

Science Communication in the Age of Misinformation

Carly M. Goldstein, PhD^{1,2,✉} · Eleanor J. Murray, ScD, MS, MPH³ · Jennifer Beard, PhD, MPH, MA⁴ ·
Alexandra M. Schnoes, PhD⁵ · Monica L. Wang, ScD^{6,7,✉}

© The Author(s) 2021. Published by Oxford University Press on behalf of the Society of Behavioral Medicine. This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited. For commercial re-use, please contact journals.permissions@oup.com

Science communication is critical for accelerating the science of behavioral medicine and addressing gaps in the bench-to-bedside and clinical-to-community translational research continuum [1]. Insufficient, inadequate, or poorly executed science communication efforts hinder science dissemination, implementation, and sustainability [2]. For example, science misinformation can directly impact population health, sometimes with devastating consequences [3] as evidenced during public health crises, such as the ongoing pandemic. Effective science communication regarding behavioral recommendations and public health messaging is critical to reduce the spread and impact of COVID-19 [3] and to promote overall health and well-being at the individual, family, community, and population levels. In accordance with the theme of this special issue, “Accelerating Behavioral Medicine Science,” this interview-style commentary includes perspectives from five experts on science communication

within epidemiology, social and behavioral sciences, clinical psychology, biology, global health, and behavioral medicine, with specific attention devoted to science communication related to COVID-19. This commentary describes the background, importance, and guidelines for behavioral medicine science communication during this uniquely challenging moment in history and provides readers with concrete, evidence-based strategies to communicate their science to maximize public health impact.

What is Science Communication and Why It Is Important?

Healthy People 2010 defined health communication as the “art and technique of informing, influencing, and motivating individual, institutional, and public audiences about important health issues [4].” Behavioral medicine scientists employ numerous disciplines (from psychology to journalism and epidemiology) to craft careful, simply worded messages disseminated via print, broadcast, and digital media to promote health and well-being [5]. However, no matter how evidence-based and plainly worded our messages are, we, as a scientific community, risk spreading confusion.

The ongoing COVID-19 pandemic has uprooted nearly every aspect of everyone’s lives, and scientific information on COVID-19 is profuse, evolving, and confusing. By early September, the U.S. death toll crested 189,000. There are at least two possible, contradictory narratives for this: on one hand, 189,000 deaths is a success—the death toll is much lower than initial forecasts of 1–2 million [6] because scientists collaborated with policymakers to implement social distancing policies and with journalists to educate the public. On the other hand, 189,000 deaths is a profound failure due to insufficient containment of the outbreak with

✉ Monica L. Wang
mlwang@bu.edu

- ¹ The Weight Control and Diabetes Research Center, The Miriam Hospital, Providence, RI, USA
- ² Department of Psychiatry and Human Behavior, The Warren Alpert Medical School, Brown University, Providence, RI, USA
- ³ Department of Epidemiology, Boston University School of Public Health, Boston, MA, USA
- ⁴ Department of Global Health, Boston University School of Public Health, Boston, MA, USA
- ⁵ iBiology, San Francisco, CA, USA
- ⁶ Department of Community Health Sciences, Boston University School of Public Health, 801 Massachusetts Ave, Boston, MA 02118, USA
- ⁷ Department of Health Policy and Management, Harvard T. H. Chan School of Public Health, Boston, MA, USA

an early, strong, coordinated, and consistent response. The lack of a coordinated response across federal, state, and local authorities was exacerbated by conflicting messages about scientific knowledge. Earlier messages about the benefits of mask-wearing were unclear, imprecise, and rapidly evolving because so little was known about the virus and best practices for containment. Although scientists are comfortable avoiding causal language to describe groundbreaking phenomena, ambiguous language confused the general public (e.g., “wearing a face mask may reduce the risk of catching COVID-19”). These science communication issues between health professionals and the public negatively impacted community- and individual-level health. The initial COVID-19 response in the USA was an unfortunate example of how muddled science communication can confuse nonscientific audiences, contribute to distrust of scientific evidence, and foster doubt about the rationale for health belief and behavior change (e.g., mask-wearing) as new evidence emerges.

Health is one priority of many (e.g., the economy, education, and housing). The intended interpretations and applications of scientific research can get lost or diluted. How can we, behavioral medicine scientists, cultivate rapport and interest among audiences who are not in health or medicine, such as the general public?

Understand That You Already Know Enough to Get Started

Many behavioral medicine scientists have stayed quiet during COVID-19 because they are not currently conducting COVID-19 research, but behavioral medicine scientists and practitioners are experts in behavior change. Theories and methods of lasting behavior change are key, needed points of education for the general public. For example, a behavioral medicine expert can advise the public on how to use positive reinforcement to help children wear masks for extended periods of time [7], the interplay between physical activity and psychological health during quarantine [8], how schools can use message framing to encourage mask policy compliance [9], or how parents can tailor information about COVID-19 to be developmentally appropriate for members of their family [10]. Behavioral medicine basics can be disseminated actively (e.g., writing an op-ed for your target audience) or passively (e.g., sharing a Centers for Disease Control and Prevention infographic on social media, which will then get shared without further effort). Regardless of the method, behavioral medicine scientists and practitioners have translatable, valuable skills and knowledge that should be disseminated to the general public and used in interdisciplinary collaborations. In

turn, the public and other fields may better recognize the value of behavioral medicine.

Tell Stories to Build Connection

One of the most important strategies that researchers and scientists can utilize to cultivate a broad audience for our scientific work is to tell stories using language that is engaging and easily understandable. This often does not come naturally as scientists are trained to submit manuscripts to peer-reviewed academic journals using a prescribed scientific format and technical language. While academic journals are a valuable form of internal science communication, subscription fees and dense thickets of jargon often push other audiences away. When we, as scientists, tell stories about research, we are reaching beyond our circles of scholarly expertise to pull our audience in using engaging language and media ranging from op-eds to tweets. A sympathetic character, their backstory, an inciting incident, tension, and resolution: these are the building blocks of narrative. Cultivating an audience requires feeling empathy for our readers and communicating that we understand *their* perspectives, which allows us to pique and hold their interest, as well as build trust. Many medical schools have built vibrant narrative medicine and medical humanities programs to provide doctors with creative ways to connect and communicate with their patients, maintain their empathy, and avoid burnout. These skills and practices are also relevant for behavioral medicine and public health scientists and should be integrated into training programs [11, 12]. To disseminate stories and amplify the spread of scientific research, behavioral scientists can consider accompanying their scientific publications with an op-ed or other short articles featuring their research on reputable, public-facing outlets. For example, *The Conversation* specializes in translating and disseminating scientific research to a broad audience and is specifically geared toward academics.

Be Strategic About the Emotions We Need to Elicit

The controversy over mask-wearing provides a useful example of why cross-disciplinary collaborations are critical when an expert is tasked with behavior change. In the absence of careful framing, communication can undermine scientific evidence and thwart critically important behavior change messages. Dr. Pamela Rutledge argues that the antimask story (“I have a right as an American to not wear a mask and it’s all a conspiracy to control me”) is more emotionally powerful than the promask story (“I am doing this to protect others and to do my part to promote health in my community”) [13]. The antimasking narrative has sewn fears about

losing individual freedom, which feels more immediately threatening and tangible than an invisible virus. To shift this narrative, scientists need to find the storyline that will evoke an urgent self-preservation response. The enormous difficulty in achieving this shared understanding in the context of a global pandemic has sickened and killed so many in the USA and worldwide, illustrating the complexity of human motivation and psychology. Epidemiologists, statisticians, and clinicians must collaborate with behavioral scientists to reframe the story.

When researchers, educators, and clinicians communicate to peers, the barriers to communication are typically low, as we have a preexisting vocabulary, value system, and shared interests. For outside audiences, what strategies and mediums can be used for effective science communication?

When scientists talk to their peers within a field, they share contextual knowledge and excitement of the topic. However, researchers in other fields, policymakers, or the general public may not have the context to understand why a specific finding is exciting, making it easy for scientific findings or recommendations to be ignored. Even amongst scientific peers, it can be easy to lose the audience's attention with a dry or overly technical presentation, hence initiatives including TED-style research talks. This is a common barrier in interdisciplinary scientific collaboration, which is concerning given the highly interdisciplinary nature of the behavioral medicine field. To minimize this kind of reception within and outside of scientific communities and to maximize the acceleration of behavioral medicine and research, we recommend the following strategies.

Capture Attention With What Speaks to the Audience, Not to the Scientist

Some topics will naturally capture the public's imagination and enthusiasm, like the discovery of a new cancer treatment. But all research has the potential to captivate nonexperts if it is communicated in a way that engages their interest and emotions. This requires knowing some critical information about the audience: Who are they? What is their context? What do they value? What do they already know about this subject [14, 15]? Fundamentally, the audience defines how scientists need to craft communication—the language, images, and format to choose and the take-home message scientists want everyone to remember [16].

Do Your Homework

But *how* does one determine the characteristics of their audience? Identifying this information requires the use

of a core skill set of scientists: research. Investigating the audience can be done rigorously, with interviews and surveys of the audience themselves (also called “market research” in business or “learner analysis” in education [17]), which is recommended when the communication is particularly important and/or requires a significant outlay of resources on the part of the communicator. For other communications (e.g., a talk, panel, and blog post), the audience information is typically gathered from the event organizer or mission statement of the media outlet. It is important to not only understand the “what” about the audience (e.g., gender, education level, socioeconomic background, race/ethnicity, and religious and political affiliations) but also the “who” (e.g., motivations, beliefs, and values) [15, 17].

Tailor Your Message

Knowing your audience allows you to craft a communication unique for your audience, which is critical for success. Targeted or tailored messages have been shown to greatly improve information retention and impact behavior change [18]. Tailoring the message is about choosing the best medium to reach the audience, selecting appropriate data and details, and writing in a language that will be easily understood. The format, content, and tone of a message should be different when speaking at an academic conference, to a patient advocacy group, to policymakers, or the general public. Audience needs should drive the choice of both content and delivery method. For example, compare the bright images and picture-book format of an online resource for children on why and how to wear masks (“Masks Aren't Scary!” from Child Care Resources [19]) versus the primarily text-based online article on mask information written for adults (“Coronavirus Face Masks and Protection FAQs” from Johns Hopkins Medicine [20]). Messages should be tailored to the presentation medium to convey context, content, and enthusiasm in a way that is appropriate developmentally, culturally, and linguistically to the audience with whom you are communicating.

Use Plain Language

Using audience-appropriate language is critical to successful communication [5]. Science has developed into many specialized fields with their own vocabularies. Even scientists in different disciplines may struggle to communicate with each other, and communication with nonscientists can be challenging. In science communication, behavioral medicine researchers and practitioners must present the take-home message in plain language. The persistent myth that using clear language “dumbs down” the science is an assumption that undermines the

capabilities of an audience [21]. The practice of conveying science in plain language is also a skill set that strengthens scientists' ability to convey the same content with a nonspecialist vocabulary. In successful science communication, the audience understands the core concepts, even if the full details are complex and not fully grasped. Plain language can also be enhanced and supported by clear rationale, visuals, and interactive tools.

What Are Some Current Perspectives From Epidemiologists on COVID-19-Related Science Communication?

Present Clear Take-Home Messages Upfront

This is an important tenet of scientific communication in general and is particularly relevant for rapidly evolving and life-threatening public health crises, such as the COVID-19 pandemic. In our information-saturated environment, clear, take-home messages in plain language should be presented first and then supported by evidence as the audience may disengage before reaching the end of the communication. The best tools for engaging all audiences have clear take-home messages accompanying explanatory visuals or interactive tools and a tone that conveys the level of excitement you hope the audience will adopt [22]. Communicating scientific information is no different. When the aim is to increase understanding, it can be useful to supplement the take-home message with information on or links to additional reputable resources. However, these same tools can be co-opted for spreading misinformation or furthering political or commercial agendas. There is rarely one simple way for the public or policymakers to differentiate between good- and bad-faith communicators. Since groups disseminating misinformation are interested in distributing their message at any cost, they often communicate more effectively than those providing clear and correct messaging [23].

Cultivate Trust

One important lesson from COVID-19 science communication is that countering misinformation—though needed—can contribute to confusion, particularly as the audience may already be overwhelmed with information and messaging overload from numerous sources and outlets. When the public cannot distinguish the expertise of information sources, countering misinformation can also seem like esoteric in-fighting. This can result in the audience gravitating to the individual or groups with whom they feel the most affinity. Creating and maintaining trust with your audience is, therefore, crucial for successfully communicating messages *and*

countering misinformation. Tailoring the message to the appropriate audience is a key facet of building trust with your audience [24]. Other ways to build trust include establishing expertise [25] and addressing miscommunication upfront [26], partnering with known and trusted sources [27], placing information into a context relevant to the lives of the audience [28], building empathy and avoiding generating hype (extravagant, unwarranted claims about scientific advances) [29], and demonstrating ethical conduct in your work and communication [29]. Finally, scientists need to directly address the misperception of “too much honesty,” especially around scientific uncertainty. Research indicates that being honest about uncertainty does not undermine trust in science [30, 31]. Being clear and upfront with what we, as scientists, know and what we do not know, providing transparency in how existing evidence is used to guide the development of recommendations, advisories, and mandates, and communicating updates efficiently and consistently as more scientific data are generated are important to maintain trust.

The spread of misinformation is common and deadly. How can scientists help the public evaluate messages they are presented with, gain (and perhaps re-gain) the public's trust, and set the record straight?

Initiate Dialogue Versus a Monologue

Many people continue to trust science and scientists [32]. However, this is neither universal nor a guarantee as our society evolves. When audiences are invited to participate in a conversation, communication outcomes are more likely to be successful [33]. Bidirectional communication allows the audience to voice their priorities and concerns; this builds trust and facilitates a more productive discussion as behavioral medicine scientists and clinicians gain more understanding of the audience's needs and perspectives and can guide the discussion accordingly [21, 34]. In contrast, “top-down” unidirectional communication can undermine trust [35]. Even in communications that, at first glance, may appear to be unidirectional (e.g., op-ed and blog post), a public-facing piece can be crafted in a way that invites curiosity and engagement from the audience (e.g., acknowledge differing perspectives and circumstances, allow commenting and sharing), even though such a “conversation” may occur over geographic distance and time.

Embrace the Personal

Trust in science and science communication is also built through vulnerability, authenticity, and honesty [36]. Vulnerability and authenticity require an integration of one's own experience, content expertise, and

values into the communication, as well as a recognition of one's own personal biases that might impede successful communication [37]. A powerful way to create a personal connection in science communication, particularly in the context of COVID-19, is through the use of personal stories and storytelling [38] (e.g., how the pandemic has impacted our own lives—not just as scientists, clinicians, or educators but as parents of school-aged children struggling to navigate remote or hybrid learning, as individuals supporting family members and elder parents during COVID-19, as friends, neighbors, and colleagues of front-line workers, as people grieving lost lives and jobs, and, ultimately, as humans who have all been touched in some way by this pandemic). Building this personal connection combined with an accurate portrayal of the science creates a more compelling message that an audience is likely to empathize and engage with and learn from.

Conclusion

Through unprecedented public health crises, shifts in normality, and civil unrest, expert voices are needed now more than ever. As behavioral medicine scientists, we must organizationally and individually communicate science with the public, journalists, colleagues, and communities, or we will continue seeing the public conversation about health shaped without our expertise. Tailoring our messages requires perspective-taking, insight, humility, and knowledge of the target audiences and will enable us to communicate more clearly within our circles of research or practice. In doing so, we maximize our impact in promoting health, changing behavior, and saving lives at the community and population levels.

Implications

Science communication is a key link between generated science and public health impact. The vital need for effective science communication that inspires individual- and community-level behavior change and guides agile policy action has been highlighted during the COVID-19 response worldwide, as well as the ongoing social justice movements that aim to target underlying causes of health inequities in the USA. The behavioral medicine research, clinical, and public policy communities require coordinated, timely, and engaging science communication to achieve maximal impact to promote health and well-being for all.

Acknowledgments: The authors wish to acknowledge the funding sources that make this work possible: K23HL136845 (C.M.G.) and 5R25GM116704 (A.M.S.). Additional thanks to J. A. Hutchins for access to her publication.

Funding: This commentary was funded by the National Heart, Lung, and Blood Institute (K23HL136845 to C.M.G.), National Institute of General Medical Sciences (5R25GM116704 to A.M.S.), and School of Medicine, Boston University (Adolescent Health Equity, Prevention, and Translation Pre-Affinity Research Center to M.L.W.).

Authors' Statement of Conflict of Interest The authors declare that they have no conflict of interest.

References

1. Abernethy AP, Wheeler JL. True translational research: Bridging the three phases of translation through data and behavior. *Transl Behav Med.* 2011;1:26–30.
2. Burns TW, O'Connor DJ, Stocklmayer SM. Science communication: A contemporary definition. *Public Understanding Sci.* 2003;12(2):183–202.
3. Bavel JJV, Baicker K, Boggio PS, et al. Using social and behavioural science to support COVID-19 pandemic response. *Nat Hum Behav.* 2020;4:460–471.
4. U.S. Department for Health and Human Services. Healthy people 2010: Final review. 2012. Available at http://www.cdc.gov/nchs/data/hpdata2010/hp2010_final_review.pdf. Accessibility verified September 8, 2020.
5. Centers for Disease Control and Prevention. *Everyday Words for Public Health Communication*. Atlanta, GA: U.S. Department of Health and Human Services; 2016. Available at <https://www.cdc.gov/other/pdf/everydaywordsforpublichealthcommunication.pdf>. Accessibility verified May 27, 2020.
6. Verity R, Okell LC, Dorigatti I, et al. Estimates of the severity of coronavirus disease 2019: A model-based analysis. *Lancet Infect Dis.* 2020;20:669–677.
7. World Health Organization. Advice on the use of masks for children in the community in the context of COVID-19: Annex to the advice on the use of masks in the context of COVID-19. Available at <https://www.who.int/publications/i/item/WHO-2019-nCoV-IPC-Masks-Children-2020.1>. Accessibility verified September 8, 2020.
8. Jiménez-Pavón D, Carbonell-Baeza A, Lavie CJ. Physical exercise as therapy to fight against the mental and physical consequences of COVID-19 quarantine: Special focus in older people. *Prog Cardiovasc Dis.* 2020;63:386–388.
9. Rothman AJ, Salovey P. Shaping perceptions to motivate healthy behavior: The role of message framing. *Psychol Bull.* 1997;121:3–19.
10. Weaver MS, Wiener L. Applying palliative care principles to communicate with children about COVID-19. *J Pain Symptom Manage.* 2020;60:e8–e11.
11. Saffran L. “Only connect”: The case for public health humanities. *Med Humanit.* 2014;40:105–110.
12. McManus IC. Humanity and the medical humanities. *Lancet.* 1995;346:1143–1145.
13. Rutledge PB. How stories spread conflict: The face mask culture wars. 2020. Available at <https://www.psychologytoday.com/us/blog/positively-media/202006/how-stories-spread-conflict-the-face-mask-culture-wars>. Accessibility verified September 5, 2020.

14. Hutchins JA. Tailoring scientific communications for audience and research narrative. *Curr Protoc Essent Lab Tech*. 2020;20(1): e40.
15. Besley JC, Dudo A. What it means to “know your audience” when communicating about science. 2019. Available at <https://theconversation.com/what-it-means-to-know-your-audience-when-communicating-about-science-111147>. Accessibility verified September 3, 2020.
16. Nickerson RS. How we know—and sometimes misjudge—what others know: Imputing one’s own knowledge to others. *Psychol Bull*. 1999;125(6):737–759.
17. Stefaniak JE, Baaki J. A layered approach to understanding your audience. *J Perform Improv*. 2013;52(6):5–10.
18. Hawkins RP, Kreuter M, Resnicow K, Fishbein M, Dijkstra A. Understanding tailoring in communicating about health. *Health Educ Res*. 2008;23:454–466.
19. Smith K. Masks aren’t scary: Why everyone is wearing masks. 2020. Available at <http://www.childcareresources.org/wp-content/uploads/2020/04/COVID-19-Masks-Book-Young-Kids.pdf>. Accessibility verified August 27, 2020.
20. Johns Hopkins Medicine. Coronavirus face masks and protections FAQs. 2020. Available at <https://www.hopkinsmedicine.org/health/conditions-and-diseases/coronavirus/coronavirus-face-masks-what-you-need-to-know>. Accessibility verified August 27, 2020.
21. Hanafiah KM. Communicating science: A shared responsibility. *Malays J Med Sci*. 2018;25:1–5.
22. Lois G. *Damn Good Advice (For People with Talent!): How to Unleash Your Creative Potential by America’s Master Communicator*. New York, NY: Phaidon Press; 2012.
23. Vosoughi S, Roy D, Aral S. The spread of true and false news online. *Science*. 2018;359:1146–1151.
24. Caulfield T, Marcon AR, Murdoch B, et al. Health misinformation and the power of narrative messaging in the public sphere. *Can J Bioeth*. 2019;2:52–60.
25. Dietz T. Bringing values and deliberation to science communication. *Proc Natl Acad Sci USA*. 2013;110(suppl 3):14081–14087.
26. Christensen D, Dube O, Haushofer J, Siddiqi B, Voors M. Community-based crisis response: Evidence from Sierra Leone’s Ebola outbreak. *AEA Pap Proc*. 2020;110:260–264.
27. Mikhailov D. *Online Challenges to Institutional Expert Authority: The Cases of English Heritage and The Royal Society*. London, UK: Department of Social and Political Sciences, Brunel University London; 2018. Available at <https://bura.brunel.ac.uk/bitstream/2438/18391/1/FulltextThesis.pdf>. Accessibility verified September 8, 2020.
28. Farmer H, McKay R, Tsakiris M. Trust in me: Trustworthy others are seen as more physically similar to the self. *Psychol Sci*. 2014;25:290–292.
29. Master Z, Resnik DB. Hype and public trust in science. *Sci Eng Ethics*. 2013;19:321–335.
30. van der Bles AM, van der Linden S, Freeman ALJ, Spiegelhalter DJ. The effects of communicating uncertainty on public trust in facts and numbers. *Proc Natl Acad Sci USA*. 2020;117:7672–7683.
31. Retzbach A, Maier M. Communicating scientific uncertainty: Media effects on public engagement with science. *Commun Res*. 2015;42(3):429–456.
32. Funk C, Hefferon M, Kennedy B, Johnson C. *Trust and Mistrust in Americans’ Views of Scientific Experts*. Washington, DC: Pew Research Center; 2019. Available at <https://www.pewresearch.org/science/2019/08/02/trust-and-mistrust-in-americans-views-of-scientific-experts/>. Accessibility verified September 8, 2020.
33. Besley JC, Dudo AD, Yuan S, Abi Ghannam N. Qualitative interviews with science communication trainers about communication objectives and goals. *Sci Commun*. 2016;38(3):356–381.
34. Leshner AI. Public engagement with science. *Science*. 2003;299:977.
35. Nisbet MC, Scheufele DA. What’s next for science communication? Promising directions and lingering distractions. *Am J Bot*. 2009;96:1767–1778.
36. Goodwin J, Dahlstrom MF. Communication strategies for earning trust in climate change debates. *WIREs Clim Change*. 2013;5(1):151–160.
37. Pronin E. How we see ourselves and how we see others. *Science*. 2008;320:1177–1180.
38. Dahlstrom MF. Using narratives and storytelling to communicate science with nonexpert audiences. *Proc Natl Acad Sci USA*. 2014;111(suppl 4):13614–13620.