringing to bear much of previous course material and theory, as well as their own understanding of public performances, to provide thoughtful and rich critical readings of these events. These seminars are an essential part of the learning experience in this course, which has garnered an average rating of 4.5/5 in course evaluations over the last seven years.

5. CONCLUSION

These varied case studies and related activities are designed to provide students with an opportunity to reflect on the performative potential of scientific press conferences, and more broadly on the way that science is framed through the media: both in the scientific stories that gain prominence and the ways that these stories are told. The process of critically analyzing these press conferences helps prepare our students to communicate in public contexts, by making them more aware of the contextual factors that impact perception and engagement in science communication. Understanding these public engagements as a performance provides aspiring science communicators with a new set of strategies with which to develop trust and engagement in their audience, increasing responsiveness to their message and improving its impact. It also helps our students to become more empowered audience members as they are better able to identify how particular elements of this messaging may work together to elicit a particular effect. Finally, it prepares them to become more effective advocates for scientific accuracy as they can share these insights and more purposefully develop strategies to counteract communicators who manipulate them.

These press conference case studies are one of multiple activities in the course aimed at the analysis and production of different science communication media, including popular and academic articles, pressers and documentary film. Often class discussion centres around the way that these elements work in concert or counterpoint to provide different perspectives on a single scientific innovation or controversy. As a discrete element of this course these and similar case studies can be integrated into engineering communication courses to introduce students to the complexity of science communication, and to contribute to their development of critical engagement with science media.

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