Article

SECURITY DIALOGUE

Security Dialogue
2016, Vol. 47(4) 329–347

DOI: 10.1177/0967010616642918
sdi.sagepub.com
SAGE

Biosecurity as a boundary object: Science, society, and the state

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Abstract
Biosecurity is a concern in many parts of the world but is differently conceived and addressed depending on context. This article draws on two cases concerned with life sciences research involving dangerous pathogens, one in the United States and one in Israel, to examine this variability. In both cases, concern revolves around issues of biosafety and bioterrorism, which are targeted by similar policies and solutions. The cases, nevertheless, differ. In the United States, biosecurity is contextualized in the dynamics between *science* and *society*, and apprehension about research with dangerous pathogens focuses on the social risks and benefits of such research. In Israel, biosecurity is contextualized in the dynamics between *science* and *the state* and hinges on whether and how far the state should restrict scientific freedom. In view of this difference, the authors advocate the development of a nuanced concept of biosecurity capable of describing and explaining local permutations. They suggest reconceptualizing biosecurity as a boundary object that mediates between competing domains and that takes variable form in efforts to resolve the problem of securing life.

Keywords
Biosecurity, boundary object, Israel, policy, USA

Introduction

How do conceptions of biosecurity reflect the politics of security? Definitions of biosecurity in scholarly literature and in common usage provide a point of departure for almost any discussion of the matter. Rappert (2009: 2), for instance, notes that scholars disagree about the notions that 'should be included under the umbrella term of "biosecurity"'. Dobson et al. (2013) argue that biosecurity provides a lens for the interrogation of many issues, including different theoretical approaches. Similarly, Collier and Lakoff (2008) assert that the term 'biosecurity' applies to many

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domains, including emerging infectious diseases, bioterrorism, cutting-edge life sciences, and food safety (see also Masco, 2014).

Most studies, however, have not looked at the concept of biosecurity itself in terms of its capacity to differentiate between related objects and fields of concern. Similarly, many studies have focused on the United States (e.g. Collier, 2008; Cooper, 2006; Lakoff, 2008, 2012; Rose, 2008; Fearnley, 2008; Masco, 2014; Wright, 2006) and have not explicitly considered their broader applicability or questioned the suitability of their conception of biosecurity to non-US contexts. Rappert (2009: 5) suggests that 'the meaning of biosecurity derives from its uses, not just the way it is defined … it is "a form of situated action"'. Rappert and Gould (2009) thus review seven 'national contexts' to show that although the international discourse on biosecurity has been dominated by the United States, different countries experience biosecurity differently.[1] Lentzos and Rose (2009) show that the idea of biosecurity in a given context depends on the local political/security rationality – that is, the idea of biosecurity emerges in different countries in relation to different threats and depends on *differing security rationalities* and approaches to countering those threats.

In this article, we analyze local problematizations of biosecurity. Our analysis draws on two cases concerned with the development of dangerous pathogens in life sciences research, one in Israel and one in the United States. We discuss how biosecurity has emerged as a distinctive object in each case. Although the two cases concern similar security issues (i.e. biosafety and bioterrorism), and although both countries have developed common solutions and followed similar policy trends, we argue that the two cases nevertheless reflect different biosecurity objects. In the United States, biosecurity is contextualized in the dynamics between *science* and *society*, whereas in Israel it is contextualized in the relational dynamic between *science* and *the state*. In the US case, concerns over scientific development of dangerous pathogens focus on the risks and benefits of such work to society. These concerns are central to the development of related governmental policy. In Israel, the relationship between science and the state, specifically the extent to which the state can or should curtail scientific freedom, is central to understanding the concept of biosecurity.

Because 'biosecurity' is not a singular, globally recognized entity but reflects different governmental and security settings, scholars need to develop a nuanced analytical concept that explains and reflects its complexity. We suggest conceptualizing biosecurity as a boundary object capable of representing heterogeneous security dynamics and solutions to the problem of securing life in varying scientific–social–state contexts.

Biosecurity as object and concept

First- and second-order observations of biosecurity

Drawing on Luhmann's work, we suggest distinguishing between first- and second-order observations of biosecurity. While first-order observation constitutes objects, second-order observation extracts concepts to draw analytical distinctions between the objects so constituted. As Luhmann (1993: 25) puts it, 'the first-order observer takes this to be the real world. But the observer of the second order faces the problem that what different observers consider to be the same thing generates quite different information for each of them'.

The literature on biosecurity refers to first-order observations in fields such as health, food, and science in different countries. Although biosecurity emerges in this literature as multiple objects, once extracted as a concept for research and reflection, it is usually analyzed by social scientists

from a singular perspective.[2] Additionally, biosecurity objects are recognized as complex and dynamic, each an assemblage of knowledge domains, experts, and techniques (Collier and Lakoff, 2008; Keck, 2008; Lakoff, 2012); however, decontextualized from a particular case, such an assemblage can be mistaken for a global phenomenon. In this article, we look at objects of biosecurity (first-order observations) in Israel and the United States. These objects, we argue, reflect a particular relationship among science, society, and the state in each country. On the basis of our comparative analysis, we suggest a conceptual reading of biosecurity as a boundary object.

As a concept, biosecurity has often been explained in relation to forms of governing, particularly Foucauldian governmentality (see Foucault, [2004] 2007). Biopolitical security apparatuses are seen as responding to the need to regulate and secure life in the context of increasing circulation and freedom. Bingham et al. (2008), for instance, argue that biosecurity is the work of making life safe by overseeing and regulating different life forms. Security is thus 'a biopolitical problem of the protection and betterment of a population's essential life processes in an indeterminate world, rather than a geopolitical matter of prevention and exclusion' (Grove, 2012: 140).[3] This analytical framework is shared by many studies of biosecurity in the public health and biological domains (e.g. Caduff, 2008, 2012; Cooper, 2006; Diprose et al., 2008; Elbe et al., 2014; Fearnley, 2008; Lakoff, 2007, 2008; Samimian-Darash, 2011; Stephenson and Jamieson, 2009), and encompasses many solutions to the problem of emerging and re-emerging biological vulnerabilities.

The current study adds to conceptualization of biosecurity within the governmentality framework and shows how biosecurity emerges in both of our cases as a distinctive problem of governing. In addition, the study examines how biosecurity reflects and reinforces the relationship between science and society in the United States and between science and the state in Israel, and how the broad idea of securing life takes particular shape in these two contexts. The concept of boundary object, we argue, effectively represents this dynamic complexity.

Boundary work and boundary objects

The concept of *boundary object* has roots in the foundational concept of *boundary work*. Coined by Thomas Gieryn (1983), 'boundary work' refers to the attribution of certain characteristics to the scientific institution to distinguish scientific from non-scientific intellectual activity. Boundary work takes place when science is threatened: when its cognitive authority, credibility, prestige, power, and resources are questioned or challenged. Boundary work is performed from an oppositional stance, rooted in the need for science to compete with non-scientific fields for the authority to diagnose and interpret a problem.

Boundary work thus occurs between social worlds. Groups committed to completing different missions develop ideologies that define their work and accumulate the resources required for that work. For instance, scientists often divert or externalize uncertainty to non-scientific fields, claiming that it belongs to other social worlds. However, even when boundaries between domains are reinforced, these domains still interface and, at times, cooperate. Star and Griesemer (1989: 393) coined the term 'boundary object' to describe objects 'plastic enough to adapt to local needs and the constraints of several parties employing them, yet robust enough to maintain a common identity across sites'. As Harvey and Chrisman (1998: 1687) see them, boundary objects moderate differences and establish commonality that both enables a degree of agreement across boundaries and leads to the creation of 'things' that have meaning to a large portion of society. These things vary from physical objects to abstractions. Boundary objects thus mediate between groups, but they do not impose uniformity on them. Instead, they act much as geographic boundaries do: they

distinguish differences while they also provide common points of reference (Harvey and Chrisman, 1998: 1686).

Whereas boundary work maintains the separateness of fields, the boundary object, whether an idea, an object, a person, or a process, straddles boundaries between social worlds. It belongs to a number of domains at the same time, thus enabling an interface exempt from the boundary work that otherwise separates domains. Boundary objects are able to impose a congruence among different groups without requiring a consensus of aims or interests.

We argue that, in our two cases, biosecurity is configured as a boundary object that brings together two competitive domains: science and society in the US case, and science and the state in the Israeli case. As a boundary object, biosecurity should be analyzed within the context of the distinct fields it bridges and in terms of how it accomplishes this work. At the same time, its uses and contestation by different parties should also be examined. As we describe in detail in the following, in the Israeli case biosecurity becomes a boundary object that reinforces the domain of science and that of the state and reshapes the relationships between the two in the debate over biosecurity policy. In the United States, biosecurity becomes a boundary object that configures the relationship between the domains of science and society.

Methodology

This article draws on fieldwork in the United States and Israel that took place during 2010–2012 and 2013–2015, respectively. The Israeli study is based on ethnographic work, including close study of the work of the National Council for Research on Biological Pathogens (NCRBP), 50 in-depth interviews with scientists, policymakers, and security officials, and collection and analysis of state documents, including minutes of parliamentary meetings, protocols, and legislation. In the United States, 25 interviews were conducted with members of the National Science Advisory Board for Biosecurity (NSABB), National Institutes of Health (NIH) advisers to this board, and top microbiologists and virologists.

Though we did not design our research as a coordinated project, after conducting our respective studies we realized that Israel and the United States provide excellent comparative cases for observing the emergence of biosecurity as a variable boundary object. Israel and the United States are the only countries with designated governmental bodies responsible for advising on and regulating life sciences research that can pose a biosecurity threat. In the United States the responsible body is the NSABB, and in Israel it is the NCRBP. Each operates under the authority of the respective country's national department of health. Although both countries have extensive biodefense programs, we do not consider those here. Rather, the current study focuses only on the problem of biosecurity in life sciences research and the policies related to this problem in each case.

The problem of biosecurity in the United States

Establishing science–society boundaries

The biosecurity problem in the United States has undergone several transformations in the decades since the end of the Cold War.[4] Especially since the post-9/11 anthrax attacks, concern has grown about bioterrorism and about how particular developments in the life sciences might contribute to that threat. The field of biosecurity has expanded in response to this increased concern.

In 2004, the Committee on Research Standards and Practices to Prevent the Destructive Application of Biotechnology issued a report entitled *Biotechnology Research in an Age of Terrorism* (National Research Council, 2004). Known as the Fink Report, it surveyed biotechnological research options

in the light of terrorist threats and formulated recommendations for precautions to be implemented by life sciences researchers. The report recommended the establishment of the NSABB to 'advise all Federal departments and agencies that conduct or support life sciences research that could be classified as "Dual Use"' (US Department of Health and Human Services (US DHHS), 2004).[5]

The term 'dual use' was borrowed from the language of arms control and disarmament, where it referred 'to technologies intended for civilian application that can also be used for military purposes' (National Research Council, 2004: 18). In its new setting, it designated a case in which 'the same technologies can be used legitimately for human betterment and misused for bioterrorism' (National Research Council, 2004: 1). That is, it pointed to cases in which someone outside the scientific community misused scientific material or information. The dual-use concept thus reinforced the distinction between science and society by confining threat and danger to sources outside science, in society.

As 'Bill Lewis', an NSABB adviser, emphasized, '[the board] wasn't meant to be a biosecurity board, even though it's in the name, but rather, its goal was to deal with dual-use research'.[6] 'Jim Brown', a biosecurity expert and an adviser to the NSABB, reiterated this mission, claiming that the board was established 'to define and articulate the concept of dual use and develop [a] sort of a framework for oversight'. Thus, at first, biosecurity was defined as a dual-use problem, which reflected a particular view of scientific research and of scientists' responsibility for avoiding risk or danger to society.

The dual-use category marked classic boundary work by scientists in their effort to insulate themselves from responsibility for social effects of their research. Implicit in this concept was the idea that the more science and society remained distinct, the lower the risk that non-scientists would use dangerous biological materials for nefarious purposes.

NSABB member 'Daniel Reynolds' emphasized that the board's goal was to deal with misuse arising from negligent actions of scientists, not with intentional malfeasance on their part:

> Most people have constrained their thinking to misuse in a very deliberate, malevolent, premeditated way. There is also a level of misuse that arises from negligence…. I don't think you want to start looking for problems where there might not be [any]. On the other hand, I think everyone realizes that the life sciences create a whole realm of capabilities that are far more potent than most other kinds of human activity.

Ironically, and the post-9/11 anthrax attacks aside, the foregoing comments illustrate a concern with a possible threat from scientists themselves, whether through negligence or malfeasance.

In March 2006, the NSABB held a meeting in which the term 'dual use research of concern' (DURC) was first presented, replacing the simpler 'dual use'.

As 'Jim Brown' explained:

> Any piece of information in the life sciences can be misused…. I've been engaged with dual use for a few years now, so it's not a strange concept to me. But, if I did bring it up to my scientific colleagues, I'm not sure what they would think of it. They might respond better to something like 'life science research of concern' [which] distinguishes all the rest of research with[in] that very small subset, which really is a very small subset, which has the high probability of being misused.

The new term reflected the idea that since '*most* if not *all* Life Sciences research *could* be considered Dual Use', it was important 'to identify *specific* Life Sciences research that could be of greatest concern for misuse' (Dual Use Criteria Working Group, 2006; emphasis added). Thus, according to the DURC definition, certain kinds of life sciences research should be considered 'of concern' to society and subject to special attention. The dynamic between science and society that the definition presents is thus different from that of the concept of dual use: it acknowledges that some

danger to society could inhere in some scientific work and that that work specifically should be monitored for its potential threat to society. The evolution of the DURC concept reveals how boundary work is challenged when risk to society is perceived to be a direct result of scientific research – 'scientists' fault'.

It then remained for the NSABB to decide how to handle the interaction between science and society and the particular form that US biosecurity oversight would take. To facilitate the assessment of research, the NSABB drew on the Fink Report to list seven categories of experiments that could potentially be misused and cause harm. However, as evidenced by the H5N1 controversy discussed below, even when presented with a reasonably clear case, the NSABB found it difficult to reach a consensus on what constituted dual-use research of concern and on how to assess the risk it posed.

From its establishment, the NSABB has maintained the scientific community's boundaries while working to address biosecurity concerns. At the same time, it has not taken any actions toward establishing biosecurity policies that differ from existing biosafety practices (Rabinow and Bennett, 2012). On the contrary, its recommendations have dealt with establishing codes of conduct, raising awareness, and implementing other tools from the biosafety arsenal. Thus, it has approached the problem as one that can be solved by self-regulation, within the scientific domain and without society's intervention. 'Simon Natcher', an NSABB staff member, commented, 'Biosecurity is more of an emerging area and you're looking at such things as personnel reliability … the culture of what goes on in laboratories … how you should act, how you should conduct yourself in terms of care … and codes of conduct'. In many ways, as NSABB member 'Stanley Lane' noted, the board is a committee of 'scientists protecting their own discipline'.

The H5N1 event: Risks and benefits to society

In September 2011, an event took place that affected global biosecurity policy and the work of the NSABB in particular.[7] Ron Fouchier, a virologist from Erasmus University in Rotterdam, revealed that his research team had managed to transform the H5N1 avian influenza virus into an aerosol transmissible among humans. Around the same time, a group of researchers at the University of Wisconsin-Madison, led by virologist Yoshihiro Kawaoka, reported similar results. Concerns regarding the implications of these results were raised only on the eve of publication of the research in the journals *Nature* and *Science*, whose editors sought the NSABB's input on the advisability of publishing (Enserink and Malakoff, 2012).

That potentially harmful studies were being conducted with little oversight and were triggering concern only at publication led to public outcry in the United States and raised questions regarding the scientific community's social obligations. In a way, the scientists involved in the research were seen as challenging the boundary between themselves and society by deliberately creating a direct threat to society. The perception that science had created the next global pandemic or the next bioterrorist event rocked the scientific world and raised major objections to publication of the studies. Once the papers arrived at the NSABB for review, the question was whether preventing their publication would neutralize the threat posed by the studies. Thomas Ingelsby of the Center for Biosecurity at the University of Pittsburgh objected to publication:

> The benefits of publishing this work do not outweigh the dangers of showing others how to replicate it…. Someone might try to make it into a weapon … but a more likely threat is that more scientists will work with the modified virus, increasing the likelihood of it escaping the lab. Small mistakes in biosafety could have terrible global consequences. (MacKenzie, 2011)

In other words, the perception of independence or separation maintained by scientists' boundary work could not be sustained. Above all, the assumption that threat was attributable only to actors

outside the scientific world began to crumble. The H5N1 case was not one of dual use in which non-scientists using scientific material or knowledge posed a threat. Instead, it was a case of dual-use research of concern, with risk inherent in the research design, not just in outsiders' perversion of research results. This was a case in which a dangerous product directly created by 'good science' introduced new risks to society.

Moreover, the event spotlighted the connection between science and society in general and science and security in particular. As 'Steven Fane' – a senior microbiologist, an architect of biosafety infrastructure, and an initiator of the Asilomar Conference – explained, 'This was not a matter of freedom, of research freedom, or the freedom of publication, but more of the matter of scientists' responsibility to society. And the social contract, which is privileged'. The 'social contract' and the security of society were perceived as being threatened and, moreover, in a way that contravened widespread ideas of the scientific mission. A public debate quickly erupted regarding scientific researchers' responsibility to society. The *New York Times* (2012) expressed its position in an editorial ominously entitled 'An Engineered Doomsday':

> Defenders of the research in Rotterdam … say the findings could prove helpful in monitoring virus samples from infected birds and animals…. But it is highly uncertain, even improbable, that the virus would mutate in nature along the pathways prodded in a laboratory environment, so [any such] benefit … seems marginal.

The scientific community seemed torn between arguments about the risks and benefits to society – human life was here threatened both by viruses and by scientists' efforts to control them. Meanwhile, the NSABB continued to wrestle with the issue of publishing the H5N1 studies.[8]

At the heart of the public debate was the question of whether the possible threat posed by publication outweighed potential harm to public health efforts if the H5N1 virus were *not* studied. Research proponents focused on this issue to argue in favor of publication (Webster, 2012; Kawaoka, 2012). Society's best interests were a major concern of scientists on both sides of the debate. The research under scrutiny had not been undertaken recklessly, but with the intent to serve the public. Biosecurity in this case had become a question of whether enabling further scientific development or preventing it would make society more 'secure'. In December 2011, the NSABB published its recommendations following its review of the papers, stating:

> While the public health benefits of such research can be important, certain information obtained through such studies has the potential to be misused for harmful purposes…. Due to the importance of the findings to the public health and research communities, the *NSABB recommends that the general conclusions highlighting the novel outcome be published, but that the manuscripts not include the methodological and other details* that could enable replication of the experiments by those who would seek to do harm. (NIH, 2011; emphasis added)

Additionally, emphasizing the importance of the studies as contributions to public health research, the NSABB recommended that full details be provided to a designated group of scientists. They would constitute a closed network of those 'authorized' to use the information to conduct 'responsible' research on the topic, a move that once again differentiated between inside and outside users of scientific products.

The World Health Organization (WHO), nevertheless, critiqued the board's work. On 30 December 2011, it released a statement expressing concern that limiting dissemination of Fouchier's and Kawaoka's work would undermine the international Pandemic Influenza Preparedness framework (see WHO, 2011). It said, 'Studies conducted under appropriate conditions [biosafety] must continue to take place so that critical scientific knowledge needed to reduce the risks posed by the H5N1 virus continues to increase'. On 16–17 February 2012, the WHO held a meeting of members

from around the globe. Participants reached consensus on two related issues: that redaction of the studies was not a viable option because of urgent public health needs and that a mechanism to limit access was not practical at that moment (WHO, 2012). In February 2012, the NSABB published a fuller explanation and defense of its recommendations regarding publication of the two articles:

> We found the potential risk of public harm to be of unusually high magnitude…. [W]e tried to balance the great risks against the benefits that could come from making the details of this research known. Because the NSABB found that there was significant potential for harm in fully publishing these results and that the harm exceeded the benefits of publication, we therefore recommended that the work not be fully communicated in an open forum…. We believe that *as scientists and as members of the general public, we have a primary responsibility 'to do no harm'* as well as to act prudently and with some humility as we consider the immense power of the life sciences to create microbes with novel and unusually consequential properties. (NSABB, 2012a: 153–154; emphasis added)

Seemingly in response to the WHO and other critics, the NSABB once again emphasized that scientists' primary responsibility is to the public good.

In February 2012, the American Society of Microbiology hosted a meeting on 'Biodefense and Emerging Diseases', during which an ad hoc session discussed the H5N1 work. In this session, Fouchier defended his work and provided a fuller explanation of the issue of pathogenicity, stressing his work's social contribution to advancing knowledge needed to protect against the virus. At that meeting, Anthony Fauci of the NIH announced that he had asked the two researchers to revise their papers and for the NSABB to review the revised manuscripts. In March, a gathering of NSABB members and more than a dozen observers, including NIH Director Francis Collins and WHO member Keiji Fukuda, took place at the NIH campus. During the gathering, the participants read the original and revised reports. Afterward, they voted to allow full publication of the revised studies (NSABB, 2012b).

Emerging biosecurity policy

Following the H5N1 episode, the US government made a number of related policy changes. On 29 March 2012, it released a policy concerning the oversight of life sciences dual-use research of concern. The policy established regular review of research funded or conducted by the government that might fall into this category. The fundamental aim of the policy was to minimize the risk while preserving the possible benefits of such research. The policy detailed 15 agents and toxins and 7 categories of experiments that would be reviewed if involved in government-affiliated research (US Government, 2012).

Almost a year later, on 21 February 2013, a framework guiding the US DHHS in making funding-related decisions about individual research proposals was issued. The framework refers to any study with the potential to generate highly pathogenic avian influenza H5N1 viruses that are transmissible among mammals through respiratory droplets. The framework aims to review research proposals while considering possible benefits, and it requires risk-mitigation measures (US DHHS, 2013).

On 24 September 2014, the White House issued new regulations for dangerous biological research. The regulations shift the burden of identifying dangerous aspects of a given research project from the funding agency to the researchers themselves (US Government, 2014). A few weeks later, on 17 October, the White House Office of Science and Technology Policy and US DHHS (2014) instituted a moratorium on funding for all research and gain-of-function studies until completion of a deliberative process to assess the risks and benefits associated with such research. As part of the deliberative process, the NSABB conducted two conferences with the aim of

advising on the design and conduct of risk/benefit assessments (NSABB, 2014), and the National Academies hosted a symposium to discuss the potential benefits and risks of gain-of-function research and identify key principles for assessing them (National Academies of Science, Engineering, and Medicine, 2014).

In the US case, we see the problem of biosecurity emerging and changing within the dynamics of the relationship between science and society. Biosecurity here functions as a boundary object that mediates the gap between science and society and at the same time reveals how the two realms observe and define their own relationship to security threats.

The problem of biosecurity in Israel

A biosecurity law: Scientists against politics

In 2004 in the *Journal of Antimicrobial Chemotherapy*, Israeli scientists Eitan Rubinstein and Abed Athamna described their research leading to the production of antibiotic-resistant anthrax bacteria (Athamna et al., 2004). According to many informants interviewed for the current study, this research and its publication precipitated Israel's engagement with the issue of biosecurity. Approximately five months after publication of the research, parliamentarians Yuval Steinitz and Arieh Eldad submitted Israel's first draft bill on biosecurity to the Knesset. The bill was intended to limit studies that increased either the potential harmfulness of biological pathogens or pathogen stability. It specified that such studies could be conducted only under a special governmental permit. The bill also required a special permit for the publication of such studies (Knesset of the State of Israel, 2004). However, it did not pass a preliminary vote in the Knesset. One year later, the Israel Academy of Sciences and the National Security Council assembled a committee to examine the issue of biotechnological research in the age of terrorism.

In an interview, 'Pini Rotem', an Israeli biological warfare researcher, described how and when he identified the need for biosecurity procedures in his work, and he related an increase in this concern to concurrent events in the United States. He specifically described the influence of the Fink Report on the establishment of the biotechnology committee mentioned earlier and on the form and content of the report that the latter eventually produced:

> I started getting involved in the issue. And I stumbled upon the Fink Report…. And then I went … specifically to the National Security Council, because there was someone there who wanted to promote this issue. And I told him, 'Look, we have to write a Fink Report of our own here in Israel.' We thought how to go about it, since the American report, the Fink Report, is a report by the American Academy of Sciences. Or the National Research Council. Now, the Israel Academy of Sciences is completely different than the American one…. So we decided to issue a letter of appointment of a committee chaired by someone from the Israel Academy of Sciences, that is, appointed *both* by the president of the Israel Academy of Sciences and the head of the National Security Council. (Emphasis added)

The influence of recent US experience is clear in this account. However, the US debate is entirely concerned with the relation of the scientific sphere to society, whereas in Israel the problem appears in the context of the relation between the state and science. Those advocating an Israeli biosecurity policy were from the National Security Council, and they called on scientists to cooperate in the effort.

The members of the biotechnology committee were experts in the scientific, medical, legal, and security fields. Their report, published in 2007, was entitled *Biotechnological Research in an Age of Terrorism* (Steering Committee on Issues in Biotechnological Research in an Age of Terrorism, 2008). Upon completion of their work, at a meeting of the Knesset's Science and Technology

Committee (28 October 2008), they endorsed a Dangerous Pathogen Control Act, similar to the failed 2004 bill.

The new bill was hotly debated in the Science and Technology Committee, in which legal and professional representatives from six ministries participated: Health, Justice, Defense, Economy, Agriculture and Rural Development, and Science, Technology and Space. Researchers in the life sciences from various universities and hospitals who attended the committee's meetings forcefully opposed the bill.

The debate went on for ten months. University representatives vociferously objected to central elements in the bill that might lead to an erosion of scientific freedom, such as a prohibition on the publication of studies that met certain criteria defined in the law and restrictions on studies of certain pathogens (these two provisions in particular were debated at meetings of the Science and Technology Committee on 28 January and 3 June 2008, respectively).

Scientists stressed not only the severity of specific provisions, but also the effect the bill might have on scientific practice in general. As Micha Safra, dean of the Faculty of Natural Sciences at the Hebrew University, argued:

> In my lab I have great amounts of tetrodotoxins, and many neurophysiologists use tetrodotoxins every day. It's not a pathogen, it kills people. It's impossible to have such great censorship on ideas, on conduct, and later on publication. It will cause a crisis in this country…. I have a request for the chairman, do not consider simply the wording of this law, but the macro, the effect of passing such a bill on science in this country, and the fact that people would run away from here.[9]

'Shlomo Bloom', a microbiologist in an Israeli research university, also viewed researchers' own safeguards as sufficient to keep dangerous agents from escaping their labs, making state intervention unnecessary:

> Either way we are committed to maintaining all these things in an orderly and safe manner. And no researcher holding dangerous bacteria – as you can see there is none here at the universities … would ever keep it in a reckless manner. It's unheard of. So do we need the university security officer to come and check the refrigerator lock? … I think there's professional responsibility…. And the researchers who deal with these things know the dangers better than anyone else. This is why I said that I can't imagine anyone taking lightly the need to guard these things.

Though it expressed the idea of dual use in conjunction with boundary work separating the scientific and social domains, the main conversation in Israel was about who would control or govern biosecurity, rather than about the products of scientific research and their risk or benefit to society. That is, the focus of the debate was the boundary between science and the state rather than between science and society. The scientific community's opposition to the legislation – and to anything perceived as political or national security intervention in research – was especially strong. 'Professor Bloom' expressed impatience with bureaucratic interference:

> I have no clue, really no clue, how many, if any, researchers at the university have something from the list in their refrigerator or freezer that they simply haven't reported.
>
> *Q*: Why do you think a situation like this could happen?
>
> Because people don't care. They disregard emails [from the local committee]. People know it's not really dangerous, people have no patience for politicians going through their freezer. Which is exactly what's going on here.

Scientists were not concerned about the potential for pathogens to escape from their labs and put society in danger but, rather, about politicians 'getting into their freezers'. The real threat, as they saw it, was the crossing of boundaries between science and the state.

'Amit Galili', who represented Israeli research universities in the Knesset committee meetings, described scientists' efforts to change the bill:

> The universities … tried to fight against the most draconian motifs in the submitted bill. One of them was that in order to engage, study such elements that were defined, described as biological pathogens, you need an approval from the Ministry of Health … and the other one was censorship. They suggested censoring articles on the subject. And that's the bread and butter of academia. They were not willing to be withheld from publishing. These were draconian requirements … and we fought them. We went against them, and we convinced them.

The Israeli scientific community thus fought to protect its boundaries to prevent state control of research methodology and content. At the same time, its defense of a separate and technocratic science, the idea that scientific knowledge gives researchers the ability to police themselves, is exactly the rationale policymakers used to justify state intervention into research. As 'Professor Rafael', member of the Regulation of Biological Pathogens Studies Committee, said:

> Scientists see things with eyes that are more focused on the issue of research, of structuring knowledge and using knowledge … to get results again, because that's what you are relying on. Bureaucrats, or actually people who see things in the more sociological level of things, [explore] how good it is for human beings and what it can do for human beings and the security level of the issue…. The issue of regulation is very important…. Afterwards thinking where this could lead us eventually, very few [scientists] think about it.

Both scientists and bureaucrats, then, worked to maintain the boundary between science and the state. While scientists were intent on forestalling political intervention in their work, state bureaucrats used the separation of science and society to advocate for a different kind of boundary work between the two spheres and thus argued *for* intervention in the scientific realm.

The Israeli case chronicles how legislation led the scientific regulatory establishment in Israel to hold serious deliberations about political issues relating to the relationship between science and the state.[10] It thus illustrates how although scientific entities worked to maintain a boundary between themselves and political regulators through the technocratic approach (Jasanoff, 1994), they still discussed and engaged with political questions involving state intervention in and regulation of science in the sphere of biosecurity policy. This process is in keeping with Leibler's (2004) and Ezrahi's (1990) claims that scientific knowledge must be understood as a political instrument and not merely technocratic knowledge external to national processes.

A biosecurity organization: The National Biosecurity Council

After much discussion and debate, the revised Regulation of Biological Pathogens Studies Bill was passed in 2008 (see Knesset of the State of Israel, 2008). In the final draft, limitation on publishing studies was removed. In addition, the list of dangerous pathogens, which was initially taken verbatim from the US Centers for Disease Control list, was adapted to Israeli needs. The law requires supervision of studies using any of the pathogens on the list. Additionally, it mandates the assembly of the National Council for Research on Biological Pathogens (NCRBP) to advise the Ministry of Health and supervise the implementation of the law. It also calls on the Council to authorize institutional bodies to administer the law, initiate educational programs, advise and approve the conduct of institutional committees, and oversee the law's implementation.

The law stipulates which persons or institutes can legally possess pathogens. It specifies the purposes for which such possession is justifiable, the procedure for obtaining research access to pathogens, and the governmental bodies charged with regulating the conduct of biological experiments in the country. Whereas the analogous US committee (the NSABB) is made up of scientists, in Israel the 15 NCRBP members represent different stakeholders: academia, biological interests, the government, the police force, industry, and the security establishment.[11]

Drawing on the concept of the boundary object, David Guston (1999: 87) presents the concept of the 'boundary organization' and discusses the 'role of the NIH Office of Technology Transfer (OTT) as a boundary organization, which mediates the new boundary negotiations in its routine work, and stabilizes the boundary by performing successfully as an agent for both politicians and scientists'. The NSABB in the United States and the NCRBP in Israel both function as boundary organizations. They are, however, different in structure, and the impetus for their formation was different. Nevertheless, both mediate boundary negotiations as a matter of routine and stabilize the boundary between science and other entities: society in the United States and the state in Israel.

In the United States, the NSABB has maintained the boundary between science and society through the definition of dual-use research, by viewing the biosecurity threat as external to science and by promoting self-regulation of the research community. Hence, the new biosecurity policy is a result of boundary work and the attempt to bring the scientific and social spheres into synchrony. In Israel, the opposite process took pace. The NCRBP was established as a result of state biosecurity policy. Composed of scientists and state officials, it was designed to work boundaries after the policy was initiated. Moreover, boundary work escalated in the Israeli case during attempts to initiate the new policy. Thus, after the biosecurity policy was in place, boundary work became more vivid.

Accordingly, the meetings of the NCRBP over the years were mainly dedicated to discussing its work and authority rather than to actual regulation of scientific research. Figuring how to work the boundaries between science and the state was a central prerequisite for formulating biosecurity conceptions and actual practices in Israel. Legislation here does not signify state dominance but, rather, an approach to biosecurity as a problem of regulation and the relationship between science and the state. Once the Regulation of Biological Pathogens Studies Bill was passed, the structuring of the problem in these terms was reinforced in the NCRBP's discussions during meetings and in its work on the law's implementation. In other words, the debate was mostly about how to specifically execute or implement the law.

In the two cases we discuss, biosecurity is not a fixed, predefined object. Rather, it emerges as a boundary object, dynamically shifting and being constituted according to the boundary work occurring in each context. Hence, in each case, biosecurity bridges a gap, on the one hand between science and society and on the other between science and the state. Analyzing biosecurity as a boundary object recognizes this dynamic and the conceptual complexity different parties bring to the relationship.

Conclusions

The problem of biosecurity in US life sciences research emerges as part of the boundary work between science and society, whereas in Israel it is part of the boundary work between science and the state. In the US case, scientists' development of dangerous pathogens and its effects on society are central to the discussion of biosecurity; that is, the ongoing debate is focused on the risks and benefits of such research to society. In the Israeli case, the debate focuses on the relationship between science and the state, on state oversight of research versus scientific freedom. The issue of social responsibility in the Israeli case is marginal at best.

In the United States, the framing of the debate has shifted over the years from biosecurity to dual-use research to dual-use research of concern. However, the discourse has remained focused on how to define the risk of research to society and on the mechanisms for doing so. The Israeli discourse has a different focus. It is, from the scientists' point of view, about 'keeping politicians out of the lab freezers' and, from the state perspective, about regulating daily scientific practice in research institutions and labs. In the United States, biosecurity policy is the result of constant boundary work between science and society (as illustrated in the work of the NSABB). In Israel, passage of the Regulation of Biological Pathogens Studies Bill in 2008 triggered such boundary work and related discourses regarding the proper relationship between science and the state. Biosecurity, as a boundary object, thus differs in these two cases, mediating as it does between different domains.

The concept of biosecurity inherently challenges science–society and science–state boundaries. In both of our cases, this challenge creates a new mediating object, around which the relationship between the competing domains is reconfigured. In Israel, the NCRBP – a boundary organization – exemplifies this reworking, as it constitutes a shared arena of both scientists and state security officials. In the United States, the NSABB, another boundary organization, challenges the taken-for-granted boundaries between science and society. Boundary work does not solve the problem of whether biosecurity should be the purview of scientific or social controls (the US case) or a scientific as opposed to a political issue (in Israel). Rather, it creates a new space in which the very debate about how to overcome boundaries becomes the biosecurity object. That is, biosecurity is not simply an ontological problem referring to the risk posed by some life science research and to the means of mitigating it. It is also a boundary object, a concept, mediating distinct observations of the object (problem and solution) and the relationship between the domains making those observations.

As Star (1989: 46) puts it, a boundary object 'sits in the middle'. Harvey and Chrisman (1998: 1686) observe that boundary objects 'mediate between different groups; [but] they do not provide a common understanding, or consensus between participants'. In short, boundary objects stabilize relationships between social worlds that do not overlap and may have conflicting interests. When the need arises for those worlds to act in concert, they must construct a means of coordination. The result is the boundary object. While recognized by all parties involved, the boundary object does not signal complete agreement in terms of worldviews, goals, or objectives (see Harvey and Chrisman, 1998: 1687).

Following Luhmann (1993, 2000), the question for second-order observation remains *how* different observers within a particular system view biosecurity. The concept of the boundary object allows us to make second-order distinctions between observations of biosecurity within and between systems. Thus, although its label does not change, biosecurity emerges as a different boundary object in different contexts. The concept of the boundary object thus enables us to analyze the US and Israeli security systems in terms of both problem and solutions and to observe these forms as more than products of a shared regime or form of governing (e.g. biopolitical security). Rather, they are contingent on particular security and political settings. The boundary object thus permits access to more heterogeneous and complex forms than do other conceptualizations of biopolitical apparatuses.

Governmentality, and critical security studies more broadly, have acknowledged the contingency of security apparatuses and forms of governing. Our study suggests that similar forms of governing should not be taken as reflecting a globally uniform template, but that they take form within distinctive, complex security and political circumstances. Biosecurity practices are not stand-alone techniques or solutions that can be selected from a universal catalogue and locally applied. They should be analyzed according to their particular historical contexts and

contingencies. In addition to identifying new forms of governing, such as preparedness, scholars should observe how these forms take shape and whether the term 'biosecurity' refers to the same object everywhere.

Moreover, the issue of biosecurity in life sciences research invites examination of the general notion of security apparatus and the problem of securing life. In the cases we consider, both freely conducted scientific research and restrictions on research (when dangerous pathogens are involved and new risks could be generated) are presented as practices promoting the protection and betterment of life. That is, both the free conduct of scientific research and its limitation are seen as enhancing biopolitical security.

In this regard, biosecurity is a boundary object that mediates not only the relationship between science, society, and the state but also, and more broadly, the ongoing tension between security and freedom. That is, it moderates between scientific freedom and research that improves life, on the one hand, and concerns surrounding possible risks that such research entails, concerns also expressed in the service of making life better and safer, on the other hand. Thus, biosecurity, as a boundary object, links freedom and security in a particular manner, encompassing opposing perceptions as well as bridging the tension between them to stabilize their relationship, via practices, policies, and understandings that perpetuate their bond.

Although both of the cases we consider are concerned with the problem of biosecurity in life sciences research, and both reveal the tension between scientific freedom and security needs, biosecurity itself emerges as a distinctive boundary object in each context. Likewise, though the resulting policies in our two cases are similar, they differ in terms of how they emerge and affect the biosecurity dynamic in each instance. The broad umbrella of governmentality, more particularly the biopolitical security apparatus, fails to account for these differences, as it does not consider the variable political contexts in which similar technologies of security can function.

Many studies question 'the kinds of politics and practices that make contemporary biosecurities' (Bingham et al., 2008: 1529). Bingham et al. go further and ask '*Why* biosecurity now' and '*are* current biosecurity practices sufficient or sufficiently multiple to be able to make life more rather than less safe?' (Bingham et al., 2008: 1529; emphasis added). We go still further and question how biosecurity emerges as a complex form to make life safe. What kinds of compromises (between security and freedom) are made? What kinds of challenges? We argue that these questions do not turn on which side provides more or less security, but on how biosecurity emerges in particular settings as a boundary object, mediating between distinct perceptions of how to make life safe.

Funding

This research was funded by the Israeli Ministry of Science, Technology, and Space (grant no. 3-10739), with initial support from the Levi Eshkol Institute at the Hebrew University of Jerusalem.

Notes

1. On the dominance of US biosecurity discourse, see Samimian-Darash (forthcoming).
2. Although Collier and Lakoff (2008: 27) argue that second-order observation is important in understanding *different kinds* of biosecurity, they nevertheless refer to biosecurity in the singular.
3. See Dobson et al. (2013) for additional theoretical framings of biosecurity in relation to geopolitics, globalization, postcolonialism, and inequality.
4. The emergence of a conceptual framework for US biosecurity policy dates back to the Biological Weapons Convention of the 1960s and 1970s. Major developments also occurred in the early 1980s. For more information, see Wright (2006), United Nations (1975), and US Congress (1990).
5. The NSABB is composed of 25 voting members, mostly microbiologists and virologists, and 20 or so ex-officials from various government departments, who are non-voting members. The board can be viewed as representing the broad US scientific community.

6. All names are pseudonyms. Unless accompanied by specific citations, direct quotes in this article are taken from interviews the authors conducted with scientists, officials, and other relevant parties. See the list of 'Interviews Cited' at the end of the reference list for further details.
7. The H5N1 event is one of several episodes that have significantly affected US biosecurity policy and associated public discussions. Others include the Australian mousepox experiment, the reconstruction of the 1918 Spanish flu, and artificial chemical synthesis of poliovirus. We aim here to explain analytically how the H5N1 case in particular helped shift US biosecurity policy. For more information on the other cases, see, for example, Selgelid (2009).
8. Whereas security concerns were paramount in US discourse, in countries where H5N1 is epidemic a preparedness discourse prevailed.
9. Meeting of the Science and Technology Committee, the Knesset, Jerusalem, 3 June 2008.
10. In Israel, a mutual symbiosis of state and science has evolved over the years that has led to wide regulation of scientific experimentation, for instance, involving genetically modified organisms (GMOs), stem-cell research, and gestational surrogacy. For examples and discussion of the state's role in regulating science in these contexts, see, for example, State of Israel (1996) and Benshushan and Schenker (1997).
11. Other countries have biosecurity laws, but rather than life science lab experiments, these relate to areas such as import and export regulation, food safety, pest management, and health permits. See, for instance, New Zealand Government (1993) and Commonwealth of Australia (2015). See also United Nations (2004).

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