The Limits of Freedom in Science – Dual Use Research

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Science has always been about breaking boundaries, but can scientists go too far? Are there boundaries that scientist should not overstep? And if so who defines these boundaries? A critical area is so called dual use research that is aimed at civilian and peaceful applications, but has also potential uses in war and terrorism. The most prominent example is possibly nuclear technology, which can be used to construct nuclear power plants on the one hand and weapons of mass destruction on the other. But also everyday technologies like the global positioning system (GPS) are problematic. Here they help me to navigate my car through an unknown city, but in crisis regions the same technology is used to effectively guide missiles that kill people. Research on dual use topics is often controversial and in the end it boils down to the questions: Is the (potential) benefit greater than the risk? And where does the freedom of researchers end?

A clear example, where a product for civil use was misused for the mass murder of people, is the infamous Zyklon B – a mixture that can release highly toxic hydrogen cyanide gas. Its original use was pest control in ships and factories, but in World War II it was used – alongside carbon monoxide – in German concentration camps to murder the Jewish inmates. Around 1000 people were locked up in one gas chamber at once with Zyklon B, which released its deadly gas after the addition of water, leaving the inmates to fight for their lives – a fight they could not win.

Sure, I can condemn the discovery of Zyklon B in hindsight, but only because I know of its extreme misuse. Its original use as a pesticide helped a lot of people by protecting food and other goods from pests.

Much more recent examples for dual use research – where we do not yet know if they will be misused – come from the field of biotechnology. The NSABB (National Science Advisory Board for Biosecurity, USA) has identified seven categories of research that they call "dual use research of concern", noting that this research needs to be under close observation:[1]

1. Enhancing of the harmful consequences of a biological agent or toxin.
2. Disrupting of immunity or the effectiveness of an immunization without clinical and/or agricultural justification.
3. Conferring to a biological agent or toxin, resistance to clinically and/or agriculturally useful prophylactic or therapeutic interventions against that agent or toxin, or facilitating their ability to evade detection methodologies.
4. Increasing the stability, transmissibility, or the ability to disseminate a biological agent or toxin.
5. Altering the host range or tropism of a biological agent or toxin.
6. Enhancing the susceptibility of a host population.
7. Generating a novel pathogenic agent or toxin, or reconstitute an eradicated or extinct biological agent.

In the last years an example of point 5 – the creation of a mutated bird flu virus, which can be transmitted between mammals by the group of Ron Fouchier – has been under controversial discussion. The question is: Why would scientists create such a virus and should this research be allowed at all?

Avian flu – or more specifically A/H5N1 – has been around for a long time. Local outbreaks of low pathogenic A/H5N1 have been reported as early as 1959 in Scotland. But it was not until 2005 that a highly pathogenic strain spread over Asia and Eastern Europe followed by Western Europe and Africa in 2006. With tens of millions of birds killed by the virus and hundreds of millions killed by farmers to prevent its spread, scientific interest in the virus rose.

The controversial work of Ron Fouchiers group was first presented on a conference in September 2011 and in November of the same year it was no longer only discussed in scientific circles. The discussion had reached the public with headlines like "Alarm as Dutch lab creates highly contagious killer flu"[2] and so it was not surprising people were concerned about the research to say the least. In response to this public fear, 40 scientists signed a moratorium to pause A/H5N1 research in January 2012. This moratorium was initially intended to last 60 days and give the scientific community, as well as the public, time to evaluate risks and benefits of the research, but as the debate intensified it was extended indefinitely. In June 2012 the results of the A/H5N1 research (obtained before the moratorium) were published with all details, accompanied by critical as well as supporting voices.[3] In January 2013 the moratorium was ended and bird flu research continues since then.

Now how do I feel about this research? Mammals can already be infected with H5N1 and there are 360 confirmed deaths associated with the virus. But until now the virus lacks the capacity to be transmitted between humans. However, the researchers showed that a few mutations – that could occur in nature – can enable infections between mammals. The researches argue, that we can take countermeasure like the creation of vaccines only if we have this infectious virus. Of course I want to be prepared as good as possible for a virus like that, but do I want to *create* a threat

to fight it? What if the virus falls into the wrong hands or somehow gets out of the laboratories?
This illustrates the dilemma of dual use research quite clearly: Results from this type of research can be used for good in the right hands, but can bring great destruction in the wrong ones. This is problematic for the researchers, not because they might aim for a destructive application of their results – most of them do not – but because once the knowledge is there, it is no longer up to them how it is used by others.
It is clear that this kind of research has to be monitored and controlled, and the public debate caused a stronger focus of policy makers in the US and the EU on the issue.
For example the US Department of Health and Human Services (HHS) proposed a policy specifically aimed at "life sciences research that, based on current understanding, can be reasonably anticipated to provide knowledge, information, products or technology that could be directly misapplied to pose a significant threat with broad potential consequences to public health and safety, agricultural crops and other plants, animals, the environment, material or national security." But is dual use research always unwanted?
Of course not: Funding agencies like the US Defense Advanced Research Projects Agency (DRAPA) specifically fund military research, whose results might never the less be used for civilian purposes – like better prosthetic limbs. Dual use always goes both ways. Recently there has been a push by the US senate to reform the way NSF (National Science Foundation) proposals are reviewed focused especially on the *application* of science. This could lead to a stronger focus on the use for military purposes.
Many questions remain: What is allowed in science? Who should decide what research is beneficial for society or not? Should science, which is not in the best interest of society, be censored and forbidden? How do we make proper risk/benefit assessments for something completely new?

History has seen much controversial research and it is often impossible to predict how new inventions will affect our life for better or for worse. As scientists who insist on our freedom, we of course have to take our responsibilities very serious and make sure – the best we can – that our work benefits society.

The best way to achieve this goal is to set up very clear rules of what is ethically acceptable and what is not. We need to make sure that resources are distributed accordingly and that these rules are followed. In controversial situations we might need time to think about what our results imply for society. In these cases a research time-out and even (temporal) (self-) censorship might give us time to look at our research from different angles.

But are we not robbing us of our own precious freedom in this way? Well not really, we are only taking the freedom from those who do not adhere to ethical standards. In my opinion, freedom is a very valuable asset, but the freedom of scientists ends where their discoveries cause harm to others.

—David Huesmann

Read more:

[1] http://oba.od.nih.gov/biosecurity/biosecurity_documents.html
[2] http://www.independent.co.uk/news/science/alarm-as-dutch-lab-creates-highly-contagious-killer-flu-6279474.html
[3] S. Herfst, E. J. A. Schrauwen, M. Linster, S. Chutinimitkul, E. de Wit, V. J. Munster, E. M. Sorrell, T. M. Bestebroer, D. F. Burke, D. J. Smith, G. F. Rimmelzwaan, A. D. M. E. Osterhaus, R. A. M., *Science* **2012**, *336*, 1534–1541.