"The Construction of New Security Concerns in the Life Sciences"

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It has been fifteen years since the anthrax attacks of 2001 that instigated much of the political pressure to develop our current biosecurity governance system. An outcome of this period has been the development of governmental policies for oversight of research of security concern (USG 2012; 2014). Crafting these policies was time-consuming, laborious, and thoroughly enmeshed in the long-standing debate that pits national security as an enemy of academic freedom. This debate has been active since at least World War II, and has covered topics as wide ranging as nuclear physics,[†] computer science (Kahn 1981), biology (Evans & Valdivia 2012), and scientific research writ large (Institute of Medicine et al 1982; Ramirez 1986). One of the major results of this debate within the life sciences has been a redrawing of a small and clearly defined space of science within which the government is allowed to exert its power to control what knowledge is produced and how it is disseminated. This space, called "Dual Use Research of Concern" (DURC), is defined as "life sciences research that, based on current understanding, can be reasonably anticipated to provide knowledge, information, products, or technologies that could be directly misapplied to pose a significant threat with broad potential consequences to public health and safety, agricultural crops and other plants, animals, the environment, materiel, or national security" (USG 2012).

Lost in this definition, and in the subsequent rollout of policies based on it, is a reason for its creation in the first place. 'Dual Use Research of Concern' is a subset of 'Dual Use Research.' Dual Use Research is a term that covers all areas of research that carry the potential for malevolent purposes. As the National Science Advisory Board for Biosecurity (NSABB) notes, "This dual use quality is inherent in a significant portion of life sciences research. In fact, it can be argued that virtually all life sciences research has dual use potential" (NSABB 2007a, 2).

This statement can be parsed in two ways. Either it means that, because all research is dual-use, we must find another classification that is more meaningful to base a governance system on, or it means that the security governance system should be embedded in all parts of the research process. To date, we have spent a great deal more time and effort on the former understanding, but much may be gained by focusing on the latter (Evans 2016). A comprehensive security governance system should provide *mechanisms for identifying what types of things we need to be concerned about*, as well as how those objects of security concern are governed. Our current system focuses too much on the governance of security concerns, and not enough on what becomes an object of concern, and why. There are reasons why we focus on there being a 'dual' use and why the life sciences get so much security attention the last few decades (Tucker 2010). These are not the only reasons we might use to structure how we define a security and what we do about it.

In this paper, I outline ways we that might augment our biosecurity governance system with a focus on the often overlooked point that all research is dual use, and most of it is not subject to security oversight. I begin by analyzing the assumptions about science, security, and their relationship to the state that underlie our current governance system, and show how those assumptions can be found in the NSABB's (2007b) *Responsible Communication of Life Science Research*

[†] See, e.g., *Hearings on H.R. 4280 Before the House Committee On Military Affairs*, 79th Congress, 1st Session. 80-82, 97-100, 118 (1945).

with Dual Use Potential. I show the limitations of these assumptions, and then propose an alternative set, that leads to radically different principles upon which we might base a system of constructing security concerns in the life sciences. I end by outlining how these principles can be practically implemented in a range of existing and novel governance mechanisms.

Two framings of Science, Security, and Society

How we understand the structure of knowledge, and therefore whether it is a threat and how it might be governed, is inextricably bound up with how we understand the structure of our society (Jasanoff 2004). When looking at security concerns in the life sciences, two framings of science and society are useful to contrast.

The first framing views science as a different type of activity from the rest of society, and therefore deserving of special treatment. It is born out of a long-held story of science as best done when it is independent of political pressures (autonomous), focused on producing true knowledge (objective), and is the basis for building a better society. Under this framing, the state's responsibility for the security of the people is often pitted against the scientists' responsibility for the autonomy of their work.

The second framing focuses on the ways that science and society are mutually constitutive. Focusing more on the practice of science than an idealized view of it, this framing looks for the social structures that shape, and are supported by, which lines of research to pursue. Deciding in which context (e.g. economic, security, health) to think about a set of knowledge is itself a matter to be carefully considered and debated, not just assumed.

Much of the governmental assessment and systems of oversight of dual use research primary work within the first framing of science as a special activity, separate from other parts of society. There are important moments, however, when the mutually constitutive nature of science is acknowledged, but these moments are not usually turned into codified ways of governing dual use research.

The NSABB Responsible Communication Principles

The NSABB is an excellent site for analyzing how the United States Government constructs security concerns around biology, and the systems to govern those concerns. Established in 2004, the NSABB is charged with providing "advice, guidance, and leadership regarding biosecurity oversight of dual use research, defined as biological research with legitimate scientific purpose that may be misused to pose a biological threat to public health and/or national security."[‡] It has been at the center of the development of governmental policies for the oversight of dual use research of concern (DURC), and it has built upon substantial work that has framed the biosecurity issue as one that must balance national security with academic freedom (Evans & Valdivia 2012).

In 2007, the NSABB published a set of tools on the *Responsible Communication of Life Sciences Research with Dual Use Potential*, which was excerpted from its proposed framework for the oversight of dual use life sciences research (NSABB 2007a; 2007b).

[‡] The NSABB's current charter can be found at http://osp.od.nih.gov/sites/default/files/NSABB_Charter_2016.pdf

These tools included a set of principles for communication, points to consider in identifying and assessing risks and benefits of communicating DURC, and considerations for developing a communication plan. The principles deserve special analysis, as they are emblematic of a way of constructing threats in biology that works well for DURC, but most of them provide little help when considering dual use issues in the rest of the life sciences, or indeed in areas of converging technology, such as automated gene sequencing and analysis that might be thought of as computer science as much as life science. The NSABB principles are provided in an appendix to this paper for easy reference.

There are eight principles in all. The first lays out an assumption that innovation proceeds through a linear model, where research leads to a "steady stream of scientific advances that underpin public health and safety, a strong and safe food supply, a healthy environment, and a vigorous economy." This linear model of innovation, while being heavily engrained within a wide range of policies since the mid-20th Century (Godin 2006, Hurlbut 2016), does not actually reflect the practice of innovation (Pielke 2007; Stokes 1997). Basing policy on this model, therefore, may be institutionally prudent, but is by no means necessary or even desirable.

Principles 2 and 3 build on this linear model, arguing that fundamental research should be treated as a special entity within governmental oversight (especially in relation to security concerns), where "any restriction of scientific communication should be the rare exception rather than the rule." In addition to providing a protected space for academic research, such a statement also envisions the knowledge production process of science to be void of any social or political contexts. Decades of research on the practices of science show this not to be the case (Doing 2008). Moreover, the idea that nothing should infringe on the production of basic research is routinely transgressed through a competing pressure within academia to patent ideas (Krimsky 2003; Mackenzie et al 1990).

The combination of a linear model of innovation and a hard line between academic freedom and national security have the effect of framing discussions about the security concerns of life science research as being a) a zero-sum game between freedom and security, and b) resolvable by drawing a line in the innovation process where societal concerns like security can come in. By making only a small subset of research a matter of concern, this way of thinking about security has the effect of reinforcing the idea that most research carries no potential for harm.

Principle 4 states that a risk-benefit analysis is the appropriate mechanism for determining the appropriate course of action around dual use research. In doing so, deference is given to a technical, quantifiable understanding of the issue over, for example, political or broader public understandings (Jasanoff 1990; Rappert 2007). At the same time, there are significant hurdles hinder universities' (Casadevall et al 2014), or even intelligence agencies' (Vogel 2013), abilities to perform a risk-benefit analysis. These hurdles are high enough when only focused on a specific list of agents and experiments of concern, and there is no indication that such list-based systems have any capacity to scale in their current form.

Principles 5 and 6 will be addressed below. Principles 7 and 8 discuss the need to avoid public misunderstanding and promote public trust. These principles provide a clear example of how the public is often mischaracterized in scientific communication: as homogenous, fearful, and ignorant. This deficit model of the public understanding of science misses an important reason why security concerns in science can cause public debate: they are one of the few ways that non-scientists are able to "question the appropriateness of existing procedures, established patterns of access to decision making, institutional prerogatives and power distributions" (Rayner 2004, p.352). Public debates about the way security concerns are constructed are also about deciding who has the authority to make these decisions. In a space like life science research, where there is substantial uncertainty around the implications of much research, we should seek out and welcome continual constructive critique on how we institutionalize the process of legitimating research, not limit the scope of concern to only those areas where we have reasonable anticipation of direct misapplication with significant threat.

The Principles clearly articulate a widely held view, in America, of the way to conceptualize security concerns in research. However, they also try to push against that view. Principles 5 and 6 state that deciding how to communicate dual use research is not a binary yes/no decision to be decided only at time of publication. Instead, "communication of dual use research can occur at multiple points throughout the research process," and consideration should be given to *how* research is designed and communicated. The problem, however, is that we are woefully lacking in our institutionalized way of thinking about security concerns to have these final two principles be heard, let alone embedded within the routine practices of science.

These last two principles, if built on different assumptions about the structure of knowledge and the relationship between science and security provide a very different trajectory for the types of governance mechanisms we need to be fostering. The overriding difference between the principles in the next section and the ones above is that the principles I suggest are about *how to determine whether a path of research poses a security concern, and what degree of concern is warranted*, rather than assuming that such a decision can be made objectively. The whole process of oversight for dual use research of concern hinges on the question of what counts as 'dual use research of concern.' As several scientific organizations have pointed out, however, "the greatest potential problem with oversight of dual use research is the ambiguity inherent in assessing whether or not it is of concern and therefore in need of further review" (American Association for the Advancement of Science et al 2008).

Analyzing many other outputs on science and security produced by the government units over the last several decades produces similar results about the frames of science and society they advance. Disjunctures between how we understand the structure of knowledge and the mechanisms we have to govern its dissemination aren't generally recognized in these reports. This has the effect that certain recommendations are either not taken up, or if they are, prove to be extremely problematic in their application.

To provide another example, the 1976 Bucy Report on *An Analysis of Export Control of U.S. Technology – A DOD Perspective* (Defense Science Board Task Force on Export of U.S. Technology 1976) understands that the transfer of technology is as much or more about the transfer of knowledge about the technology through sustained interaction than it is about the transfer of physical objects, thereby acknowledging the contextuality of knowledge and the importance of tacit (unwritten) knowledge and skill. At the same time, the report also concludes that export controls are an acceptable mechanism to control knowledge flow, even though they work best when the things controlled are discrete, excludable, and clearly definable entities. This disjuncture between the understanding of the structure of knowledge and the mechanism used to govern knowledge flow can explain much of the difficulty that the United States has had in export controls of knowledge, particularly around the issue of 'deemed exports' (Evans & Valdivia 2012).

Principles for crafting new objects of security concern within the life sciences

The principles I suggest below focus on the overlooked aspect of governing dual use research: that the type and degree of security concern posed by a piece of knowledge is, in most cases, unclear. They focus on the process through which we construct objects of security concern, rather than what to do once concerns are identified.

1. Life science research has been used to improve public health and safety, as well as provide for a safe food supply, a healthy environment, and a vigorous economy, but it has also aided in the accidental and purposeful debilitation, death, and destruction of people, the economy, and the environment. Which of these are likely outcomes is not always clear at any stage of research.
2. In rare cases where there is broad acceptance of the security concerns around an area of research, such as 'experiments of concern' done on Select Agents with federal funds, established procedures for conduct and oversight of research should be followed.
3. For all lines of research taken, there are many that are not pursued. Decisions about which lines to pursue, as well as the actual conduct of research, are inextricably embedded in cultural, economic, political, and technical systems.
4. Communities, not individuals, are best placed to determine the level of security concern around an area of research. A relationship of mutual trust and shared expertise should be fostered in particular between the life science and intelligence communities.
5. Broader public debates about security concerns in research are not 'crises of trust in science'. Instead, they are opportunities to assess "societal preferences for principles of achieving consent to a technology, distributing liabilities, and investing trust in institutions" (Rayner & Canton 1987).
6. We cannot expect researchers to be engaged in this conversation unless their training and aspirations include it from the beginning, and it is incorporated within a broader curriculum on responsible research and innovation. This must be clearly championed and internalized by their mentors and advisors (Palmer et al 2015).

Taken together, these new principles suggest a different course of action in governing dual use research than that codified in the oversight processes currently being rolled out by the US Government. They are largely in line, however, with many recommendations made a decade ago by the National Research Council report on *Globalization, Biosecurity, and the Future of the Life Sciences* (NRC 2006), often called the Lemon-Relman report after its co-chairs. The committee recommended shifting away from a list of Select Agents to instead consider a function-based categorization of concerning research advances. It also recommended "strengthening and enhancing the scientific and technical expertise within and across the security communities" and adopting and promoting "a common culture of awareness and a shared sense of responsibility within the global community of life scientists." Similar recommendations were made even earlier in the NRC report on *Biotechnology Research in an Age of Terrorism* (NRC 2004), often called the Fink Report.[§] Gerald Epstein has added to these recommendations that, "at its core, a dual-use oversight process should be a means of ensuring that the judgement of informed, independent observers with a variety of perspectives is brought to bear on weighing the societal benefits of the proposed research against its potential security liabilities" (Epstein 2012, p.28).

With a few exceptions, why haven't these recommendations been built upon in the subsequent years? One of the main reasons is that there is a lack of appreciation of the extent of institutional inertia and incentive structures that favor seeing science as an activity disconnected from society, particularly within undergraduate and graduate education in the United States. Whenever Asilomar[**] or the impartiality of science is invoked, another brick is added to the wall of separation between science and society.

To move down a path that is in line with these new principles, three first steps seem logical: revitalizing engagement between scientists and the security and intelligence communities; crafting new statements of mutual assurance between the government and the research community; and reforming the way students are trained about all broader aspects of their discipline, including security.

There exists no more powerful statement of the separation of science from government intrusion than the Presidential National Security Decision Directive (NSDD) 189, signed in 1985 by Ronald Reagan. Titled the *National Policy on the Transfer of Scientific, Technical, and Engineering Information*, it defined the concept of 'fundamental research' in order to say that it is an area of scientific work that is largely protected from government regulations and oversight. NSDD-189 has been invoked by every administration since, but significant attention to the dual use potential of all research requires that we revisit this defining document. One of its major issues is that it is a *static* document. Like the Select Agent List, NSDD-189 was designed to serve a specific purpose within the world of export controls, but it does so by drawing a line in the sand (Evans & Valdivia 2012). The sands, however, are moving, and just as a list of agents is too static to catch concerning

[§] Recommendation 1 stated that "that national and international professional societies and related organizations and institutions create programs to educate scientists about the nature of the dual use dilemma in biotechnology and their responsibilities to mitigate its risks." Recommendation 6 stated that "the national security and law enforcement communities develop new channels of sustained communication with the life sciences community about how to mitigate the risks of bioterrorism."

[**] This refers to a gathering of molecular biologists and a few others at the Asilomar conference venue in California in 1975 to develop a self-governance system for genetic engineering.

new research, so too is a hard line between science and security. NSDD-189 should be replaced with a statement on the mutual responsibility of scientists and the state to work together in determining objects of security concern. It should also have a mechanism to facilitate that mutual responsibility.

We should be fostering the creation and—just as importantly—analysis of bodies like the National Science Advisory Board for Biosecurity. While the NSABB was at the heart of the H5N1 avian influenza journal article publication review controversy, that isn't a role that its institutional embedding fully supports. It is telling that the entire membership of the Board was replace after that episode. At the same time, the NSABB was working on strengthening connections between the intelligence community and journal editors, but abandoned that work when the H5N1 issue surfaced (NSABB 2011). More thorough analyses than the one done above of the assumptions the NSABB is making in the actions it takes are critically needed.

Another body that deserves more attention is the Department of Commerce's Emerging Technology Research Advisory Committee (ETRAC). This Committee ostensibly has a method for determining the degree of security concern in emerging technology, but the method has not been publicly disclosed. The Committee also has minimal representation from the life sciences on it. These types of bodies, along with the proposed Science and Security Commission from the 2007 NRC report on *Science and Security in a Post 9/11 World* (NRC 2007), form a more responsive approach to the identification of security concerns. They also provide important linkages between the scientific and intelligence and security communities.

It is the outputs of these new bodies that can help form a new understanding of the relationship between the government and the scientific community. Instead of reaffirming the divide between academic freedom and security, as the NSABB's DURC oversight policies do, these documents should make statements like, "doing due diligence in ensuring the potential for harm is minimized in the production of new knowledge requires the close cooperation and trust of the scientific and security communities."

These standing Committees are not the only types of bodies that are going against the grain. The FBI's Weapons of Mass Destruction Directorate (WMDD) has done significant work in the past decade to refashion itself as a resource for the scientific community when thinking through security concerns, rather than just an enforcement agency that brings bad people to justice. While the program has gone from strength to strength in its efforts, its style of engagement is not yet institutionally engrained to the point that a few changes in top personnel wouldn't topple much of its work. Making public how the WMDD works, and why, will help in making the case for its continued work, and possible lessons for other countries.

In all of these cases, a primary goal of analyzing these institutions is in encouraging the articulation of how they construct security concerns. The process of deciding what constitutes a threat should be open to public debate, even if the carrying out of that process is done behind closed doors.

Finally, and perhaps the hardest to achieve, is the reformation of the way we educate young scientists about security and the other broader aspects of their work. Work in the past has been devoted largely to building biosecurity education modules, but framing security concerns as a security issue may itself be counter-productive when trying to build a dialogue between the government and scientists, as well as internationally between governments (Epstein 2012). More resonance will likely be received when discussing these topics through conversations about responsible research. The strongest change, however, will come from efforts to seed a post-Asilomar understanding of the relationship between science and security in the next generation of academic leaders in emerging technology, and then support their efforts at institutional change in how they train their students. Programs like the Synthetic Biology Leadership Excellence Accelerator Program (Synbio LEAP)[††] and the international Genetically Engineered Machines (iGEM)[‡‡] competition should be strengthened as spaces for the reconfiguration of the identity of scientists and their place as one of many forms of expertise that make our society and our environment thrive.

The concept of 'dual use research of concern' has a very limited remit, though within that remit it forms a useful way of identifying worrying research and adequately addressing it. For the vast majority of life science research, and all of the research that converges with the life sciences, the DURC model does not provide useful guidance for how to think about security concerns. The limitations of DURC are grounded in a set of assumptions about science and its relation to society that do not match well to the practices of either group. The new principles articulated above, in contrast, embody contemporary understanding of how science and security communities work in practice.

How we decide what is DURC should be a point of public debate, not a matter that is simply decided. By establishing working networks between scientific, state, NGO, and industry, we can enable more flexible governance for emerging concerns by creating spaces where these debates can happen. Policy, practice, and training must all be modified, however, if we are serious about better governing emerging security concerns in the life sciences.

[††] synbioleap.org

[‡‡] igem.org

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Appendix

Principles for the Responsible Communication of Research With Dual Use Potential, Excerpted from NSABB (2007a)

1. The open and unfettered sharing of information and technologies has been a hallmark of the life sciences and has fostered a steady stream of scientific advances that underpin public health and safety, a strong and safe food supply, a healthy environment, and a vigorous economy.
2. Progress in the life sciences relies heavily on the communication of research findings so that the findings can be both validated and used for further research.
3. Life sciences research should be communicated to the fullest extent possible to ensure the continued advancement of human, animal, plant, and environmental health. Consequently, any restriction of scientific communication should be the rare exception rather than the rule.
4. There is a need for reasonable balance in decisions about the communication of research with dual use potential. It is important to recognize the potential for the deliberate and malevolent misuse of dual use research findings and to consider whether the disclosure of certain information might reasonably pose a threat to national security (i.e., public health and safety, agricultural crops and other plants, animals, the environment, or materiel). If the communication of dual use research does pose potential security risks, the logical next step is a risk-benefit analysis of communicating the information.
5. After weighing the risks and benefits of communicating dual use research findings, the decision regarding communication is not necessarily a binary (yes/no) one. Rather, a range of options for communication should be identified and considered. The options available will depend on the research setting (e.g., academia, government, or private). They could range from full and immediate communication, to delayed and/or modified communication, to restricted/no communication, and could be recommended singly or in appropriate combinations on a case-by-case basis, depending on the nature of the dual use finding and the potential risks associated with its communication.
6. Paradigms for the responsible communication of research with dual use potential should also take into consideration that the communication of dual use research can occur at multiple points throughout the research process, that is, at points well upstream of the publication stage (see Figure 1 below). Thus, it is important to apply principles and practices of responsible communication at these early stages as well.
7. It is important to consider not only what is communicated but also the way in which it is communicated. Investigators and sponsors of research with dual use potential should recognize that the communication of certain dual use information is likely to raise biosecurity concerns, not only within the scientific community but also within the general public. Consideration should be given to the potential for public concern and misunderstanding and for sensationalism. Thought should be given to the need for the inclusion of contextual and explanatory information that might minimize such concerns and misunderstanding.
8. Public trust is essential to the vitality of the life sciences research enterprise. It has always been important for life scientists to participate in activities that enhance public understanding of their research. However, because of the potential for public

misunderstanding of and concerns about dual use research, it is especially important that life scientists conducting research with dual use potential engage in outreach on a regular basis to increase awareness of the importance of the research and to reassure the public that the research is being conducted and communicated responsibly.