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Tacit Diplomacy in Life Sciences: A Foundation for Science Diplomacy

David R. Benson and Roger K. Kjelgren

GLOBALLY, advances in the life sciences are viewed in a positive light, as contributing to improvements in public health, agricultural, and economic development. At the same time, some of these advances can generate disquiet, misunderstanding, and even suspicion in diplomatic and security communities if they fall, for example, in the categories of dual use research, genetically modified organisms (GMOs), or synthetic biology. Examples from each of these categories are often raised in diplomatic venues ranging from multilateral discussions such as under the Biological and Toxin Weapons Convention (BTWC) to a host of international meetings. In general, the concerns have a biosecurity or biosafety tenor. They emanate from fears that rogue governments or terrorists can misuse enabling technologies or that accidental release of pathogens or GMOs can occur and cause human or environmental damage.

Although some life science advances have generated worry in diplomatic circles, scientists using the technologies and conducting the research are far more likely to embrace new advances as they emerge, usually, but not always, without controversy. So what accounts for the different attitudes, and what might be done

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to reconcile the positive progression of science with diplomatic and security concerns? This article highlights the roles played by the unprecedented rise of international collaborations in scientific communities, the internationalization of science education, and the attendant slow but steady adoption of norms of behavior. These roles together knit a kind of "tacit diplomacy" that helps to mitigate concerns about advances in the life sciences.

Diplomacy can involve scientific issues in diverse ways. For example, scientific cooperation can help to change a diplomatic relationship, or enhance the economic trade and/or security of the United States (or another country).[1] Science also informs the diplomatic processes related to, for example, securing arms control, mitigating climate change, improving food security, or reducing illegal trade in endangered species.[2, 3] Tacit diplomacy in science governs how the global community of scientists interacts via understood, but generally unstated, behavioral norms. Absent this foundation, science diplomacy cannot work optimally or sustainably.

Most scientists recognize the set of norms that are tacitly assumed to operate in collaborative science and in the communication of scientific knowledge. The InterAcademy Council, an organization of national academies from countries around the world, lists seven values or norms that characterize successful scientific interactions: honesty, fairness, objectivity, reliability, skepticism, accountability, and openness.[4] Tacit diplomacy among scientists assumes that these norms are at least nominally in place, unless proven otherwise, with the result being the evolution of that elusive, bilateral human behavior of mutual trust. The outcome of tacit diplomacy is that scientists interacting with colleagues from very different countries and cultures can achieve common goals.

The power of tacit diplomacy derives from its implementation in international scientific interactions that globally number in the millions each year. Such interactions range from formal collaborations to less formal points of contact via email, video conference, or telephone, at international and national conferences and meetings and invited seminars. In the aggregate these contacts strengthen norms at an interpersonal level, for example in faculty-advisor–student or colleague–colleague relationships rather than government-to-government relationships. Importantly, such behavioral norms spread along with the migration of technology and scientific understandings.

Tacit diplomacy cannot be imposed by international and national organizations or by governments that often desire to manage or "do something" about the risks of misuse or the spread of scientific advances that are of concern. Such management is often expressed in top-down notions of oversight (regulations), education (e.g., research integrity or biosecurity training), awareness-raising exercises, and written codes of conduct. While each of these notions has local utility, they are of questionable effect in dealing with broader underlying issues that are primarily ethical in nature.[5]

A number of global trends have promoted the spread of tacit diplomacy and are of considerably broader significance than management tools when it comes

to garnering adherence to norms. Some trends can also erode tacit diplomacy in science. Both need to be understood to increase awareness and consideration in diplomatic arenas.

Global Trends that Promote Tacit Diplomacy

Trends that promote tacit diplomacy in the life sciences generally coincide with those in all of science and technology (S&T). Some are well-known contributors to globalization in general: the Internet lubricating collaborations, expanding information access, and facilitating research investment globally; greater ease of air travel allowing scientists to develop collaborations at meetings, use large shared facilities, and study overseas; and the expanding use of English, in particular the near universal acceptance of English as the common language of science.[6]

A more specific trend that reflects and promotes the internationalization of science is the steady increase in global research and development funding. From 1996 to 2011, global funding, life sciences included, increased nearly two and one-half times worldwide in real dollars, with the recognition that S&T is key to innovation and economic growth.[7] Increased funding has allowed developing countries with emerging economies to aggressively seek international partners for developing science while building their own infrastructure and programs. For these countries to succeed, adherence to norms and development of trust are essential.

There has been a dramatic increase in collaboration reflected by internationally coauthored articles. For example, the proportion of S&T publications from the United States having international coauthors rose from 7 percent in 1986 to 29 percent in 2010.8 Open-access scientific journals and still-evolving policies in the large publishing houses lower barriers to collaborative publication between scientists in developing and developed countries, creating a more integrated global science community.[9]

An increasing number of undergraduate and graduate students are seeking higher quality training outside their home country.[10] For example, Brazil's Science without Borders program has the goal of sending one hundred thousand students to study abroad by 2015. In 2012, foreign students received about 34 percent of all science and engineering doctorates awarded in the United States,[11] an increase from about 15 percent in 1977.[12] PhD programs have also proliferated in Asian countries, such as China, Singapore, and Australia, catering to students from less-developed countries. Returning students bring new technologies, fresh scientific perspectives and patterns of normative scientific behaviors that facilitate science diplomacy.

Finally, solutions to global challenges increasingly require pollination across disciplinary borders of basic and applied life sciences, social science, and engineering.[13, 14, 15] Issues involving emerging infectious diseases, climate change, food security, fisheries management, for example, touch multiple countries and

scientific disciplines. Diplomatic efforts aimed at their resolution proceed more effectively from a foundation of trust built by tacit diplomacy developed among scientists across appropriate disciplines.

Global Trends that Erode Tacit Diplomacy

Science is also vulnerable to countervailing trends that undermine the trust and credibility that lie at the core of tacit diplomacy. These trends may emerge from individual misbehavior, cultural misunderstandings, or more pervasively from larger economic or political pressures, particularly in the life sciences where rapidly advancing genetic technology intertwines with the potential for profit.

Because peer-reviewed publications are the currency of science, it is no surprise that stratagems for circumventing the system have evolved. While most online journals maintain excellent peer review processes, a subset of publishers, mainly based in developing countries, avoid peer review or replace it with cursory reviews and often require substantial payment by the author.[16] Less rigorous peer review lowers the bar for publication, resulting in questionable results and more retractions.[17, 18]

Alternatively, authorships and even author position can be purchased on manuscripts as a way to pad credentials.[19] In some instances, scientists at nationally supported institutions are paid for publishing in English-language scientific journals listed in the Science Citation Index, a product of the Institute for Scientific Information; the higher the journal's prestige, or impact factor, the more (often considerably more) money one earns.[20] Such developments put pressure on scientists, especially young ones, to skirt scientific norms or even fabricate data. The result is reduced trust and an undermining of the normal operation of tacit diplomacy among scientists.

Expansion of global science has largely depended on national or regional governmental patronage. Unfortunately, in the United States, government funding for university science research has declined at the state and, more recently, federal levels. This decline, combined with the Bayh-Dole Act of 1980, which allows universities to commercially exploit U.S. government-funded research, has resulted in science innovations being viewed as revenue streams. Commercialization of university research, like online publishing, is a double-edged sword. It can promote science, but it can also diminish communication, trust, and science as tacit diplomacy if appropriate agreements are not in place, particularly if international partners are involved.

Examples of Tacit Diplomacy in the Life Sciences

Recent examples in the life sciences illustrate how the broad influence of tacit diplomacy could help to mitigate a dual use research controversy, counterbalance a source of diplomatic tension or rectify an unbalanced policy.

Dual Use Research of Concern

As noted above, dual use research of concern is often highlighted in diplomatic venues, particularly when high profile studies emerge. An example is the creation of mammalian transmissible strains of the highly pathogenic avian influenza virus A/H5N1 and the more recent proposal involving another influenza virus A/H7N9.[21] Articles describing the research involving A/H5N1 in particular were variously discussed, condemned, or supported for more than two years in scientific literature, at government departments and agencies, and in diplomatic venues. There were multiple misgivings concerning the potential for misuse, accidental release, and the spread of simplified enabling technologies that could potentially open new areas of science to broader populations, including terrorists.

Scientific concerns about the A/H5N1 studies were eventually allayed to the extent that the initially embargoed articles were published in full despite lingering concerns at various levels. For example, members of the National Science Advisory Board for Biosecurity, the U.S. federal advisory committee charged with providing advice, guidance, and leadership about dual use research, were split on the issue, with the committee initially recommending the withholding of certain details from publication before later supporting full publication. Although concerns were also expressed in diplomatic venues such as the BTWC, they were mitigated in part because the scientists involved as authors or collaborators hailed from many countries, including China, Indonesia, Japan, the Netherlands, the United Kingdom, the United States, and Vietnam. Furthermore, many of the authors had coauthored other articles in recent years with scientists from many other countries to form an extended web of collaboration. The international character of the work established confidence that it was not aimed at bioweapon development. It also provided confidence that the work and containment protocols would be done safely because of the understandings, trust, and shared norms achieved over time through the operation of tacit diplomacy among scientists.

More generally, the A/H5N1 studies highlight profound increases in creative abilities in the life sciences over the past decades. DNA and protein synthesis and sequencing, computational biology, synthetic biology, and various high-throughput "-omics" approaches to investigating biological systems are now standard in many life sciences labs. The spread of these advances has created enormous opportunities for all nations, along with a vast new pool of dual-use worries for individuals and organizations charged with anticipating adverse events. Yet, despite unprecedented access to knowledge and abilities in the life

sciences, the incidence of adverse events has not increased, and may have actually decreased, particularly in proportion to the number of practitioners.

Part of the apparent decrease is no doubt due to the strengthened legislation during the 1990s and after 9/11 and the ensuing anthrax attacks. Together they provided robust controls over pathogens, especially "select agents." Another reason may well be that the norms of scientific behavior have spread in tandem with these powerful new biological technologies through tacit diplomacy. From a practical policy perspective, active promotion and exchange of advances in science and technology that create more opportunities for international engagement, within the bounds of national interests, would seem to be a logical way forward to maintain biosecurity.

International Public Health

A second example illustrates how a foundation of tacit diplomacy developed among scientists over years created an environment where controversies could be addressed equitably. In 2006, Indonesia became the center of human infection with A/H5N1 influenza viruses. Indonesian officials refused to provide samples of the virus to the World Health Organization for distribution because they felt it was unfair for pharmaceutical companies to develop vaccines and diagnostics that the source country could not afford. The episode touches on issues of bio-piracy where genes or organisms are commercially developed without compensation to the originating country, creating diplomatic tension and eroding relationships.[22, 23]

In 2011, the conflict was successfully resolved, after almost five years of negotiations, with the adoption of the pandemic influenza preparedness framework.[24] The agreement redressed concerns by encouraging member states to share viruses and provide equitable access to benefits including vaccines and technology. The framework is nonbinding to states but indirectly acknowledges the importance of tacit diplomacy in the interactions among scientists who conduct research, analyze and share results, apportion credit, and produce benefits. It repeatedly notes that recipients who conduct research on virus samples will include the participation of scientists from the submitting laboratories, especially those from developing countries, through the publication process. The framework thus provides a structure within which tacit diplomacy can continue to operate with the goal of producing a global benefit. The asymmetry between benefits accruing to developed versus developing states initially strained the normal operation of tacit diplomacy in science; the eventual resolution strengthened tacit diplomacy.

Global Food Security

Global food security provides an example where tacit diplomacy has failed to make a difference in international policy. At the core of food security is a complex blend of applied biological sciences—agronomy, horticulture, animal science, pest management—that enable efficient production of sufficient carbohydrates,

protein, and other nutrients to sustain human health. The crucial complementary sciences of climate, economics, and human behavior are networked around this core. Together, they constitute a knowledge ecosystem. Tacit diplomacy allows this ecosystem of scientific disciplines to be nimble in addressing the challenges to food production in the face of environmental change and population growth.

These challenges have stimulated debate about balancing the historical model of high resource input, industrial (and profitable) agriculture with a potentially more sustainable model of high knowledge input, localized, and diversified agriculture. Within the scientific community this debate is slowly being resolved, moderated by the behaviors instilled by tacit diplomacy. However, the absence of a strong scientific voice articulating the nuances of the debate at international policy levels can create an information void that commercial interests can fill disproportionately and, thereby, affect the allocation of resources and attention.

As an example, many genetically modified (GM) crops incorporate genes to reduce pesticide use. Such crops can help solve some intractable pest problems, so they have a valid role in the scientific debate over reducing resource inputs in both industrial and diversified agriculture models. But outside science, the debate over GM crops pits agribusiness against those fearing threats to human health. Contention over GM crops as an ongoing U.S. trade issue with Europe has allowed unedited agribusiness influence to seep into post-2008 U.S. food security policies and inflate the role of GM crops in global food security in emerging economies. While the scientific community has repudiated flawed studies purportedly showing health threats from GM crops,[25] it has also rigorously evaluated the limits of such crops, particularly in responding to environmental challenges such as drought.[26, 27] However, the latter, more nuanced, evaluations have not informed policy as effectively as the former. As a result, a weakened link between the ecosystem of scientific tacit diplomacy and U.S. agricultural foreign policy has led to an unbalanced information framework for addressing global food security.

Using Tacit Diplomacy in Formal Diplomacy

Understanding how tacit diplomacy works in science should help diplomats better formulate diplomatic goals and policies. Such understandings should also help representatives from the security world to better estimate risks and, perhaps more importantly, identify where gaps may exist. On a personal note, from 2012 to 2013 the authors navigated short distances in diplomacy by participating as Jefferson Science Fellows at the U.S. Department of State. Such programs provide unbiased scientific input in the diplomatic world and contribute the perspective of individuals who understand how scientists interact. Thus, one way to take advantage of the opportunities created by tacit diplomacy would be to create more venues for scientists to interact internationally with diplomats and scientific colleagues in other countries, particularly in science-rich arenas such as

biosecurity and agriculture. A reciprocal program, where foreign service officers serve a rotation within the scientific community, would also be beneficial. Such an opportunity would provide a big-picture perspective on diplomacy in science and its countervailing issues, to match the "thirty-thousand foot" perspective on general foreign policy making. SD

Endnotes

1. Vaughan C. Turekian and Norman P. Neureiter, "The Past as Prologue," *Science & Diplomacy* 1, no. 1 (2012), http://www.sciencediplomacy.org/editorial/2012/science-and-diplomacy.
2. Richard G. Lugar, "Nunn-Lugar: Science Cooperation Essential for Nonproliferation Efforts," *Science & Diplomacy* 1, no. 1 (2012), http://www.sciencediplomacy.org/perspective/2012/nunn-lugar.
3. Robert D. Hormats, "Science Diplomacy and Twenty-first Century Statecraft," *Science & Diplomacy* 1, no. 1 (2012), http://www.sciencediplomacy.org/perspective/2012/science-diplomacy-and-twenty-first-century-statecraft.
4. *Responsible Conduct in the Global Research Enterprise: A Policy Report*, InterAcademy Council (September 2012), http://www.interacademies.net/File.aspx?id=19789.
5. Nicholas H. Steneck, "Global Research Integrity Training," *Science* 340, no. 6132 (2013): 552-53, http://www.sciencemag.org/content/340/6132/552.summary.
6. Daphne van Weijen, "The Language of (Future) Scientific Communication," *Research Trends*, no. 31 (2012), http://www.researchtrends.com/issue-31-november-2012/the-language-of-future-scientific-communication.
7. *Science and Engineering Indicators 2012*, National Science Board, National Science Foundation (January, 2012), http://www.nsf.gov/statistics/seind12/c2/c2s3.htm.
8. Jonathan Adams, "Collaborations: The rise of research networks," *Nature* 490, no. 7420 (2012). http://www.nature.com/nature/journal/v490/n7420/full/490335a.html.
9. Jagadeesh Bayry, "Journals: Open-access boom in developing nations," *Nature* 497, no. 7447 (2013): 40, http://www.nature.com/nature/journal/v497/n7447/full/497040e.html.
10. British Council, *The Shape of Things to Come: Higher education global trends and emerging opportunities to 2020* (2012), http://ihe.britishcouncil.org/educationintelligence/shape-of-things-to-come.
11. *Science and Engineering Indicators 2012*, National Science Board, National Science Foundation.
12. *Science and Engineering Indicators 1993*, National Science Board, National Science Foundation (December, 1993), http://www.nsf.gov/statistics/seind93.
13. Anna Evely et al., "Defining and evaluating the impact of cross-disciplinary conservation research," *Environmental Conservation* 37, no. 4 (2010): 442–50.
14. Julie Trottier and David B. Brooks, "Academic Tribes and Transboundary Water Management," *Science & Diplomacy* 2, no. 2 (2013), http://www.sciencediplomacy.org/article/2013/academic-tribes-and-transboundary-water-management.
15. Harold Varmus, "Making PEPFAR," *Science & Diplomacy* 2, no. 4 (2013), http://www.sciencediplomacy.org/article/2013/making-pepfar.
16. John Bohannon, "Who's Afraid of Peer Review?" *Science* 342, no. 6154 (2013): 60–65.
17. R. Grant Steen, Arturo Casadevall, and Ferric C. Fang, "Why Has the Number of Scientific Retractions Increased?" *PLoS One* (2013).
18. "How science goes wrong," *The Economist*, October 19, 2013, http://www.economist.com/news/leaders/21588069-scientific-research-has-changed-world-now-it-needs-change-itself-how-science-goes-wrong.
19. Mara Hvistendahl, "China's Publication Bazaar," *Science* 342, no. 6162 (2013):1035–39.
20. Jufang Shao and Huiyun Shen, "The outflow of academic papers from China: Why is it happening and can it be stemmed?" *Learned Publishing* 24, no. 2 (2011): 95–97.
21. Arturo Casadevall and Thomas Shenk, "The H5N1 Moratorium Controversy and Debate," *mBio* 3, no. 5.
22. John Merson, "Bio-prospecting or bio-piracy: Intellectual property rights and biodiversity in a colonial and postcolonial context," in *Nature and Empire: Science and the Colonial Enterprise*, Roy Macleod, ed. (Chicago: University of Chicago Press, 2000), 282–96.
23. "EU ponders biopiracy law to protect indigenous people," *EurActiv.com*, April 30, 2013, http://www.euractiv.com/health/eu-mulls-biopiracy-law-news-519381.
24. *Pandemic Influenza Preparedness Framework: For the sharing of influenza viruses and access to vaccines and other benefits*, World Health Organization (2011), http://whqlibdoc.who.int/publications/2011/9789241503082_eng.pdf.

25. "Final review of the Séralini et al. (2012a) publication on a 2-year rodent feeding study with glyphosate formulations and GM maize NK603 as published online on 19 September 2012 in Food and Chemical Toxicology," *European Food Safety Authority Journal* 10, no. 11 (2012): 2986, http://www.efsa.europa.eu/en/efsajournal/pub/2986.htm.
26. D. W. Lawlor, "Genetic engineering to improve plant performance under drought: Physiological evaluation of achievements, limitations, and possibilities," *Journal of Experimental Botany* 64, no. 1 (2013): 83–108.
27. Doug Gurian-Sherman, *High and dry: Why genetic engineering is not solving agriculture's drought problem in a thirsty world*, Union of Concerned Scientists (2012), http://www.ucsusa.org/food_and_agriculture/our-failing-food-system/genetic-engineering/high-and-dry.html.

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