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Science with Impact

How to Engage People, Change Practice, and Influence Policy

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Science with Impact takes readers on a journey through the ethical and practical questions and choices that emerge through the process of doing research: What research questions matter and to whom? How should we seek to answer them? Who do we need to involve and how? When and with whom should we communicate about our research? How do we talk about uncertainty in our results? Should we try to influence policy through activism and advocacy? This book discusses these questions through stories, humor, and case studies of research from around the world. Written for a multidisciplinary audience, the book avoids the use of jargon and is accessible for both undergraduate and graduate students of diverse backgrounds.

Introduction: Science—The Next Generation

The introduction chapter will introduce the reader to the main themes of the book through arguably the most popular sci-fi franchise of all time: Star Trek. In the utopian vision of Star Trek, science's role as a beneficiary goes unquestioned, not only for humanity, but across the reaches of the galaxy. I will argue that one of the key differences between our current reality and this fictional future are the choices that we make as a society about science and technology, as well as the choices that we make during the entire research process. The chapter concludes with a call to action: if we want science to have a bigger role in shaping policy and human behavior, we need a "next generation" of scientists who think differently about what impact means in science.

Chapter 1. Will You Please Just Listen to Me?

This chapter uses the recent popular film *Don't Look Up*, which was written as an allegory for how governments, media, and the wider public have largely ignored decades of warnings from scientists about climate change, as a vehicle to unpack how science, and science communication, is largely misunderstood in society. *Don't Look Up* tells the story of astronomists who discover that a comet will collide with Earth within the year, causing the extermination of the human population. However, when they present their findings to policymakers and the larger public, they are met with derision and apathy. Even as the scientists spend their time and money trying to save the world, nothing works. So why aren't the facts enough to incite change or influence policy? How can it be that large groups of individuals see some scientific findings as conflicting with their worldviews, thus forestalling societal change and political action? This chapter explores these questions, drawing on recent research from the fields of behavioral science and policy studies, and explains why we need to go beyond the *Please Just Listen to Me* model of science dissemination if we are to make real-world impact with our research.

Chapter 2. Will I Please Just Listen to You?

So, what does science with impact look like, and how does it occur? Chapter 2 begins to address these questions by sharing the real-world example of how polio was eradicated in India. As recently as 2009, India was considered the polio epicenter of the world, with half of the world's cases. But incredibly, the last case of polio was identified in India in 2011. The story of how India achieved such a resounding success offers lessons for how to spread other types of science-based attitudes and behaviors. This chapter continues with the themes of Chapter 1 by questioning the value of high visibility public science and quickly spreading ideas for generating change. It brings in scholarship on information flows and social network analysis, which suggests that while big media platforms and social media can provide reach (getting an idea "out there") they are not effective in the spread of innovations, social norms, or cultural movements. This research suggests that change starts and spreads in the peripheries of societies, where new ideas take hold among smaller social networks by means of strong social ties, which then connect to other social networks, and then eventually they are adopted by the centers. The ideas in this chapter point to opportunities for members of the scientific community—whether

researchers, educators, or communicators—to serve as “access points” by connecting, in a direct and personal way, with people from communities that have been underserved by science.

Chapter 3. From Impact to Encounter

This chapter describes my own journey of studying impact in science. I describe my PhD research, carried out in the Bolivian Amazon, that was focused on “researching research.” I worked with Bolivian scientists, indigenous leaders, and park rangers in one of the most biodiverse places on the planet to better understand different perceptions of scientific research and what “impact” looks like to practitioners and community groups. We found that while most of the research conducted in the region had implications for management, it was relatively rare, especially among foreign-based researchers, to share the results of their science locally. This had led to local resentment towards research and was in some cases closing the doors for future scientists to do work in the region. But the story was not all negative. Some Bolivian biologists were doing things differently, and the lessons gleaned from their experiences tell another story about what scientific impact could look like. The chapter also draws on the work of the famed twentieth-century psychologist, Gordon Allport, who developed a theory that is still seen to be one of the best ways to improve relations between groups experiencing conflict. This theory, known as the “contact hypothesis,” suggests that if certain conditions are met, direct contact between members of different groups can lead to mutual understanding and appreciation, which in turn can reduce prejudice and stereotyping. However, if such conditions are not met, rather than improving intergroup relations, contact can create even more conflict. The chapter concludes that, similarly, scientific impact is all about the “nature of the contact” between researchers and extra-academic partners and sets the stage for the rest of the book where these ideas will be further explored.

Chapter 4. Asking a Good Question

In the early 2010s, corn and bean farmers in Pennsylvania were struggling – their crops were being decimated by slugs, and it seemed that no matter what they tried, it didn’t work. At the same time, John Tooker was a new Assistant Professor of entomology at Penn State University with a partial extension position. John was interested in doing research on problems that farmers in the area were facing, and when they told him about their challenges with the slugs, he had his charge. This chapter tells the story of what happened next, and how it led to changes in farming

practice and agricultural policy in the United States, as well as a better understanding of the basic science of soil food chains. It probes the reader to reflect on the following questions: How do we come up with good research questions? Who decides what questions matter? Why is involving non-academic partners in the development of research questions important for generating societal impact of science? The chapter also explores the issue of groupthink in science, and the power of diverse perspectives for innovative research.

Chapter 5. The Privilege of Choice: Methods, Permissions, and Location

The term “parachute research” is increasingly discussed as being problematic in science, but rarely is it explored in depth or taught to new students of science. This chapter explores the ethical challenges that many researchers may encounter when making choices about where, how, and with whom they will do their research. Readers will be prompted to reflect on why some places are over-researched (and others under-researched), how researchers can become more “culturally competent,” and ways to think about what informed consent means in an era of artificial intelligence and biotechnology. It also explores novel approaches to creating low-cost methods and materials to democratize science in places with fewer economic resources, and poses the essential (but often unasked) question: Are there instances when it is not the right time, or place, or we are not the right person, to do a certain research study?

Chapter 6. The Power of Participation: Data Collection

Science is often thought of as a collection of facts, but those of us who are active researchers know that it is a lively, evolving pursuit that challenges us to engage with the universe in a meaningful way. This continuous cycle of discovery reflects the essence of scientific endeavor: it's not just about what we know, but how we seek to know more. This chapter emphasizes the value of teaching science as a dynamic process through which members of the public can fully engage. I will share stories from over a decade of experience of doing participatory (citizen) science with non-profits and community groups and demonstrate how this approach leads not only to impactful work for society, but also for the scientific community. The human mind is a social mind and much of what we understand about our world is visceral and grounded in place, and we can share our knowledge with our students by creating spaces where the scientific journey is one of self- and collective discovery, curiosity, and agency.

Chapter 7. Rethinking the “Peer” in Peer Review

One of the most important, and misunderstood, aspects of the scientific process is publishing and peer review. Similarly, one of the most pertinent questions about the role of science in society today is who gets to participate in decisions about what science is needed and how that information should be shared in society. This chapter explores this question through examples of how “evidence” is used to inform policy and practice and presents alternative structures to the current system of who is included or excluded in science. It opens with a story about how a team of statisticians and mathematicians from the University College London created a website to communicate the complex statistical outcomes of children’s heart surgery to parents and doctors. Rather than creating the website on their own, the researchers engaged the parents of children undergoing heart surgery in its creation, which led to improved understanding of the risks and benefits of different procedures and options. The chapter concludes with a call to both funders and administrators of higher education to rethink what types of products count in research, and how to reward researchers who break free of the “publish and perish” model of scientific productivity.

Chapter 8. The Scientist Next Door: Conversations, Communities, and Connections

Science communication is often perceived as a one-way street, where scientists deliver information to the public in a straightforward manner. But communication scholars know that impactful science communication is inherently a two-way process that thrives on interaction and invites feedback, questions, and discussion. This chapter demonstrates how conversations about science can enrich understanding and foster trust, as communicators can address misconceptions and tailor their messages to meet the needs and interests of their audience. It explores radical approaches to science communication techniques, including examples of researchers who have attempted to engage with science deniers, and a novel technique called “deep canvassing” that has been shown to change people’s minds about controversial topics. By creating opportunities for collaboration and listening, science communication not only informs but also empowers individuals, encouraging them to become informed participants in scientific discourse. This reciprocal relationship can ultimately enhance the relevance and impact of science in society.

Chapter 9. The Skeptic in the Mirror: The Essential Role of Uncertainty in Science

Uncertainty is part of the standard operating procedure for doing science: it reflects the inherent nature of scientific inquiry, where knowledge is continually evolving and subject to revision based on new evidence. However, uncertainty is also rarely talked about. This chapter takes the case of mask-wearing during the COVID-19 pandemic to argue why embracing uncertainty fosters a more accurate understanding of the complexities of natural phenomena, reminding both scientists and the public that conclusions are often provisional and dependent on current data. This openness can help build trust, as it encourages transparency about the limits of what we know and the risks of overconfidence in findings. Moreover, recognizing uncertainty promotes critical thinking and a more nuanced appreciation of scientific debates, empowering individuals to make informed decisions in a world where many issues—like whether to issue a mask mandate in schools—are fraught with difficult tradeoffs. The chapter concludes with a call for scientists to be more open about the values that drive them.

Chapter 10. In the Belly of the Beast: Scientists, Policymaking, and Advocacy

Scientists often misunderstand the policy process by viewing it as a straightforward application of facts and data, underestimating the complexities involved in decision-making. But policymaking is influenced by a myriad of factors, including political, social, and economic considerations, which can sometimes overshadow scientific evidence. This chapter aims to help scientists engage more effectively with policymakers by understanding the context in which decisions are made, including the interests and priorities of various stakeholders. It will draw upon interviews and conversations with political lobbyists and scientists who work in boundary organizations, which are typically set up to promote two-way communication between scientific and political communities. This chapter will question the important of facts in these interactions and show rather the importance of long-term relationships and regular dialogue. It also includes a story of a college professor who has spent over a decade teaching policy advocacy to budding environmental scientists, and the lessons that she has learned along the way.

Conclusion and Acknowledgments: From Boldly Going to Steadily Engaging

The short conclusion chapter brings us back to the Star Trek multiverse through the lens of its newest iteration: Lower Decks. This last series is something of an unlikely addition to the Star Trek canon—it's a cartoon parody, and its main characters are the underlings of Star Fleet society on a relatively unimportant starship. The characters and plots in Lower Decks remind us that making social impact through science is less about bold, new discoveries and more about steady and thoughtful engagement over the long term. It is dependent on understanding communication as a process of two-way dialogue based in listening and connection, and long-term commitments to people, places, and ideas. And it is an undertaking of the many rather than the mission of a select few. The chapter (and book) ends with a call for the scientific community—particularly individuals in positions of power—to support research with real world impact.