IN-DEPTH IMPLEMENTATION OF THE BTWC: EDUCATION AND OUTREACH

by Brian Rappert, Marie Chevrier and Malcolm Dando [1]

Introduction

1. Article IV of the Biological and Toxin Weapons Convention states that:

> *Each State party to this Convention shall, in accordance with its constitutional processes, take any necessary measure to prohibit and prevent the development, production, stockpiling, acquisition or retention of agents, toxins, weapons, equipment and means of delivery specified in Article I of the Convention, within the territory of such state, under its jurisdiction or under its control anywhere.*

It is important to note that the requirement is both to prohibit and to prevent contravention of the Convention. The prevention requirement is evident in paragraph 1 of the Final Declaration of the 1996 Fourth BTWC Review Conference in regard to Article IV. This paragraph states that:[2]

> *1. The Conference underlines the importance of Article IV. It reaffirms the commitment of States Parties to take the necessary national measures under this Article, in accordance with their constitutional processes. These measures are to ensure the prohibition and prevention of the development, production, stockpiling, acquisition or retention of the agents, toxins, weapons, equipment and means of delivery specified in Article I of the Convention anywhere within their territory, under their jurisdiction or under their control, in order to prevent their use for purposes contrary to the Convention. The States Parties recognize the need to ensure, through the review and/or adoption of national measures, the effective fulfilment of their obligations under the Convention in order, inter alia, to exclude use of biological and toxin weapons in terrorist or criminal activity.*

The Final Declaration of the Fourth Review Conference in paragraphs 3 and 4, using language similar to that at previous Review Conference, went on to point out the importance of education and the value that such measures would contribute to increasing the effectiveness of the Convention:

> *3. The Conference notes the importance of:*
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> …

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[2] United Nations, *Fourth Review Conference of the States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction*. BWC/CONF.IV/9, Geneva 25 November- 6 December 1996. Available at http://www.opbw.org.

Inclusion in textbooks and in medical, scientific and military education programmes of information dealing with the prohibitions and provisions as contained in the Biological and Toxin Weapons Convention and the Geneva Protocol of 1925.

4. The Conference believes that such measures which States Parties might undertake in accordance with their constitutional processes would strengthen the effectiveness of the Convention, as requested by the Second and Third Review Conferences.

It is evident that the States Parties have long recognized the importance of education in regard to the prohibitions embodied in the Convention.

2. At the Fifth Review Conference of the BTWC in 2001-2002 the States Parties agreed that there should be a series of annual Meetings of States Parties prepared by Meetings of Experts during the intersessional period from 2003 to 2005 and that the topic to be considered in 2005 would be:

The content, promulgation and adoption of codes of conduct for scientists.

One clear outcome from the meetings in 2005 was that a great deal of education and awareness raising amongst life and associated scientists would be required if they were to be effectively involved in the development, promulgation and adoption of codes of conduct in support of the in-depth national implementation of the Convention.[3]

3. This Review Conference Paper starts by noting some of the statements that have been made recently by various scientific bodies on the need for awareness raising. It then goes on to consider the outcome of the Meeting of States Parties and the Meeting of Experts in 2005 focusing particularly on the evident links between education, awareness raising and the development and implementation of codes of conduct in support of the Convention. An outline is then given of the various educational initiatives underway for life scientists in relation to the BTWC. This leads to the formulation of a number of critical questions that we suggest have to be raised in designing and implementing such initiatives. We then concentrate on educational initiatives for life scientists on the possible misuse of the results of benign civil work by those with malign intent[4].

4. In the main body of this Review Conference Paper a detailed account is given of a series of interactive seminars carried out by Dando and Rappert first with life scientists in the UK, and then of a series of comparative interactive seminars carried out with life scientists in other European countries, South Africa and the United States. The outcome of these seminars showed that the life scientist communities in the UK, Europe, South Africa and the United States were generally unaware of the prohibitions of the BTWC and were consequently unaware of the

[3] Dando, M.R. (2006) Article IV: National Implementation: Education, Outreach and Codes of Conduct., pp 119-134 in Pearson, G.S., Sims, N.A. and Dando, M. R., (Eds.) *Key Points for the Sixth Review Conference*. University of Bradford, September. Available at http://www.brad.ac.uk/acad/sbtwc.

[4] Atlas, R.M. and Dando, M.R. (2006) The dual-use dilemma for the life sciences: Perspectives, conumdrums and global solutions. *Biosecurity and Bioterrorism*, **4**, (3), 1 -11.

possible misuse of benign civil work in this field. It became evident that engaging the life sciences communities in the prohibitions of the BTWC and thus in becoming aware of the possibility that their work might be misused to cause harm would require careful consideration. Such engagement is necessary to raise their awareness and hence achieve their involvement in developing and implementing codes of conduct. Nevertheless, we believe that we have identified ways in which it is possible to engage life scientists. This Review Conference Paper describe two educational modules developed on the basis of our interactive seminars. The first is a multi-media webcast of a seminar at the New York Academy of Sciences and the second is a role play exercise developed in co-operation with the third author (Chevrier). Both of these products have been made available on the web.[5]

5. Overall this Review Conference Paper is a contribution to understanding the difficulties of education and outreach to those engaged in the life sciences about the obligations of the BTWC, and to proposing solutions to facilitate their education and outreach. This paper concludes that whilst there is a great need for new educational initiatives it is possible to develop educational tools that those engaged in the life scientists find interesting and useful. There would be considerable benefit for the in-depth implementation of the Convention, if the States Parties at the Sixth Review Conference were to encourage such educational initiatives and to agree that one of the intersessional meetings between the Sixth and Seventh Review Conferences should address the topic of education and outreach so as to promote in-depth implementation of the Convention.

Recent Statements on Awareness Raising

6. Professional societies in some countries have been concerned for some time about the importance of achieving greater education and awareness raising in regard to the BTWC and its obligations. In a 1999 report "Biotechnology, Weapons and Humanity", the British Medical Association (BMA) stressed that the international scientific and medical community needed to be aware of the dangers posed by biological weapons and needed to reinforce the norm against their acceptability. To achieve this, the BMA called for more medical courses on the signs of diseases likely to be caused by relevant agents and for scientists and doctors to *"stimulate public debate on the ethical and scientific issues surrounding biotechnology and its possible uses in warfare"*.[6] The need for enhanced education of professionals to effectively monitor disease outbreaks and respond to them was also highlighted at conferences such as the First US National Symposium on Medical and Public Health Response to Bioterrorism in 1999 and the Second Symposium in 2000.[7]

7. Interest in education and outreach has increased substantially post-9/11 and the anthrax attacks in the US, paralleling the substantial increase in public attention to the dangers posed by

[5] http://www.projects.ex.ac.uk/codesofconduct/BiosecuritySeminar/index.htm

[6] British Medical Association. 1999. *Biotechnology, Weapons and Humanity* London: Harwood Academic Publishers: 102.

[7] See *Emerging and Infectious Diseases* 5(4) http://www.cdc.gov/ncidod/eid/vol5no4/contents.htm and the Second National Symposium on Medical and Public Health Response to Bioterrorism http://www.upmc-biosecurity.org/pages/events/2nd_symposia/presentations.html. For similar discussions see 'Bio-Technology and Bio-Weapons: Weapon of the 21st Century?' 2001. American Association for the Advancement of Science Annual Meeting and Science Innovation Exposition 15 – 20 February San Francisco, CA at http://www.aaas.org.

biological weapons in general. The World Medical Associations' "Declaration of Washington on Biological Weapons" said *'medical associations and all who are concerned with health care bear a special responsibility to lead in educating the public and policy makers about the implications of biological weapons and to mobilize universal support for condemning research, development, or use of such weapons as morally and ethically unacceptable'*. The Associations called for international and national health-related organizations to devise plans for the *'education of physicians and public health workers about emerging infectious diseases and potential biological weapons'*.[8] In a November 2001 statement[9] on biological weapons, US President Bush called *inter alia* for the establishment of an oversight mechanism for certain forms of research, a code of conduct for bioscientists, and responsible handling of pathogenic organisms.

8. The enactment of legislation such as the 2001 Patriot Act and Public Health Security and Bioterrorism Preparedness and Response Act of 2002 in the US and the 2001 Anti-Terrorism, Crime and Security Act in UK placed various conditions on how dangerous agents could be handled. Such legislation necessitated that individuals and institutions became knowledgeable about their legal obligations.

9. Education has also been a strong theme in proposals to establish self-governance systems in the life sciences in response to wider concerns about the potential misuse of findings and techniques. Such systems can only be effective if individuals are sufficiently well-informed to know how to act and to police any transgressions of rules and standards. The National Academies report "Biotechnology Research in an Age of Terrorism" in 2003 strongly recommended life science community self-governance mechanisms. The report's first recommendation was 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"* .[10] A subsequent report published by the NRC entitled "Seeking Security" specifically addressed the control of genomic research.[11] It reiterated the overall call for life science community self-governance and the need for national and international educational efforts.

10. In 2002 the Royal Society in the UK urged that *"Consideration should be given to some formal introduction of ethical issues into academic courses, perhaps at undergraduate and certainly at postgraduate level."* [12] A 2004 meeting entitled "Do No Harm: Reducing the Potential for the Misuse of Life Science Research" sponsored by the Royal Society and the Wellcome Trust brought together British scientists, policy makers, and others. One of the meeting's central conclusions was that:

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[8] World Medical Association. *Declaration of Washington on Biological Weapons* 17.400, 2002. Available at http://www.wma.net/e/policy/b1.htm

[9] Bush G. *President's Statement on Biological Weapons* 1 November 2001, see http://www.whitehouse.gov/news/releases/2001/11/20011101.html

[10] National Research Council. 2003. *Biotechnology Research in an Age of Terrorism* Washington, D.C.: National Research Council: 111.

[11] National Research Council. 2004. *Seeking Security* Washington, DC: National Research Council.

[12] Royal Society. 2002. *Submission to the Foreign and Commonwealth Office Green Paper on Strengthening the Biological and Toxin Weapons Convention* September: 4.

Education and awareness-raising training are needed to ensure that scientists at all levels are aware of their legal and ethical responsibilities and consider the possible consequences of their research. University department heads, research institute directors, vice chancellors and Universities UK would be ideally placed to take this forward for the academic community. However, these bodies would need to be co-ordinated. The Association of British Pharmaceutical Industries and the BioIndustry Association could take the lead for industrial training.[13]

This central recommendation was given alongside statements about the desirability of self-governance rather than new legislation.

11. The 2002 Appeal of the International Committee of the Red Cross, "Biotechnology, Weapons and Humanity", asked the scientific and medical communities and biotechnology and pharmaceutical industries:

** To scrutinize all research with potentially dangerous consequences and to ensure it is submitted to rigorous and independent peer review;*
** To adopt professional and industrial codes of conduct aimed at preventing the abuse of biological agents;*
** To ensure effective regulation of research programs, facilities and biological agents which may lend themselves to misuse, and supervision of individuals with access to sensitive technologies; and*
** To support enhanced national and international programs to prevent and respond to the spread of infectious disease*.[14]

The successful undertaking of such measures depends on well-educated communities. To raise the profile of Appeal and the potential dangers, the ICRC has held a number of round table meetings around the world since 2003. Much of the attention given to education has received impetus from and given impetus to efforts to develop and promulgate codes of conduct as shown by the activities of the NRC, ICRC, Royal Society and Wellcome Trust mentioned above.[15]

12. A number of initiatives related to codes of conduct have had direct or indirect implications for education. For instance, in September 2002, the report of the UN Policy Working Group on the United Nations and Terrorism included Recommendation 21 that:

Relevant United Nations offices should be tasked with producing proposals to reinforce ethical norms, and the creation of codes of conduct for scientists, through international and national scientific societies and institutions that teach sciences or engineering skills related to weapons technologies should be encouraged. Such codes of conduct would aim to prevent the involvement of defence scientists or technical experts in terrorist

[13] Report of Royal Society and Wellcome Trust Meeting 2004. 'Do No Harm – Reducing the Potential for the Misuse of Life Science Research' 7 October: 1.
[14] International Committee of the Red Cross 2004 *Responsibilities of Actors in the Life Sciences to Prevent Hostile Use*, Geneva, ICRC.
[15] For a discussion about codes see Brian Rappert. 2004. *Towards a Life Sciences Code: Countering the Threats from Biological Weapons* Bradford Briefing Papers (2nd series) No. 13 http://www.brad.ac.uk/acad/sbtwc/briefing/bw-briefing.htm

activities and restrict public access to knowledge and expertise on the development, production, stockpiling and use of weapons of mass destruction or related technologies.[16]

In late 2005, 68 national science academies of the InterAcademy Panel agreed a statement on biosecurity[17] that was intended to inform those who were taking steps to devise codes. Among its provisions, the InterAcademy Panel statement said:

Awareness

Scientists have an obligation to do no harm. They should always take into consideration the reasonably foreseeable consequences of their own activities. They should therefore:

** always bear in mind the potential consequences – possibly harmful – of their research and recognize that individual good conscience does not justify ignoring the possible misuse of their scientific endeavour;*
** refuse to undertake research that has only harmful consequences for humankind.*

Education and Information

Scientists should be aware of, disseminate information about and teach national and international laws and regulations, as well as policies and principles aimed at preventing the misuse of biological research.

The International Centre for Genetic Engineering and Biotechnology, which was among those tasked with taking forward Recommendation 21 of the UN Policy Working Group on the United Nations and Terrorism for biological weapons, produced a similar statement[18] to that of the IAP intended to inform those engaged in devising a code of conduct. Among the '*building blocks'* identified included the requirement that *"scientists must be constantly aware of the ethical implications of their work"* and that they *"must strive to know, diffuse and teach the knowledge of national and international regulations aimed at abolishing the harmful use of biological agents"*.

Meeting of States Parties in 2005

13. The States Parties to the BTWC decided[19] at the Fifth Review Conference to hold annual Meetings of the States Parties prepared by Meetings of Experts to discuss, and promote common understanding and effective action on five topics. The topic for the meetings in 2005 was "*The*

[16] United Nations. *Annex Report of the Policy Working Group on the United Nations and Terrorism* A/57/273-S/2002/875, 6 August 2002.Available at http://www.un.dk/doc/A.57.0273_S.2002.875.pdf
[17] InterAcademy Panel on International Issues. 2005. *Statement on Biosecurity* Trieste: IAP: 1-2. http://www.interacademies.net/Object.File/Master/5/690/Biosecurity%20Statement.pdf
[18] ICGEB. 2005. Working Paper Prepared by the International Centre for Genetic Engineering and Biotechnology. Presented to Experts Meeting of States Parties to the BTWC: 3-4
[19]United Nations, Fifth Review Conference of the Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction, Geneva, 19 November - 7 December 2001 and 11 - 22 November 2002, *Final Document*, BWC/CONF.V/17, 2002. Available at http://www.opbw.org

content, promulgation, and adoption of codes of conduct for scientists". All of the initiatives related to codes mentioned above provided input to the meetings held in 2005. Education figured centrally in many of the codes of conduct related papers and presentations by State Parties. Countries as diverse as Australia, China, Germany, Japan and Pakistan made statements about the need for scientists to be knowledgeable about laboratory safety procedures and cognizant of the ethical implications of research. Germany, for instance, said that in relation to research relevant to the life sciences that might be misused: *'Governments should therefore encourage universities to make [risk management] training obligatory in their biomedical and bioscience curricula'*.[20] It went further to promote a licensing system for those working in the areas of genetic engineering and pathogenic micro-organisms. Such a licence *'should be contingent upon proper training on the content of the Biological and Toxin Weapons Convention and the obligations incumbent on scientists under this treaty, as well as training on ethical decision-making and risk assessment'*.

14. The Final Report[21] of the Meeting of States Parties contained a number of education-related points, including:

> *18. On the mandate to discuss, and promote common understanding and effective action on the content, promulgation and adoption of codes of conduct for scientists, the States Parties recognised that:*
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> *(a) while the primary responsibility for implementing the Convention rests with States Parties**, codes of conduct, voluntarily adopted, for scientists in the fields relevant to the Convention can support the object and purpose of the Convention by making a significant and effective contribution**, in conjunction with other measures including national legislation, to combating the present and future threats posed by biological and toxin weapons, as well as by raising awareness of the Convention, and by helping relevant actors to fulfil their legal, regulatory and professional obligations and ethical principles…*
>
> *(d) codes of conduct should avoid impeding scientific discovery, placing undue constraints on research or international cooperation and exchange for peaceful purposes;*
>
> *(e) science should be used for peaceful purposes only but has the potential to be misused in ways that are prohibited by the Convention, and **therefore codes of conduct should require and enable relevant actors to have a clear understanding of the content, purpose and reasonably foreseeable consequences of their activities, and of the need to abide by the obligations contained in the Convention.***

[20] Ambassador Bernhard Brasack. 2005. *German Statement to Meeting of States Parties to the Biological Weapons Convention* 5 December: p3.

[21] Meeting of the States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction. 2005. *Report of the Meeting of States Parties*. BWC/MSP/2005/3 14 December 2005: pp3-4.

19. The States Parties recognised that all those with a responsibility for, or legitimate interest in, codes of conduct should be involved in their development, promulgation and adoption. The States Parties agreed on the value of codes of conduct applying not just to scientists, but to all those involved in scientific activity, including managers and technical and ancillary staff.

…

*22. On the promulgation of codes of conduct**, recognising that codes of conduct will be most effective if they, and the principles underlying them, are widely known and understood, the States Parties agreed on the value of continuous efforts on promulgation through appropriate channels.*** [Emphases added]

The States Parties recognized that codes of conduct had significant value in implementing national legislation as well as the need for those engaged in the life sciences having an adequate understanding of the prohibitions embodied in the Convention in order to be actively involved in the development and implementation of such codes.

15. In addition, the Final Report of the Meeting of States Parties said that the States Parties further considered that in pursuing the above understandings and actions, States Parties could, according to their respective circumstances, consider the considerations, lessons, perspectives, recommendations, conclusions and proposals drawn from the presentations, statements, working papers and interventions made by delegations on the topic under discussion at the Meeting of Experts, as contained in Annex I of the Report of the Meeting of Experts (BWC/MSP/2005/MX/3), as well as the synthesis of these considerations, lessons, perspectives, recommendations, conclusions and proposals contained in BWC/MSP/2005/L.1, which was attached to the Final Report as Annex I. Although the annex has no status, it made a number of more detailed recommendations about the content, promulgation, and adoption of codes of conduct. A number of points made about the content of codes have a direct or indirect bearing on education. For example, the Annex under the heading of "References to norms, laws and standards" stated that:

4. Recognising the dual-use dimension of much scientific activity and that in accordance with the Convention scientists should use their knowledge and abilities for the advancement of human and animal welfare in addition to respecting human rights and protecting the environment, it was suggested that codes of conduct should:

(i) Be aimed at the individual consciences of scientists and others…

(iv) Require individuals to have a clear understanding of the content and purpose of their research or other work, and to consider its potential security consequences including dual-use implications;

(v) Be aimed at the intent and potential of the research, rather than attempting to define permissible or forbidden experiments. [Emphasis added]

It then went on under "Ethical guidance" to state:

5. Recognising that codes of conduct should reflect the norms established by the Convention and should be consistent with national legislative and regulatory frameworks as well as with relevant professional standards, it was suggested that codes of conduct should:

(i) Refer to the Convention, and require awareness of and compliance with its provisions and with those of related national laws and regulations, including those dealing with export and transfer;

(ii) Require individuals to follow appropriate standards and procedures for biosafety, biosecurity, good laboratory and manufacturing practices, risk management, environmental protection, and other standards and procedures that relate to the safe and secure handling, storage and transfer of potentially hazardous materials;

(iii) Require individuals to be properly trained, qualified and licensed, as applicable, for the work they undertake, in accordance with relevant legislation and regulations. [Emphases added]

In regard to "Notification, sanctions and consequences" it said:

6. Recognising that codes of conduct should help individuals make decisions and take action in accordance with the purposes and objectives of the Convention, it was suggested that codes of conduct should:

(i) Require individuals to investigate thoroughly and take into account the reasonably foreseeable social, environmental, health and security consequences of any proposed research or other scientific work;

(ii) Require individuals to analyse, assess and evaluate data throughout each step of the research process in order to be aware of emerging or unexpected implications that may be relevant to the Convention;

(iii) Contain guidance on the criteria and procedures for determining whether or not certain research or other work entails unacceptable risks…

(v) Contain guidance on the handling, dissemination and publication of research results, data and other information;

(vi) Encourage, as far as possible, transparency, peer review and open discussion of all scientific activity and its implications . [Emphasis added]

16. Since the Meeting of States Parties in 2005, attention has continued to be given to education in various fora. For example, the US National Science Advisory Board for Biosecurity (NSABB) was set up with the intention of taking forward many of the recommendations of

"Biotechnology Research in an Age of Terrorism". In particular it was charged[22] with developing *"mandatory programs for education and training in biosecurity issues for all scientists and laboratory workers at federally-funded institutions"*. While NSABB had not yet by mid-2006 addressed this particular requirement, it is notable that education has occupied a prominent position in pursuing a number of its other activities. For instance, in seeking to develop guidelines for the oversight of life sciences research of concern, NSABB identified the education level of the scientific community and others about the potential for misuse of research as a core issue. If awareness of the potential for misuse of research is deficient or highly variable, it becomes difficult to ensure consistent and appropriate judgements are made. In addition to education functioning as a requirement for proper procedures it is a specific aim of other functions of the NSABB. It is understood that the intention is that NSABB advice on the communication of potential for misuse of life science research would be part of undergraduate and postgraduate courses.

17. In addition, groups of university researchers and others have highlighted the importance of education in preventing the malign use of science. This has been explicitly stated as in a paper[23] entitled "Global Biosecurity: The Vital Role of Academic Leadership" which derived from a conference held at Virginia Polytechnic Institute. As part of a wide ranging appeal for action, the authors called for academics to *"Design, validate and disseminate a suite of effective training materials which can be understood and used by all leaders, practitioners, trainers and students"*. The Controlling Dangerous Pathogens Project of the Center for International and Security Studies at Maryland (CISSM) convened a Regional Workshop on Dual-Use Research, in Matrahaza, Hungary, from May 12-14, 2006. The summary report stresses the importance of education and training programmes.[24] The importance of education has been more implicit in recommendations[25] for the synthetic biology community to devise standards and procedures for community self-governance.

What Educational Activities are Taking Place?

18. Many of the calls and statements surveyed earlier regarding the need for education and outreach are largely just that, general declarations identifying the need for such activities and intended to encourage more or less well specified future education and outreach activities. Thus far, the translation of these calls into educational activities have been rather modest. This section describes some of the practical educational actions being undertaken up to October 2006 in relation to the BTWC. The intention is to illustrate the range of choices available.

[22] http://www.biosecurityboard.gov/revised%20NSABB%20charter%20signed%20031606.pdf
[23] R. Murch, D. Franz, and P. Singer. 2006. *Global Biosecurity: The Vital Role of Academic Leadership* Occasional Paper Number 1 Toronto: University of Toronto: 1.
[24] http://www.cissm.umd.edu/papers/display.php?id=156
[25] S. Maurer, K. Lucas & S. Terrell. 2006. *From Understanding to Action: Community-Based Options for Improving Safety and Security in Synthetic Biology* Berkeley: Goldman School of Public Policy University of California. See http://gspp.berkeley.edu/iths/UC%20White%20Paper.pdf

19. In recent years educational activities in the area of biological weapons have included initiatives such as:[26]

- The ICRC, as part of its "Biotechnology, Weapons and Humanity" appeal, has held informal roundtables for representatives in government, industry and academia to promote awareness of the humanitarian norms against the hostile use of the life sciences and to facilitate dialogue about how to prevent the hostile use of these sciences. In addition, it has produced a document[27] entitled "Preventing Hostile Use of the Life Sciences: From Ethics and Law to Best Practice" to provide principles to inform practice.

- The Institute on Global Conflict and Cooperation within the University of California runs a two week summer course for graduate students and junior professionals examining the threat of bioterrorism. This course[28] is aimed at those seeking to work in public policy, and is primarily for, but not exclusively, individuals based in the US. Topics include the science of biological weapons, intelligence assessments, international prohibition regimes and attack response activities to attacks.

- The World Health Organization, through its Biosafety Programme, has undertaken various activities to reduce the accidental or inadvertent spread of disease from the handling or usage of pathogens. This includes the provision of technical assistance and information as well as the development of standards. In 2005 WHO also considered the misuse potential of work in the life sciences in its publication "Governing Life Science Research – Opportunities and Risk for Public Health".[29]

- Sandia National Laboratories in the US has an International Biological Threat Reduction program[30] intended for practitioners in the life sciences aimed at minimizing biological risks from research. It has organized workshops, lab consultations and conferences on such matters as assessing the risks with agents, laboratory biosecurity/biosafety procedures, transportation of agents, methods of pathogen and disease surveillance, means for reducing outbreaks, and export control compliance. Over 20 countries have participated in these activities.

- The BioWeapons Prevention Project (BWPP)[31] has convened meetings between NGOs, governments, and others intended to find ways of addressing the specific biosecurity needs of participating countries and constituencies as part of its wider activities to facilitating networking, (e.g., February 2005 in New Zealand). Future plans include continuing such meetings in regions such as Francophone Africa.

[26] The authors were greatly aided in producing this list by the participation of Brian Rappert in a two-day workshop at NTI titled 'Educating and Training the International Life Sciences Community on Dual Use Dangers' 25-26 July 2006.

[27] http://www.icrc.org/Web/Eng/siteeng0.nsf/html/66NC2R?OpenDocument&style=Custo_Final.3&View=defaultBody2

[28] http://www-igcc.ucsd.edu/cprograms/PPBT/PPBT.php

[29] WHO. (2005) *Governing Life Science Research – Opportunities and Risk for Public Health.* Paris: WHO.

[30] http://www.lanl.gov/orgs/chs/cbtr.shtml

[31] http://www.bwpp.org

- The Center for Arms Control and Non-Proliferation produced an online educational program entitled "Biosecurity: Risks, Responses, and Responsibilities".[32] This program includes information on the threat of biological weapons, the history of their use, the dual capability of modern biology, and national and international efforts to reduce the threats associated with these weapons.

- The Southeast Regional Center of Excellence for Biodefense and Emerging Infections (SECREB) has established an online module intended for those engaged in biological research.[33] The Center is one of 10 regional centres in the US set up under the National Institutes of Health to conduct research in the area of biodefence. Its main focus is the misuse potential of modern life science – the potential for research to be used for beneficent and malevolent purposes – and the measures scientists, technicians and others might undertaken to minimize concerns stemming from their work.

- The Federation of American Scientists has produced a series of on-line educational modules designed to increase awareness of biosecurity and promote enhanced self-regulation by scientists.[34]

- The US Nuclear Threat Initiative has produced a general online tutorial that provides information on countering the threat of bioterrorism.[35] It also has complied a listing of university and institute courses taught with material relevant to the problem of biological weapons.[36]

- The Stockholm International Peace Research Institute, the Free University Brussels, and the International Relations and Security Network have developed on education module about the non-proliferation of chemical and biological weapons.[37] This module, however, is not specifically geared to training for scientists and related life science professionals,

- Middlebury College (Virginia, US) convened a fourth annual workshop for those studying nuclear, chemical and biological weapons to develop curriculum and course syllabus with special respect to non-proliferation, in May 2006.[38]

- A further development has been the adoption by the United Nations Security Council of Resolution 1540 (2004)[39]. This includes as its eighth operative paragraph that the Security Council:

[32] http://www.armscontrolcenter.org/resources/biosecurity_course/
[33] http://www.serceb.org/modules/serceb_cores/index.php?id=3
[34] http://fas.org/main/content.jsp?formAction=297&contentId=561
[35] http://www.nti.org/h_learnmore/bwtutorial/index.html
[36] http://www.nti.org/h_learnmore/h5_teachtoolkit.html
[37] http://cbw.sipri.se/
[38]https://segue.middlebury.edu/index.php?&site=nonproliferaton&section=12161&page=50403&action=site
[39] United Nations Security Council, *Resolution 1540 (2004) Adopted by the Security Council at its 4956th meeting, on 28 April 2004*, S/RES/1540 (2004), 28 April 2004.

8. Calls upon *all States:*

> *(a) To promote the universal adoption and full implementation, and, where necessary, strengthening of multilateral treaties to which they are parties, whose aim is to prevent the proliferation of nuclear, biological or chemical weapons;*
>
> *(b) To adopt national rules and regulations, where it has not yet been done, to ensure compliance with their commitments under the key multilateral nonproliferation treaties;*
>
> *(c) To renew and fulfil their commitment to multilateral cooperation, in particular within the framework of the International Atomic Energy Agency, the Organization for the Prohibition of Chemical Weapons and the Biological and Toxin Weapons Convention, as important means of pursuing and achieving their common objectives in the area of non-proliferation and of promoting international cooperation for peaceful purposes;*
>
> (d) ***To develop appropriate ways to work with and inform industry and the public regarding their obligations under such laws.*** [Emphasis added].[40]

Some Questions that Need to be Addressed

20. The survey of various calls for education and practical actions in the area of education highlight a number of key questions:

> * *What should education entail by way of subject matter?* Proposals regarding the subject matter of educational provisions have ranged from information about the diseases associated with biological weapons, to details about national and international legislation and regulation related to laboratory safety and the physical security of agents, to the social and ethical questions arising from the potential for the malign use of research. Each approach poses its own demands. Assessments about the likely source of threats are implicit within determinations of what subject matter needs what attention. Determinations about the urgency of education about these matters have indirect consequences for how BTWC-related matters have to be weighed against other education priorities.
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> * *Who needs to be educated?* Many of the national and international regulations regarding the physical security of pathogens set down parameters for who needs to fulfil these obligations. The issues involved in raising awareness of the potential malign application of research findings and techniques are more complex and require a larger audience. Recommendations of who needs to be educated varies between those working with dangerous agents to a wider range of those associated with the life

[40] United Nations Security Council, Resolution 1540 (2004) *Adopted by the Security Council at its 4956th meeting on 28th April 2004*, S/RES/1540 (2004) 28th April.

sciences (e.g. including certain mathematicians, engineers) to politicians and the public at large.

Determining who should be the audience and at what point in time depends on assessments about where the potential misuse of the life sciences problem lies and how it can best be addressed. Follow-on questions arise of whether the likely threats are going to be associated with dangerous pathogens and toxins or are there significant threats associated with areas of work such as neuroscience and bioregulation.[41] The geographic location of any activities of concern is a follow-up question; do such activities of concern arise in those countries with the most active biotechnology activities, the most lax controls, the most frequent outbreaks of pathogenic diseases, or some other criteria?

Making these determinations will also depend on the desired end state of education. Is the goal to raise awareness of certain concerns or to require certain forms of behaviour? Is the goal to get those with benign intent to recognize a certain potential associated with their work or to change their actions? If the proper audience is broadly conceived to involve a range of life scientists, then the first goal of raising awareness would be much easier to achieve.

* *Who is the educator?* In any education activities, not only the audience but also the role of the educator must be considered. Again the distinction between rules and regulations associated with physical security and the malign potential of biotechnology is germane. While the former lends itself to resolution through established government procedures for formulating policy, the latter poses more difficult questions about who is in a position to educate whom.

* *What is the purpose of education?* Is education meant to impart an authoritative understanding to a particular audience (e.g. practicing scientists) or is it to elicit an understanding from individuals based on what they already know? Stated somewhat differently, is the purpose of educational activities to confront deficient or misconceived ways of understanding the intersection of the life sciences and the BTWC or is it to enable individuals to make sense of these issues for themselves? Education in relation to rules and regulations for pathogen storage and transfer, for instance, is often associated with prescriptive instruction about obligations. The purpose of education about the wider malign potential of biotechnology though is less certain and more complicated. These complications arise in part because of the widely-supported approach of the scientific community toward self-governance and the thorny social and ethical issues associated with the governance of activities in the life sciences. In this case the question of whether education should amount to telling individuals what to think or whether it should amount to enabling individuals to decide that for themselves is one which needs to be addressed. The latter can be achieved through the provisions of well tailored materials while the former would typically require much more.

[41] On the latter see National Research Council. 2006. *Globalization, Biosecurity and the Future of the Life Sciences* (Washington, DC: NRC).

* *Does it matter if educational messages differ?* International agreements such as the BTWC and the 1925 Geneva Protocol provide the cornerstone for the international prohibition of biological weapons. Nevertheless, in some respects there is room for interpretation regarding what can legally be done within the provisions of the agreements. For instance, what activities can be justified for 'protective purposes'? The term is not specified in the Convention. As some aspects of biodefence activities may have some offensive relevance, drawing lines about what is permissible may not be straightforward. Similarly, the extent and nature of national implementation varies significantly, with a not inconsequential number of signatories to the BTWC having no implementation legislation.[42] While variation in interpretation and implementation allows for individual nations to undertake actions bearing in mind their resources and respective circumstances, it does mean the make-up, emphasis, and prioritization of any BTWC education activities is likely to differ in significant ways. Evaluations of adequacy of such a varied situation are likely to depend on assessments of the source of biological threats and their likely targets.

These questions point out the choices and challenges in devising educational modules to raise awareness of the BTWC and its prohibitions. While in the abstract education might be an activity that receives near universal support, there are some critical issues that need to be kept in mind when developing such activities.

Interactive UK Educational Seminars

21. This section examines the insights gained from the seminars undertaken by Dando and Rappert in the UK. A more in-depth but preliminary analysis of them was given in Bradford Briefing Paper No. 16[43] which was written to assisting the deliberations in Geneva by States Parties at the Meeting of Experts in June 2005. The analysis of these seminars is extended here.

22. 25 seminars (two being pilots) were carried out between October 2004 and May 2005 in UK university life science-related departments (with another in Germany). These were conducted as part of the relevant department's faculty seminar series. Access to the seminar series was gained either through contacting known individuals in the departments who would then propose the seminar locally, or (as in the majority of the cases) the faculty member responsible for organizing the seminars was identified and then contacted. Based on an assessment of universities with active life science-related departments, 85 departments in 75 universities were contacted. Several of these did not have a research seminar series.

23. In relation to the question '*What should education entail by way of subject matter?'*, these seminars addressed the potential for misuse of the work of life scientists. In particular they considered the communication, undertaking, and oversight of activities in the life sciences, rather than the more traditional concerns about the security of pathogens and personnel in laboratories.

[42] Pearson, G. and N. Sims. 2005. *The BTWC Sixth Review Conference in 2006* Bradford Review Conference Paper No. 15 November. Available at www.brad.ac.uk/acad/sbtwc.

[43] Dando, M. and B. Rappert. 2005. *Codes of Conduct for the Life Sciences: Some Insights from UK Academia* Bradford Briefing Paper No. 16 (2nd Series). http://www.brad.ac.uk/acad/sbtwc/briefing/BP_16_2ndseries.pdf

24. In relation to the question of '*What is the purpose of education?*', these seminars sought to combine imparting and eliciting an understanding of the potential for misuse of benign civil work. Earlier investigations by the authors had given reason to believe that little prior consideration was given to the potential for misuse by practicing life scientists in the UK. Consequently, these seminars were planned both to *raise awareness* about the potential misuse of the life sciences issues by conveying information about policy and scientific developments and to *encourage discussion and deliberation between scientists* about the potential for misuse. The seminar consisted of a series of PowerPoint slides providing information and posing key questions to initiate group discussion.

Method

25. To achieve these goals, a focus group method was employed. Two advantages are frequently claimed for this type of research. First, it is 'ideal for exploring people's experiences, opinions, wishes and concerns. The methodology is particularly useful for allowing participants to generate their own questions, frames and concepts and to pursue their own priorities in their own terms, in their own vocabulary'.[44] As such, focus groups enable a richer examination of the 'why's behind individuals' thinking than might be realized by surveys. As a second advantage, they entail 'the explicit use of the group interaction to produce data and insights that would be less accessible without the interaction found in groups'.[45] Furthermore 'focus group interviews produce data derived from a group process in a focused manner. As a result, participants influence each other, opinions change, and new insights emerge. Focus group participants learn from each other, and things learned can shape attitudes and opinions. The discussion is evolutionary, building on previous comments and points of view.'[46]

26. In relation to exploring the issues relating to the potential misuse of the life sciences, the advantages from a focus group approach were highly desirable. Because Dando and Rappert suspected initially (and later confirmed) that the potential misuse security dimensions of the life sciences would be a rather novel topic for in-depth discussion for many of those engaged in the life sciences, gaining an understanding of how the life scientists conceived of and framed the fundamental issues at stake was vital. The basic focus group format meant the seminars would not simply amount to a back and forth conversation between the presenters and participants. The interaction *between* peers was seen as a way of minimizing any awkwardness or hostilities associated with our inquiring about the potential for misuse of scientists' work. The peer-to-peer communication meant scientists would be learning from one another regarding alternative ways of assessing issues relating to potential misuse.

27. While 'focus groups' vary, in the main they generally consist of assembling 5-9 people together to collectively discuss a predetermined set of issues through the guide of a moderator (or facilitator).[47] The seminars conducted by Dando and Rappert differed from this general set

[44] J. Kitzinger and R. Barbour. 1999. 'Introduction' In Barbour, Rosaline and Jenny Kitzinger (eds). *Developing Focus Group Research* London: Sage.
[45] D. Morgan. 1998. *Focus Groups as Qualitative Research*. London: Sage:
[46] R. Krueger. 1998. *Developing Questions for Focus Groups*. London: Sage.
[47] D. Stewart and P. Shamdasani. 1992. *Focus Groups* London: Sage.

up in two important respects. The first deviation related to the question of '*Who needs to be educated?*' The seminars took place as part of existing university seminar series. As a result, the audience was not restricted to nine participants. The average attendance was 25. This limited the time any individual participant could speak and meant in some sessions many of those present did not speak at all.

28. However, there were a number of benefits of using this pre-existing venue. Dando and Rappert were able to reach a much larger audience than would have otherwise been possible. This meant that participants could include those who might be doing work that would not immediately be identified as highly relevant, but who might have departmental responsibilities related to furthering ethics education (e.g., directors of undergraduate studies, current and future co-ordinators of ethics modules). As another advantage, graduate and undergraduate students as well as faculty members were often able to attend these sessions and thereby listen and partake in these discussions. Also, by using a pre-existing departmental event that faculty members were expected to attend, it was possible to reduce the likelihood that potential attendees would not be present because they deemed BTWC issues unrelated to their work. Finally, because of the importance of departmental decision making within universities, we were reaching *in situ* those individuals in a group format who *as a group* would be implementing any future biosecurity measures. Some of those individuals would be more assertive, junior, vocal, credible, reserved, knowledgeable, etc. than others in departmental group decision making, so we wanted to engage them in a group setting that paralleled this situation.

29. The second deviation from the usual format of focus groups involved the rationale for the questions posed. The goal in conducting so many sessions was not to get as many responses as possible to a set of predetermined questions. Because the issues raised have not traditionally been high profile concerns within the life sciences and because they entail difficult social and ethical matters, it was necessary to critically examine how to ask questions about issues relating to potential misuse. Dando and Rappert varied the types of questions asked and their ordering so as to find ways of probing the evaluations presented. So, although the seminars differed in the ordering and content of what was asked, certain key questions were asked: Are there experiments or lines of work that should not be done? Are some results better left unpublished or otherwise restricted in its dissemination? Are the envisioned systems of pre-project oversight strategies sensible?

30. To underline the point, this *transformation* of questioning was done to find better ways of getting participants to openly discuss the reasoning for their evaluations. For instance, as noted in Briefing Paper No.16, many of our initial slides and questions were designed to test where scientists would start expressing biosecurity concerns. However, one of the major recurring themes of the seminars was the 'inevitability of science'. Many said that the question of *whether* some line of work should be done (or published) was futile since it *would* be done (in the end by someone, somewhere). The extent this reasoning was heard led us to drop certain slides probing boundaries and instead seek to develop lines of questioning to better understand and probe characterizations of inevitability. So, a slide was introduced that outlined the recent significant expansion of biodefence programmes in the US and another that explicitly challenged notions about inevitability by comparing the limited funds dedicated to many tropical diseases against those recently made available for likely biological weapon agents.

31. As another instance of transformation, the early 2001 publication of the IL-4 mousepox experiment was the test case for asking participants if benign use research that might be misused should be widely published.[48] In almost every seminar we conducted, an overwhelmingly preference was expressed for publishing in the open scientific press. In order to test this way of thinking, we introduced a slide asking about the appropriateness of engaging with non-professional audiences. That slide detailed how one of the Australian researchers also communicated the possible malign use implications of the IL-4 mousepox experiment to a semi-popular press outlet. Specifically this was done by an article in the *New Scientist* titled 'Disaster in the Making: An Engineered Mouse Virus Leaves Us One Step Away from the Ultimate Bioweapon'. The researcher was quoted as saying 'We wanted to warn the general population that this potentially dangerous technology is available….We wanted to make it clear to the scientific community that they should be careful, that it is not too difficult to create severe organisms.'[49] The question posed by this argument is, if 'we need to know', who is the 'we' that needs to know? In contrast to similar opinions about communication within the scientific community, the merits of public communication lead to sharp disagreement. In closely listening to and reflecting on practicing scientists' arguments in order to revise the way that the moderators conducted the seminars, both they and participants acted as educators.

Analysis

32. The analysis carried out in the Briefing Paper No. 16 was limited to data gathered during the two pilot seminars and 15 of the subsequent seminars. One of its central conclusions was that there was little evidence that many participants had given much consideration to the issues relating to the potential misuse of the life sciences. Further, there was little evidence that participants:

a. regarded bioterrorism or bioweapons as a substantial threat;
b. considered that developments in the life sciences research contributed to biothreats;
c. were aware of the current debates and concerns about potential misuse of the life sciences; or
d. were familiar with the BTWC.

The results from the remainder of the seminars were consistent with all of these points. A particular surprise was that so few of the participants (less than 10% in most groups) had heard of the mousepox experiment that has figured so largely in the security literature.

33. The analysis also noted responses to key questions asked in the seminars. For example, when asked 'Are there experiments that should not be done?', the vast majority of those responding supported undertaking the 'contentious' experiments described in the seminar as well as potential others. It was argued that these experiments provided knowledge and

[48] Jackson, R. Ramsay, A., Christensen, C., Beaton, S. Hall, D., & Ramshaw, I. 2001. 'Expression of Mouse Interleukin-4 by a Recombinant Ectromelia Virus Suppresses Cytolytic Lymphocyte Responses and Overcomes Genetic Resistance to Mousepox' *Journal of Virology* 75(3): 1205-1210.
[49] New Scientist. 2001. 'Disaster in the making: An engineered mouse virus leaves us one step away from the ultimate bioweapon' *New Scientist* 169 (2273): 4.

techniques that would be useful for a range of benign and defensive efforts**.** Yet, at a more basic level, the validity of asking such questions was doubted because of the said inevitability of science. Likewise seminar attendees overwhelmingly doubted the advisability of restricting publications; reasons for this included the importance of communication in countering the deliberate and natural spread of disease, the limitations of the details in articles preventing the easy replication of research, and the status of publications as just one way in which life scientists share information.

34. Further, overall scepticism was expressed about the advisability of pre-project biosecurity oversight systems. While it was suggested that any such system might provide a necessary guard against outside interference in science, raise awareness of issues relating to potential misuse, and act as part of the needed reforms of wider university practices, the majority of responses were critical in nature. Such systems were deemed unworkable because of the impossibility of knowing the future implications of research, ineffective because terrorists would circumvent them, misplaced because British universities were not the types of places that should be causes of concern, and counterproductive because of the amount of existing regulations. The results from the remainder of the seminars were consistent with each of these points.

35. The major exception to this overall consistent picture was one of the last seminars we conducted. The seminar consisted largely of first year biology students. This was done at the request of a professor who organized an earlier one for faculty members. Here the conversation was reversed, with the 'weight of gravity' of responses clearly tilted towards limiting publications, forgoing lines of research, and imposing oversight regulations.

36. The stark contrast in our experiences with this audience of largely first year students led us to re-consider the potential and limitations of the seminar design. While the content and the form of the seminars had been repeatedly modified in response to experience, this was done in relation with a particular kind of audience: those with highly specialized scientific expertise, generally unaware of policy discussions relating to potential misuse and often sceptical about the feasibility or necessity of proposed policy initiatives. By finding ways of testing out the thinking expressed by such an audience, the seminars developed along a certain avenue. Efforts were made to unpack central notions such as the 'inevitability of science'. However, in doing so, to a degree we did not appreciate at the time, the seminar content became designed around challenging a limited profile of responses. When faced with an audience that expressed a different type of evaluation, many of the lines of questionings in the seminar did not have the same relevance. In this way we learnt the limitations of what we had created.

37. One implication drawn from this work in Briefing Paper No. 16 was that if the States Parties to the BTWC wish to engage practising life scientists in consideration of issues related to codes of conduct, a significant awareness-raising exercise was urgently required. Such an exercise was needed over the longer term in order to benefit from scientists' creative input in the national development and implementation of codes of conduct in support of the in-depth implementation of the Convention. It was also argued that for the section of the life science communities in universities, there is every reason to consider whether the longer-term awareness-raising strategy should involve the development of educational provisions dealing with the problems of potential misuse of science and technology within the standard curriculum for life scientists. Further, it

certainly appeared that well-tailored and well-presented educational material would be welcomed by instructors. Yet, the demands in devising suitable material and getting it into university curricula should not be underestimated. It took Dando and Rappert a good deal of time to work the seminar up into a useful educational session. In addition, the mere provision of well-tailored material should not be regarded as sufficient for the inclusion of considerations of potential misuse within university curriculum given overall limited attention to these issues in the past by the life science community.

Comparative Educational Seminars

Background

38. The work described in Briefing Paper No, 16 was extended in January 2006 by carrying out similar seminars in the Netherlands, the US, and South Africa. It was envisaged that each of these countries would provide a useful basis for comparison with the work already carried out in the UK. It was thought that the Dutch tradition of consensus based science policy would yield a different type and tenor of responses regarding the governance of science. In the US, there had been extensive policy debate about potential misuse and about the substantial funds dedicated to biodefence which suggested that the seminars in the US might produce a different response. As an emerging country with a recent offensive biological weapons program, it was thought that South African respondents might offer a markedly different set of responses than those heard in Europe and North America.

39. More speculatively, it was thought that responses to the sequence of slides and questions developed in the British context would lead to country specific types of dominant evaluations. We thought Dutch responses would be less antipathetic to proposals for oversight measures from the scientific community than the UK in view of the way in which science policy is formulated in the Netherlands. Given funding allocation decisions in the US and the public concern there about possible biological terrorism, it was thought that participants in the US would be significantly more concerned about the threats from bioterrorism as well as sympathetic to dedicating public resources to countering it than British scientists. The relatively limited public resources in South Africa for both funding and regulating science along with pressing health priorities lead us to think that participants there would be more sceptical than those in the UK regarding the need for funding or regulating work with the potential for misuse in the life sciences. As a result of these assumptions, it was thought that the approach developed for the UK seminars would not 'work' –in the sense that it would be necessary to significantly revise what information was presented, the questions posed and their ordering so as to probe the dominant type responses being offered in each country.

Setting up the Seminars

40. Access proved to be a major issue. However, gaining access was not only a necessary condition for undertaking the research and educational activities envisioned, it also provided a means of indexing awareness and concerns about issues relating to potential misuse of the life sciences. A variety of expectations were held initially regarding the ease of setting up these sessions in each country.

41. Initially it was envisioned that The Netherlands would be the most straightforward case. In mid-2005 Dando and Rappert made contact with the Royal Netherlands Academy of Arts and Sciences (KNAW) who agreed to facilitate the process. The Dutch Academy had taken an active interest in the general topic of biosecurity because it eventually became the lead national academy for the InterAcademy Panel's working group on biosecurity. KNAW supplied the contact details for the directors of relevant Dutch research schools and a list of university and other contacts from the Dutch Biologist Association. In the early autumn of 2005 it also contacted the directors of the research schools to endorse the seminar, underlined that all travel expenses would be paid through our research grant, and let the professors know they would be contacted in the future to set up one.

42. The initial plan was that at least eight seminars would be undertaken. Because the number of universities in the Netherlands is in about 15 or so and some of them do not study the life sciences, it was decided that eight would provide a fairly comprehensive coverage of universities. Within universities with more than one relevant department, efforts could be made to widely distribute notices of any seminar to attract cross-departmental attendance.

43. However, against the initial expectations of KNAW and the authors, it was rather difficult to set up the seminars. As of August 2006 only four seminars have been arranged; with one being part of a training day for graduate students. Three were undertaken in the autumn of 2005 and one in the spring of 2006. The reason for the low take up of the seminars in the Netherlands is not clear. Although the initial contacts were made in the less than ideal planning time of slightly after the start of the 2005-6 academic year, it seems unlikely that this could account for such a low level of response. Perhaps a more likely reason is a low relevance attached by those contacted to potential misuse or BTWC issues.

44. In contrast, whilst we had some initial concerns because of our unfamiliarity with the country, organising the seminars in South Africa was relatively straightforward because they were arranged by Chandré Gould at the Institute for Security Studies (Africa). Because of Dr. Gould's past work on South Africa's biological weapons program[50] and her continuing engagement in this and other policy areas, she was able to draw on pre-existing links within universities. Where these did not exist, heads of departments were contacted. Of those universities with active research programs approached, only one declined to host a session. Seven seminars were conducted over a two week period in May 2006, six with universities and one with a public institute. The seminars drew a total of 249 participants with the numbers of individuals ranging from 9 to 50. As Gould has recently been appointed to the South African government's Non-Proliferation Council, the work undertaken in these seminars will inform the Council's policy deliberations and decisions.

45. We did not expect problems in organising seminars in the United States. However, because of the large number of universities in the US and the numbers of life science departments in

[50] C. Gould and Marlene Burger, *Secrets and Lies: Wouter Basson and South Africa's Chemical and Biological Warfare Programme*, Zebra Press, South Africa, 2002 and C. Gould and P. Folb. "The Role of Professionals in the South African Chemical and Biological Warfare Programme", *Minerva*, Number 40, Netherlands. Kluwer Academic Publishers, 2002.

major universities, it was not planned nor has it been possible to undertake seminars across a large number of relevant institutions. Instead of seeking to be representative, seminars were undertaken with major bioscience research universities and related organizations in the US with a view to treating the responses heard as indicative of the types of responses of those in other such organizations. Thus far 12 seminars have been conducted in the US over the course of three visits during the first half of 2006. In most of cases those seminars were set up through personal contacts by the authors in the host departments directly or in other departments that then facilitated contact with necessary individuals. The American Association for the Advancement of Science and the National Academy of Science also assisted in finding contacts**.**

46. Although it was not planned at the start of this project, contacts between Dando and the Finnish Ministry for Foreign Affairs led to 2 seminars being conducted in Finland in May 2006. These seminars were designed to feed into internal government deliberations in the build up to Finland assuming the EU presidency in July 2006. The Ministry for Foreign Affairs identified contacts at two universities in Finland doing work most closely associated with human pathogens and both agreed to arrange our seminars with other biosecurity talks. Forty participants attended the first session (including various government officials) and 17 attended the second.

Educational Themes

47. Interactive group discussions are not straightforward to analyze. The *interactive* dimension of the focus groups means that individual sessions can evolve along lines that depend on the particular exchanges. In recognition of their interactive feature, the results of focus groups are rarely highly quantified, in contrast to survey research, for example. Instead, recurring themes are explored. Consistent with such a practice, this Review Conference Paper identifies broad areas of difference and commonality between the discussions in different countries, the changes in the strategies employed to probe participants' reasoning, and the major issues relevant to BTWC education. In addition, the seminars in the UK have also been re-examined in this respect.

48. It is important to recall that the structure of the seminars were transformed over time in order to find better ways of getting participants to elaborate the reasoning behind their evaluations. As a sense of likely responses emerged, the seminar content and structure were revised so as to test out the reasoning for participants' statements and to validate the emerging appreciations that were being developed by the authors.

49. In the end, much of our questioning was built around (i) seeking the limits to and meaning of the suggestion 'we need to know' and (ii) generating discussion about appraisals of the appropriateness and feasibility of proposed policy initiatives. In regard to (i), when those in British universities were questioned about the advisability of publishing or undertaking work that might be misused, the participating scientists and students repeatedly stressed the importance of going ahead with such actions to stay ahead of threats and combat disease (save for the seminar with first year students noted earlier). With the expectation that this would be the dominant type of initial response offered to any of our questions, we were then able to test the limits of this thinking. Examples of scientists communicating to the general public and limiting communication to government scientists were used to ask who the participants meant by the 'we'

(or 'they') that needed to know. The substantial increases in biodefence funding in the US was used to question just how much needed to be known. Our expectation of likely disagreement about these more detailed questions of who is in the 'we' and how much needed to be known were the means of probing any initial flat suggestion that 'we need to know'.

50. This sense of the importance but disputed bounds of needing to know was a core component of our expectations for responses based on the UK seminars. So too was the expectation that appraisals of the appropriateness and feasibility of proposed policy initiatives – such as the pre-project oversight system being considered by NSABB in the US, the science journals manuscript submission review process, and the proposal review procedures initiated by some funders – would be mixed but side towards scepticism. This Review Conference Paper briefly first notes some differences from the UK findings in the seminars carried out in the Netherlands, South Africa, Finland, and US.

Major Differences

51. As already noted, in planning the Dutch seminars we expected a different tenor of discussion. Based on the four seminars undertaken so far, it is difficult to justify any statements regarding there being a pattern of difference between responses in the two countries. However, the initial work undertaken is at least suggestive of a somewhat greater willingness in the Netherlands to at least consider the possibility that the potential misuse of some results in the life sciences would warrant rethinking what work is undertaken, under what conditions, and how it is published. For instance, in relation to questions about the advisability of the IL-4 mousepox experiment leading to publication of a standard scientific article, misgivings were expressed in two of the seminars about whether this was advisable. After a couple of comments in support of open publishing in the first seminar, two senior faculty members commented on the need for at least some initial rethink on how research is published. Although mixed appraisals were offered in two of the four Dutch seminars to publishing IL-4 in the open scientific literature, this situation was quite rare in the UK. Only three of the 24 non-pilot British seminars were comparable in the sense that more than one faculty member spoke to the possible appropriateness of limiting publishing in some manner early on in the sessions.

52. Responses from the South Africa seminars exhibited an important difference from those in the UK as well. As noted above, our initial assumption was that participants in South Africa would indicate a greater degree of scepticism than those in the UK regarding the need for funding or procedures for regulating work in the life sciences that might have the potential for misuse. It was thought this would stem from the resource demands of funding and regulating science along with pressing health priorities in the country. However, *overall* the broad results were mixed. What is key though is the *distribution* of those mixed responses. In 5 of the 7 South African seminars, responses regarding proposed *policy initiatives* were overwhelming receptive (in 2) or overwhelming critical (in 3) in character. While the 'need to know' was a major theme, the seminars in South Africa saw some of the most vociferous positive and negative comments regarding the appropriateness of governance measures. Each of these 5 would have been regarded as outlier seminars in the UK or any of the other countries visited. In short, the discussions where highly polarized between different institutions. As a result of this variability, it became quite difficult to anticipate the likely direction of the conversations.

53. A significant difference between the US seminars and those elsewhere was the greater knowledge about biosecurity discussions in general, potential misuse policy initiatives, and related BW issues. This is perhaps not surprising because of the heightened attention to potential misuse issues in the US and because nearly all the organizations visited had a direct stake in that they were receiving biodefence research funding. In the UK, while participants brought a variety of expert knowledge to bear in their responses, relatively few brought in what might be referred to as 'potential misuse specific information' as part of the discussion. Only 19 individuals across the 24 seminars in the UK made reference to information beyond that provided by the presenters about potential misuse policy developments, the past history of biological weapons, current biosecurity events (e.g., efforts to reconstruct 1918 Spanish Flu), or relevant provisions of arms control. Three of these 19 individuals' statements were inaccurate. In all but a few cases, the information noted was passing in character; such as indicating basic awareness about the former BW programme in the Soviet Union or having limited familiarity with a policy initiative. In contrast, in the US multiple individuals generally brought additional information to bear in the discussion (though this is not meant to imply that the audiences as a whole were necessarily well informed about these issues). Yet, despite this relative level of knowledge, US participants responded in the same broad fashion as elsewhere and the same strategies of questioning worked.

Major Similarities

54. Despite such difference between the seminars held in the different countries, the degree of similarity between the responses in the seminars was much more pronounced. In theory, there were a number of ways in which the seminar format for questioning and discussion might not have worked: participants might have remained silent; questions might not have been answered because they were deemed inappropriate or irrelevant; participants might have repeatedly put questions back to us so as to disrupt the planned question and answer format; senior figures might have dominated the discussions at the cost of fostering group interactions; responses might have been such that the basic logic of questioning failed to engage participants' reasoning. These ways relate not only to *what* might have been said but also *how* the interactions unfolded within the seminars.

55. There were other important areas of similarity in the discussions. Although it was initially anticipated that far more support would have been given to dedicating public resources to research in order to counter bioterrorism in the American rather than the British seminars, this was not the case. Overall assessments in the former were quite mixed, with repeated concerns about how biodefence funding was bought at the expense of research in other areas of health, showing a similarity to seminars in the UK.

Major Similarities in Discussions

56. Throughout the seminars in the various countries 'the need to know' was a recurring theme. Seminar participants repeatedly voiced concerns that impediments or limitations to what work was done or how it might be communicated would jeopardize the peaceful and defensive benefits stemming from work in the life sciences.

57. While there were different notions of responsibility, a matter that repeatedly generated debate across the countries visited was the advisability of communicating *beyond* specialist scientific audiences. The communication to such an audience has been a topic of much consideration in recent years far beyond matters of potential misuse in the life sciences. Members of the public require some grasp of science in order to take informed positions on many topics or to make educated lifestyle choices. Public funding of much of the work conducted in universities places a demand on scientists to make their work open and socially relevant. Yet, as indicated by disputes about the safety of genetically modified foods, vaccines, or tobacco products in Europe and North America, just how and what should be said to the public can be a matter of some contention. The communication of science raises important questions about the place of experts in modern societies. A Dutch seminar was typical of the ambivalence voiced about public communication in the discussions. Here participants raised both the pros and cons of communicating potential misuse concerns via popular publications. On the one hand, such communication could be vital in mobilizing funds and political action. On the other hand, participants perceived a potential danger that such publication would bring negative attention to recombinant DNA or life sciences more generally.

58. A basic tension between the need to raise awareness and the hazards of doing so were evident in many other aspects of the discussions. So, while publicly communicating potential misuse concerns might generate untoward attention, not doing so could later lead to accusations of a cover-up or paternalistic practices by scientists. Thus communication might generate needed political action but it could also generate political interference in research. Any attention to potential misuse concerns might spur thinking and action by scientists and governments with benign intent and protective concerns, but also those with malign intent pursuing harmful goals. Assessing whether and how to communicate potential misuse concerns was a source of much debate.

59. An important educational aim was to ensure that the assumptions and inferences underlying evaluations were evident so that they too could be discussed. Assumptions regarding the consequences of publishing in certain outlets, for example, could influence the assessment of the merits of communicating concerns to certain audiences. Concerns about maintaining funding raised important questions of responsibility and proper conduct. For example, to what extent should the desire to publish in order to facilitate further funding be moderated by concerns about the potential misuse of the results. In the earlier analysis of the British seminars it was noted that questions about the proper choices of what research gets done or how it is communicated were repeatedly said to be irrelevant because the development and spread of science was inevitable. Inevitability also was a theme in the non-UK seminars.

Major Similarities in Interactions

60. The interactions in the seminars were managed to promote reflection and deliberation. Initially Dando and Rappert were asking questions during the seminars and the participants providing responses to the questions posed. In contrast to typical university department seminars where the presenters are questioned by attendees on the basis of the information and arguments they forward, here attendees where questioned on the basis of certain information given by the presenters.

61. Because, generally, Dando and Rappert were the questioners and the participants were the responders this placed limitations on the types of questioning that took place. For instance, we tried not to advance our own assessment about the questions discussed but instead inquired about others' assessments. Attempts early on in the British seminars to introduce a slide at the end of the seminars that directly spoke to and challenged some of the claims of participants so as to generate further discussion roundly failed to do so. Early experience also suggested that efforts to put forward appraisals of our own into discussions between participants closed down more exchanges that it opened. Consequently, we adopted a different strategy. When time permitted, at the close of the seminar we would provide a statement that addressed our concerns with potential misuse of the life sciences at a general level, but not one that spoke to the specific questions posed in the seminars.

62. The division in questioner and responder roles fostered particular types of interactions. The 'educational process' entailed trying to get the participants to exchange views among themselves rather than between the moderators and participants. The desire to refrain from advocating positions was meant to ensure an open environment for discussion, to minimize antagonistic exchanges between moderators and participants, but it also meant that if participants did not raise certain pertinent points they often did not enter into the discussion.

63. The types of questions we, as moderators, posed also influenced how our agendas and aims in undertaking the seminars did or did not enter into the seminar dialogue**.** As part of the introduction to the seminar, we gave a brief account of our interest in potential misuse of the life sciences. In the UK, Finland, the Netherlands, and the US, this was overwhelmingly treated as sufficient. During the seminar itself, it was exceeding rare for participants to query our aims and agendas. In the twenty-four UK seminars, this only took place twice and it never took place in the Finland or the Netherlands. The major exception to this pattern was South Africa. In five of the seven seminars, participants there voiced questions or made assertions regarding the agendas and aims of us as initiators of these discussion as well as those of the organiser, Chandré Gould. While it is possible to attribute this to curiosity, the geographic distance travelled or random chance, part of the reason appeared related to repeatedly expressed apprehension about who was concerned about life science potential misuse issues. In those three seminars where responses to proposed policy initiatives were overwhelming critical, queries about our aims and agendas mixed with assessments that bioterrorism and potential misuse of the life sciences were a distinctly American preoccupation. By implication, if not by outright assertion, we were then regarded as agents for this overseas preoccupation.

64. Indeed, one of the limitations of the format of the seminars was in probing the reasoning and implications of suggestions that concern with bioterrorism and the potential misuse of the life sciences were regarded as being a distinctly American preoccupation. As with the suggestion that 'research is inevitable', such assertions often had the effect of cutting off further discussion and reflection. While an effort was made to include non-US activities and statements to indicate that there was some degree of international attention to these issues, in the future this seminar should find ways of opening up such appraisals as was done in relation to the 'need to know'.

65. Another overall educational similarity related to expertise. If the participants had repeatedly displayed knowledge about the potential misuse of the life sciences policy issues, the exchanges could have involved quite detailed and thorough examinations of particular options. Instead, as noted earlier, overall the seminars were characterized by a stark division in expertise. Participants indicated expertise in their field of study while the moderators were the ones that marshaled information about the potential misuse of the life sciences policy issues. Even in the US, where multiple individuals in a session might have displayed considerable familiarity with the policy issues, participants rarely responded in a way which challenged our characterizations or information. As such, the quotes, figures and information we provided became highly important in establishing the terms of the discussion.

66. Our significant control of the questioning process combined with participants' comparative unfamiliarity with potential misuse of the life sciences policy matters meant our interventions as moderators could be highly consequential for the types of exchanges generated. This was case for both the pre-scripted monologues given for each slide as well as the unscripted dialogue that followed. The tension faced throughout the seminars was how to introduce a topic to initiate discussion, but not do so in a manner that then closed it down. We adopted a strategy that was important for the types of interactions fostered. To begin with the content of scripted monologues developed over time. The unscripted interventions were highly dependent on the specifics of respondents' contributions. It is possible, however, to make some general comments which indicate the broad orientation we eventually adopted in thinking about what information to cite and how. After presenting the information related to each slide we sought evaluations about the questions asked then further questioned in an effort to make explicit the assumptions and inferences informing those evaluations. If participants asked for further details about the policy issues we provided it, but otherwise we tried to refrain from bringing in additional information or our own evaluations after posing the question on each slide. The aim was generate discussion about a concrete area of inquiry. The basic slides would then be revised as we became aware of recurring queries.

67. The plan to question the basis for their evaluations rather than put forward our own had its problems, however. Especially given the time constraints of the sessions, whether or not and just how we should correct inaccuracies in their assumptions or inferences was a continuing source of concern. A danger was that frequent interjections about the facts would move the interactions closer to a one way provision of information. A second problem was how to facilitate discussion when participants had different levels of familiarity with the scientific and policy issues raised. One option would have been to allow those with specialized expertise and close familiarity with policy issues to dominate the discussions. We made the decision that this was not an outcome we as moderators would welcome. So in deciding who to acknowledge for questioning and when to stop discussion about a particular slide, we tried to ensure as many participants as possible spoke. This was motivated, in part, by an assessment that the issues raised in considering potential misuse of the life sciences issues entailed basic social and ethical questions about which all participants could offer valuable contributions even if they lacked some specific substantive knowledge.

Educational Modules

68. The previous sub-sections outlined various aspects of the seminars conducted. It might be assumed that educational efforts in general or question and answer sessions as described would be rather straightforward exercises. However, we would argue that there are many issues for consideration in how these are undertaken. The account given here has suggested something of the negotiations that arise in practice regarding such questions as 'What should education activities entail by way of subject matter?', 'Who is the educator and who is to be educated?' and 'What is the purpose of education?'. Our questioning and probing approach only provides the starting point for considering what took place in practice. Over the course of conducting the seminars, much consideration was given to how best to pose our questions.

69. An overall conclusion from the second set of comparative educational seminars was that they confirmed certain key findings from the UK seminars. Clearly if you believe that any particular piece of research will undoubtedly be done by somebody somewhere, and that communication of results will happen sometime somehow, there is little room in your thinking for consideration of codes of conduct that at least, in principal, call such notions into question. Thus we believe that :

> i) there is undoubtedly a need to raise awareness of potential misuse of the life sciences issues amongst the life science community in the countries we visited (and by implication in many others as well): and,
>
> ii) our seminars were an effective way of raising such awareness.

However, a further question arose as it also became clear that our seminars carried out in the manner described were not an *efficient* method of raising awareness. Although personal contacts are often essential in raising the profile of BW-related issues, means need to be found to reach much larger numbers of scientists in different countries with the expenditure of less time and effort. The development of educational modules is one way of doing this. This section describes two such products deriving from our work.

70. The prevalence of the internet-based communications within international scientific and medical communities makes the internet a possible mechanism for spreading educational materials. Thus one obvious possibility was to put a version of the seminar on the web so that it could be accessed easily by many life scientists. This objective was met by developing a video version of a seminar. A second approach was to transform the seminar into a role play exercise that could be used as part of a regular course for life scientists. This exercise was again made available widely by putting the necessary documentation onto the web.[51] These two approaches are considered in turn below.

The Video Seminar

71. On 28 March 2006, Dando and Rappert presented their seminar at the New York Academy of Sciences (NYAS). NYAS was founded in 1817 as an independent, nonprofit, and membership-based organization. Its main purpose is 'to advance the understanding of science, technology,

[51] http://www.projects.ex.ac.uk/codesofconduct/BiosecuritySeminar/Education/index.htm

and medicine, and to stimulate new ways to think about how their research is applied in society and the world.'[52] This seminar was one of numerous science outreach events held by the Academy every year. Previously the NYAS had organized two meetings on biological weapons-related issues. In November 2001, a meeting discussed responses to bioterrorism in light of the anthrax letter attacks in the US. In November 2003, a meeting titled "National Security and Biological Research: What Are the Boundaries?" was also held at the Academy. An audio recording with PowerPoint presentations of the second is freely available on the web[53], though the first is only open to NYAS members.

72. It was agreed beforehand that our seminar would be video recorded and made freely available on the web. The recording is now accessible through the NYAS' *e*Briefing series.[54] It is in three parts, which are reproduced as Appendices 1A, 1B and 1C of the electronic version of this paper (available at http://www.brad.ac.uk/acad/sbtwc/ briefing/RCPapers.htm): a. the video recording, b. the write-up of the session from a science journalist who attended and c. a further information resource created by Dando and Rappert. The basic idea of the latter was to illustrate alternative appraisals made of the questions posed. The discussions generated at the NYAS seminar, like any individual seminar, only included a limited number of lines of argument. Acknowledging alternative evaluations of the issues discussed and, crucially, elaborating the reasoning for these differences is vital in provoking greater reflection on potential misuse of life sciences issues.

73. To this end, each seminar slide in Appendix 1C is linked to additional web pages. These web pages explain the reasoning for Dando and Rappert asking the particular questions posed, provide anonymous examples of exchanges from other seminars that complement what was said at the NYAS, and offer questions for further consideration. In this way those watching the video seminar have access to multiple types of information: a video recording of the NYAS discussion (Appendix 1A), the analysis of it by a journalist (Appendix 1B), transcribed recording material from other seminars (Appendix 1C), and a commentary on what is being done by the presenters (also in Appendix 1C). Instructors may use the *e*Briefing in a number of ways; individuals may watch it in their own time or during course teaching, the recorded conversation can be viewed on its own or in conjunction with the other forms of analysis presented, viewers can be asked to consider the responses to the questions posed or alternative questions can be formulated, etc.

74. However, attention should be given to certain limitations about this recording as an educational tool. First, unlike the other seminars, this did not take place in a university departmental setting. This raises questions about the representiveness of the responses offered. However, the exchanges generated were generally similar to those heard elsewhere. Second, the hierarchical interactional dynamics between students –faculty members – senior faculty members (that so often arise in university seminars) are not evident in the NYAS setting. In this respect the recording of this particular session has certain limitations as a template model for undertaking one of these seminars elsewhere. Third, the discussion generated is not as lively or interactive as that in many of the other seminars we conducted; no doubt in part due to the presence of various recording equipment in the room. Finally, as with the role playing exercise to

[52] http://www.nyas.org/about/index.asp
[53] http://www.nyas.org/ebriefreps/splash.asp?intEbriefID=243
[54] http://www.nyas.org/ebrief/miniEB.asp?ebriefID=531&PartnerCD=UK&TrackCD=eB531

be discussed below, the seminar focused on policy developments in Western countries, mainly the US. This drawback though could be turned into an educational advantage if instructors were to ask listeners to reflect on the geographic peculiarities of the dialogue.

The Role Playing Exercise

75**.** Role playing is an educational tool that produces learning through experience. Other forms of learning through experience include case studies and simulations. Learning through experience typically leads to greater assimilation of material and longer retention. Moreover, by assigning students to roles it allows them the freedom to make controversial or experimental claims from the safety of a role. It also assures the organizers that an array of views is represented. This is particularly important in a classroom setting where the students are likely to be a more homogeneous group than the audience we had for our seminars, whose participants typically had a variety of backgrounds, experience and levels of seniority. The objective was to produce a stand alone teaching kit that would provide instructors with a readily accessible and fairly novel method for raising potential misuse of life sciences issues with their students. This sub-section outlines how we set out to produce the exercise and it describes our thinking relating to this line of educational work.

76. In transforming the original seminar into a role play exercise there were three practical problems to address in our initial *pilot* study. Because our baseline target was a class of students taking a course in the life sciences we needed to solve the problem of homogeneity described above. We did this by writing 12 different roles that the participants could play in the exercise, including life scientists at different stages in their careers as well as people in other occupations that had an interest in potential misuse of life sciences issues.

77. A second problem concerned how the instructor – who would take on the role of presenting the seminar in the exercise – was to be able to present the necessary information and to ask the required questions of the participants. With two experienced people presenting the original seminars it had become possible over time to minimise the number of slides and the information they contained, as an explanatory verbal commentary had been evolved for each slide in the slide sequence. We could not expect the instructor to posses the necessary expertise to do this, so it was necessary to build more information into the slides (and to back this up with material that could be accessed if the instructor thought it necessary before the exercise was carried out). Finally, in order to openly and thoroughly examine the diverse arguments presented, the instructor/presenter had to have or to acquire some of the interactive techniques we had developed in the seminars to delve more deeply into why people held the views they put forward. This need was met by writing specific sections of the teaching notes for the pilot study to provide some assistance on how this might be done. In addition a few of the roles we created were designed to assist the instructor in the probing and questioning portion of the seminar.

78. Thus it was expected that three documents would eventually be provided on the web to be downloaded by the instructor in order to carry out the role play exercise:

1. A description of the roles for participants;

2. Detailed slides in sequence; and

3. The teaching notes for the instructor.

Each of the three documents, and an appendix to the teaching notes giving more details on the data on the powerpoint slides, were prepared for the pilot study. One of the authors (Chevrier) who had previously designed a number of role play exercises had observed three of the later seminars by Dando and Rappert in the United States. All three authors then collaborated to develop the material required for the pilot study of the role play exercise.

79. The pilot study was carried out in cooperation with a biologist colleague in a university in the United States. A diverse group of 22 participants were present. After a brief introduction by our biologist colleague, Rappert gave an overview of what we had been doing in the seminars and of our plans to develop the role play as an educational module. Rappert then observed the pilot study in operation from amongst the participants. Chevrier and Dando acted as the presenters and ran through the slides and questions which took about the usual 50 minutes. Finally, Rappert opened up a discussion by the participants of the substantive issues brought up in the exercise and of the operation of the pilot study itself. The three authors of this Review Conference Paper then consulted with some of the participants and a person who had been assigned to take a note of the arguments presented before extensively reviewing what needed to be altered in the design and documentation.

80. For the pilot study we had written eleven roles:

Undergraduate student;

Graduate student;

First year post doctoral.

Young faculty scientist;

Eminent professor;

Greenpeace scientist;

Government scientist;

Science reporter;

Public health official;

Police officer;

Senior scientist.

Each role was a composite character based on what we had heard in our seminars. As a result of the debrief, we added another role. This was the university public relations official who had an interest in making sure that news about the work carried out in the University's laboratories was widely known. Subsequently we added also additional roles including two members of the public, a student in forensic science, and a representative of the biotechnology industry. Depending on the size of the class, an instructor could replicate any or all of the roles.

81. At the start of the seminar, each participant was given a one page description of their role and all were allowed a few minutes to digest the information. As there were 11 roles and 22 participants in the pilot study each role was played by two different people. We distributed the role descriptions in order 1-11 and then again 1-11 as people entered the room. No attempt was made to target particular roles to particular people in the pilot study. The one-page role descriptions had two initial paragraphs that did not vary. They detailed what the objective of the role play was, how to play a role and how the exercise would be run. Each role description had a unique third paragraph describing the particular character to be played. A helpful ''motto' was included for each. So the Police Office description was headed "I do not understand all the science, but I am the one that has to implement the law and it is my responsibility to protect the public." The role descriptions did not state what the particular character would say in response to the questions asked in the slide sequence, but indicated who the person was and what general orientation he or she was likely to have. In addition, certain roles (for example the Science Reporter and the Greenpeace Scientist) were written in such a manner as to encourage these participants to ask probing questions of others.

82**.** Reactions by the participants in the debrief to the pilot study of the role playing exercise were positive. It was said to be a novel and usable method for classroom teaching. As one of the real life senior scientists in the audience noted, while we as individuals think we are an average person with average views, playing a role makes you realise that there are people with very different views. On the negative side though, the dynamics of this role playing seminar could not be divorced from the general hierarchical features of university department seminars in which senior participants often lead and control discussions. It was not possible, for instance, to overcome the resistance that relatively young graduate students might have in asserting themselves in front of self-assured faculty members simply by giving them a role to play.

83**.** As a result of the pilot, we made substantial changes to the one-page description document for the roles. First, the material in the first two paragraphs was shortened so that there was less detail to absorb. In a role play exercise as part of a class, roles are typically distributed several days or a week beforehand so there is often a much longer time for people to think about their roles and even to get into groups to discuss how their role might be played. This was not possible in the pilot study and might not be possible in some classroom settings. Second, and importantly, the participants pointed out during the debrief that playing a role with which they did not agree was sometimes quite difficult. They felt the need to put their own thinking forward rather than waiting for the debrief as their handout suggested. As our objective was to get a variety of views aired and examined, we altered the instructions to say that participants could put their view forward if they felt the need. This could be done in two ways after the view of the character was stated: i) the participant could say what he or she thought the character would say

and then add that they understand other people hold a different view, or ii) the participant could say that he or she did not agree personally with what was being stated.

84. Our discussions of the slides prior to the pilot study had led us to believe it was necessary to both add more material to the slides and to simplify the material so that much of what we said in the seminars was available visually for the instructor/presenter. These would allow the instructor/presenter to more easily run through the seminar. Despite such efforts it was clear from the debrief that the process had not been taken as far as was necessary. So after the pilot study we changed each of a number of the slides that led to key questions into a small group of slides that carried more information but in a form that could more readily be digested. We also decided that the more detailed information that we had put about each slide into the appendix to the teaching note should go as notes to the relevant slides so that it was simpler for the intending instructor/presenter to review the whole thing in advance.

85. A different problem in regard to the slide sequence was also evident in the pilot study. In the real seminars the two presenters had transitioned between the groups of slides dealing with communication, funding and oversight by making links between the issues raised in each. While this enabled a rather smooth transition, it did rely on the presenters being quite familiar and comfortable with the issues discussed. In order to facilitate the transition for those that were not familiar or comfortable we added a couple of sentences to each slide introducing the new topic.

86. A key issue in the seminars is how they can be conducted in such a way as to encourage thorough and open inquiry. In this regard it is important that those present think about why particular views are held and what further implications follow from what is stated. It is important to elicit why individuals hold certain views in order to avoid the discussions turning in a simple statement of one stereotypical view after another. Doing so though requires a skillful management of the discussion, which even those experienced in running interactive seminars can fail to meet. We had put ideas on how to get to a desired level of interaction in the teaching notes prepared for the pilot study, but concluded that more explicit action was necessary. In the original seminars we had simply had slides with the relevant information that we talked through. We then added a line with the question in bold. Following the pilot we changed the slide animation so that the question 'faded in' slowly followed with 'Why?' and 'What implications?' also fading in as appropriate. Thus the participants were reminded of the key objectives without the presenter having to think how to do that within the discussions. We also added a short table of good practice questions in following up responses to the teaching note so that the presenter could have this ready to consult prior to and during the exercise. The demands of facilitating relatively thorough and open inquiry in practice, though, should not be underestimated.

87. Thus as a result of the pilot of the role play exercise we have developed the first version of an educational module that can be used to help raise awareness of life scientists in a classroom setting. As noted previously, this documentation is available on the web and a copy is given in Appendix 2 A (Role Playing Simulation Materials: Teaching Note), 2 B (Role Playing Simulation Materials: Roles), and 2 C (Role Playing Simulation Materials: Powerpoint Slides) on the electronic version of this paper at http://www.brad.ac.uk.acad/sbtwc/briefing/RCpapers.htm.

Conclusions

Educational Issues

88. The experience of carrying out over the past two years the 51 seminars described here involving some 1500 participants in the life sciences in six countries – UK, Finland, Germany, Netherlands, South Africa, and US – across three continents, and of constructing the educational modules reinforces the view that there is a great need for education and outreach to raise awareness amongst the life science community of the Biological and Toxin Weapons Convention and of the prohibitions it embodies. In addition, our findings demonstrate that despite the current low levels of interest and awareness in the life science community, there are ways to effectively engage these practicing scientists in participation in well-designed educational modules.

89. However, the difficulties involved in raising awareness in the life and associated sciences communities around the world in order that they can effectively participate, for example in the development of codes of conduct in support of national legislation, should not be underestimated. Our findings again show that despite the recent international attention given to the problem of the potential misuse of the life sciences, our initial findings in the UK were essentially replicated in our later seminars in the UK, and in the other countries (Finland, Germany, Netherlands, South Africa and the US) we visited. In such circumstances it is quite unrealistic to expect that simply, for example, adding a lecture to a standard course in the life sciences will make a great deal of difference.

90. A fundamental conclusion from this study therefore is that in depth implementation of the BTWC within States Parties requires a significant effort on education and outreach for such implementation to be effective. To achieve this, a simple declaration as at previous Review Conferences about the importance of education will be insufficient and States Parties will need to take concerted action to ensure increased educational provision and outreach.

Issues for the Review Conference

91. Thus as a first step we recommend that the paragraph in the Article IV section of the Final Declaration of the Fourth Review Conference which notes the importance of education might usefully be extended at the Sixth Review Conference so as to include codes of conduct as shown in the bold text below:

> *The Conference notes the importance of:*
>
> *- Legislative, administrative and other measures designed to enhance domestic compliance with the Convention;*
>
> *- Legislation regarding the physical protection of laboratories and facilities to prevent unauthorized access to and removal of microbial or other biological agents, or toxins:*

- Inclusion in textbooks and in medical, scientific and military education programmes of information dealing with the prohibitions and provisions contained in the Biological and Toxin Weapons Convention and the Geneva Protocol of 1925.

- The adoption of consequential codes of conduct for those engaged in relevant areas of science and technology.

92. It should be recalled that the mandate[55] for the annual Meetings of States Parties held between 2003 and 2005 included the requirement:

The Sixth Review Conference will consider the work of the meetings and decide on any further action.

93. It has been recommended[56] that the outcome of the Meeting of States Parties in 2005 that considered the topic:

The content, promulgation and adoption of codes of conduct for scientists.

should be incorporated into the Article IV section of the Final Declaration of the Sixth Review Conference by using language along the following lines:

The Conference in regard to the content, promulgation and adoption of codes of conduct recognises that:

a. while the primary responsibility for implementing the Convention rests with States Parties, codes of conduct, voluntarily adopted, for scientists in the fields relevant to the Convention can support the object and purpose of the Convention by making a significant and effective contribution, in conjunction with other measures including national legislation, to combating the present and future threats posed by biological and toxin weapons, as well as by raising awareness of the Convention, and by helping relevant actors to fulfil their legal, regulatory and professional obligations and ethical principles;

b. codes of conduct should reflect the provisions of the Convention and contribute to national implementation measures;

c. a range of different approaches exist to develop codes of conduct in view of differences in national requirements and circumstances;

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[55] United Nations, *Fifth Review Conference of the States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction*, Geneva, 19 November – 7 December 2001 and 11 – 22 November 2002, Final Document, BWC/CONF.V/17, Geneva, 2002. Available at http://www.opbw.org

[56] Dando, M. R. (2006) Article IV: National Implementation: Education, Outreach and Codes of Conduct., pp 119-134 in Pearson, G.S., Sims, N.A. and M.R. Dando (Eds.) *Key Points for the Sixth Review Conference*. University of Bradford, September. Available at http://www.brad.ac.uk/acad/sbtwc.

d. codes of conduct should avoid impeding scientific discovery, placing undue constraints on research or international cooperation and exchange for peaceful purposes;

e. science should be used for peaceful purposes only but has the potential to be misused in ways that are prohibited by the Convention, and therefore codes of conduct should require and enable relevant actors to have a clear understanding of the content, purpose and reasonably foreseeable consequences of their activities, and of the need to abide by the obligations contained in the Convention.

In addition, the Conference recognises that all those with a responsibility for, or legitimate interest in, codes of conduct should be involved in their development, promulgation and adoption. The Conference agrees on the value of codes of conduct applying not just to scientists, but to all those involved in scientific activity, including managers and technical and ancillary staff.

On the content of codes of conduct, recognising the principles listed in paragraph 7 above, the Conference agrees on the importance of codes of conduct being:

a. compatible with national legislation and regulatory controls and contributing to national implementation measures;

b. simple, clear and easily understandable both to scientists and to wider civil society;

c. relevant, helpful and effective for guiding relevant actors in making decisions and taking action in accordance with the purposes and objectives of the Convention;

d. sufficiently broad in scope;

e. regularly reviewed, evaluated for effectiveness, and revised as necessary.

On the adoption of codes of conduct, recognising that it is important to build on and coordinate with existing efforts, and avoid imposing burdensome and duplicative measures, the Conference agrees on the value of:

a. demonstrating the benefits of codes and encouraging relevant actors to develop codes themselves;

b. using existing codes, mechanisms, frameworks and bodies as far as possible; and

c. tailoring adoption strategies according to the needs of each relevant sector.

On the promulgation of codes of conduct, recognising that codes of conduct will be most effective if they, and the principles underlying them, are widely known and understood, the Conference agrees on the value of continuous efforts on promulgation through appropriate channels.

94. In considering further action, it is recommended that the Sixth Review Conference should call upon all States Parties to foster the adoption of such codes of conduct and to provide an annual report thereon to the UN Department for Disarmament Affairs:

The Conference having reviewed the activities in regard to codes of conduct undertaken by the States Parties at and since the Meeting of States Parties in 2005, calls upon all States Parties to foster the adoption of such codes of conduct as appropriate and to provide an annual report of progress thereon to the United Nations Department for Disarmament Affairs to provide to all States Parties

95. It is also recommended that the States Parties in considering the value of education and outreach to aid the in-depth implementation of the Convention should incorporate the substance of the language relating to outreach and implementation in the eighth operative paragraph of Security Council resolution 1540 (2004) which states:

To develop appropriate ways to work with and inform industry and the public regarding their obligations under such laws;

into the Article IV section of the Final Declaration of the Sixth Review Conference by using language along the following lines modified slightly so as to include academia as well as industry:

The Conference recognizing the benefits of promoting effective national implementation of Article IV of the Convention calls upon all States Parties to develop appropriate ways to work with and inform industry, academia and the public regarding their obligations under such laws.

96. In addition, it is recommended that the States Parties should agree to hold an annual Meeting of States Parties prepared for by a Meeting of Experts during the intersessional period between the Sixth and Seventh Review Conferences to consider the topic:

Education and outreach for all those concerned with the life sciences.

At such an annual Meeting, a detailed review of the various education and outreach initiatives and evolving notions of best practice could be made. The combination of actions recommended here would together go some way to ensure that a continuing and expanding education and outreach process would be aiding the in-depth implementation of the Convention. The Seventh Review Conference in 2011 could then determine what further actions are need to further improve the implementation of the Convention.

97. It is noted that one of the EU papers for the Sixth Review Conference entitled "*EU Paper on the Intersessional Programme of Work: Its utility and contribution to fulfilling the object and purpose of the BTWC between 2003-2005 and a case for further intersessional work after 2006*"[57] includes as a topic for a further annual Meeting of States Parties in the intersessional period between 2006 and 2011:

> *"iv - Raising of the awareness of the biological risk in national populations (linked to Article X)"*

and proposes that *"this topic would cover the strategies implemented at national level to prepare the population for biological risks and to encourage the adoption of appropriate health-related behaviour. More generally, educational measures in the area of biological disarmament and nonproliferation could be examined."*

98. Whilst this proposal is welcomed, it could not reflect the findings of our work, based on 51 seminars involving some 1500 participants in six countries – UK Finland, Germany, Netherlands, South Africa and the US – over three continents, that those engaged in the life sciences are generally unaware of the prohibitions and obligations of the BTWC. In these circumstances, the EU proposal does not go far enough to address the importance of education and outreach for the life sciences. It can be predicted that the outcome of the intersessional meeting proposed by the EU will be largely as has been reported in this Review Conference Paper.

99. Consequently we recommend that the States Parties at the Sixth Review Conference adopt the recommendations put forward in this Review Conference Paper.

[57] http://www.unog.ch/80256EDD006B8954/(httpAssets)/A464B158F971F2A3C12571F10032BE16/$file/EU_WP_07_France_UK_Intersessional_Work_Program.pdf

LIST OF APPENDICES

(available at http://www.brad.ac.uk/acad/sbtwc/ briefing/RCPapers.htm)

1 A. Video Seminar: The video recording

1 B. Video Seminar: The write-up of the session from a science journalist who attended

1 C. Video Seminar: A further information resource created by Dando and Rappert

2 A. Role Play Simulation Materials: Teaching Note

2 B. Role Play Simulation Materials: Roles

2 C. Role Play Simulation Materials: Powerpoint Slides