

Science and Terrorism

Post-conference after-thoughts

The World Federation of Scientists conference on terrorism divided into four working groups:

1. Cross-cultural and cross-disciplinary tools and countermeasures,
2. Cross-disciplinary challenges to the quantification of risk,
3. Cross-cultural and cross-disciplinary community responses, and
4. Cross-cultural evaluation of societal responses.

The last of these groups, under the chairmanship of Ahmad Kamal made a distinction between responses to the threat of terrorism that are *top-down* and responses that are *bottom-up*: the first being reactionary and defensive, the latter being focused on the motivations of terrorists.

For most of the conference's deliberations top-down and bottom-up were kept in separate compartments. The first group focused on issues of detection, control, resilience and prevention. The second group focused on ways to quantify the threat to those on top from those below. And the third group concentrated on preparation for, and response to, successful acts of terrorism. But at the end of the conference the fourth group's concerns were adopted in the form of a consensus that it would be desirable to form a "cross-cultural", "multi-cultural" panel.

The remit of such a panel was not clear to this participant. But the use of the word "culture" in all the group reports alludes to a supposition that conflicting values lie at the roots of the problem of terrorism. This suggests two approaches to "the problem of terrorism": top-down, the dominant culture crushes or controls the weaker; or, bottom-up, all cultures seek mutual understanding and accommodation.

Assuming that the World Federation of Scientists prefers the latter approach, a first step for such a panel might be to pursue a framework that contains the diverse understandings of the words "risk" and "culture" that emerged in the conference deliberations. The paper below makes some suggestions. It is a revised version of a paper prepared, before the conference, for the group on risk quantification. Footnotes have been added (in this font) to highlight issues that might benefit from further discussion.

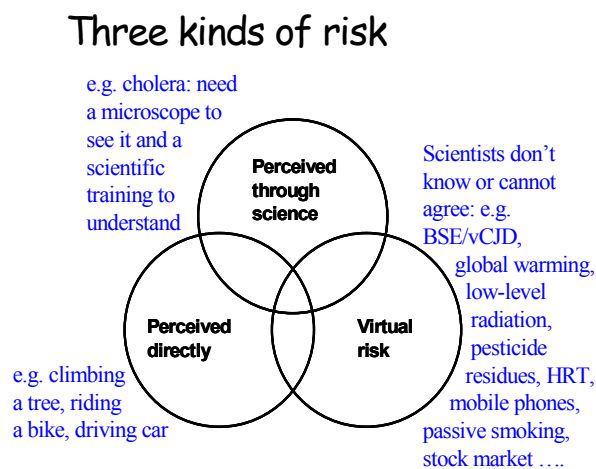
*I would like to pay tribute to Charles Penn for his superb distillation of the deliberations of Group 2 – the group addressing the challenges to the quantification of risk. The after-thoughts presented below are the product of further reflection, **not** a challenge to the accuracy of Charles' representation of our deliberations.*

Challenges to the Quantification of the Risks of Terrorism

On starting this paper, I typed "risk" into Google and got 47.7 million hits. Sampling a small fraction of the millions of websites on which the word is found will reveal that it means different things to different people. Many arguments could be eliminated from this literature if people were to be clear about the type of risk under discussion. Figure 1 presents a typology that I have found useful in clearing away some unnecessary arguments.

- *Directly perceptible risks* are managed using *judgment* – a combination of instinct, intuition and experience. We duck if we see something about to hit us and we do not undertake a formal probabilistic risk assessment before we cross the road.
- Other risks are *perceived with the help of science*. Physicists, chemists, biologists, doctors, engineers, statisticians, actuaries, epidemiologists have all helped us to see, and manage, risks that are invisible to the naked eye.
- There is a third much larger and more difficult category. Over 80 years ago Frank Knight in his classic work *Risk, Uncertainty and Profit*, distinguished between “risk” – when you know the odds - and “uncertainty” – when you don’t. This latter category might be termed *virtual risk*.

Figure 1



Terrorist threats fall into all three circles. Passengers on the London underground, urged to look out for suspect bags, and airport security personnel conducting finger-searches of passengers' luggage rely on direct perception¹. Science provides sensitive scanners, surveillance devices and passenger profiles to assist the separation of terrorists from the millions of innocent people with whom they mingle². But the greatest and most difficult threats of terrorism lie in the *virtual* circle; here we are in the realm of competing unconfirmable hypotheses³.

¹ Governments of all countries that have identified themselves as likely targets of terrorism have launched campaigns urging heightened vigilance upon their citizens.

² Most of the discussion at the conference was focused on applications of science to the detection, measurement and containment of threats and the denial of access to, or hardening of, potential targets. The first purpose of Group 2 (the quantification-of-risk group) was to “aid and inform decision making”.

³ Group 2 acknowledged that some risks cannot, *as yet*, be quantified, and stressed that “the limits of quantification should be evident.” But it went on to stress that quantification was essential to rational decision making - “We need to be able to quantify the risk of harm to societal values (such as freedom, economy etc) using comparable metrics to the quantification of both the actuarial and perceived impact of terrorism, so that a risk benefit analysis on controls and countermeasures can be undertaken.” Unresolved in the group's deliberations was the question of whether or not some risks might remain forever beyond the possibility of quantification. The majority view, conveyed in our report, was that we should “propose methods for quantifying values such as freedom and national economy, governance and stability.” ***I argue below that the pursuit of such methods is futile.***

Virtual risks are socially or culturally constructed – when science cannot settle an argument people are liberated to argue from pre-established beliefs, convictions and prejudices. They may, or may not be real, but beliefs about them have real consequences. And, as with directly perceptible risks, when dealing with them we are forced to fall back on *judgment*. When virtual risks get mistaken for risks about which science has clear and useful advice to offer, much confusion results. Pretending we know the odds when we don't generates fruitless, often acrimonious, debate.

Managing risk

Let us first look (Figure 2) at the management of directly perceptible risk. The model postulates that

- everyone has a propensity to take risks;
- this propensity varies from one individual to another;
- this propensity is influenced by the perceived rewards of risk taking;
- perceptions of risk are influenced by experience of accident losses - one's own and others';
- individual risk-taking decisions represent a balancing act in which perceptions of risk are weighed against propensity to take risks; and
- *accident losses are, by definition, a consequence of taking risks – to take a risk is to do something that has a probability of an adverse outcome – the more risks people take, the greater, on average, will be both the rewards they gain and the losses they incur.*

After an accident it is often observed, in head-shaking tones, that the person responsible did not understand the risk. But if one accepts the above definition of risk, it is possible to conclude that they did understand the risk – and their number came up. They were unlucky.⁴

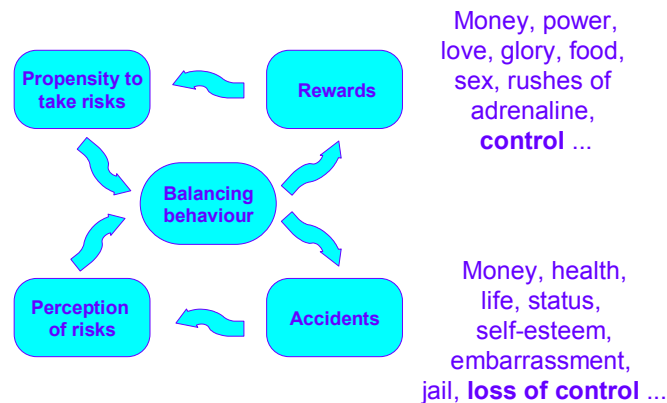
Figure 2 describes risk management as a form of cost-benefit analysis without the \$signs. Certainly money can be a significant reward, and accidents can lead to its loss. But the “rewards” and “accidents” boxes are full of many other incommensurable variables⁵.

⁴ The discussions of counter-measures reported by Groups 1 and 3 display, in terms of the model represented by Figure 2, a profound bottom-loop bias. They focus on reducing “accidents” and virtually ignore the costs of doing so – both the financial costs of extra security, but also the opportunity costs. On 12 May 2004 associations representing 95% of the US research community complained in a petition to the Government that post 9/11 visa restrictions threatened irreparable damage “to our nation’s higher education and scientific enterprises, economy, and national security” (<http://www.aaas.org/news/releases/2004/0512visa.shtml>). The unrestrained pursuit of the precautionary principle allied to a vivid imagination will bankrupt any government and, applied to the threat of terrorism, sacrifice economic efficiency and civil liberties. **Risk management is a balancing act that must acknowledge the impossibility of zero risk – and the possibility of bad luck.** See “When Bad luck is Good” - <http://www.techcentralstation.com/012104F.html>

⁵ The risks and rewards associated with terrorism include hate, anger, resentment, humiliation, freedom, triumph, vengeance and, of increasing significance, the rewards of martyrdom. **The prospect of finding a common metric for this mixed bag of variables would appear remote.**

Figure 2

The risk thermostat



Control and *loss of control* are highlighted because they create particular difficulties. Consider the case of mobile phones. The risk associated with using a handset is contested but, according to the available literature⁶, would appear to range from tiny to non-existent. Measured in terms of radiation exposure, the risk associated with the base stations – unless one is up the mast with one's ear to the transmitter – is orders of magnitude less. Yet people are queuing up around the world in their billions to take the first, voluntary, risk, while almost all the opposition is focussed on the base stations, which are seen as impositions.

What kills you matters. To the people living close to them, chemical plants and nuclear reactors are resented as imposed risks – unless you work there, in which case the risk is usually considered voluntary and perceived as much lower. But these are *benign* impositions – no one assumes the plant operators want to murder their neighbours. Terrorist threats are *malignly* imposed risks and their evil intent amplifies the perceived risk still further.

The 191 people killed by the Madrid bombers on 11 March 2004 is equivalent to the number killed in road accidents in Spain every 12 or 13 days. The grief of families and friends one might suppose is similar in both cases. The latter tragedies usually merit only a few column inches in the local press. The former evoked three days of national mourning in Spain and a 3 minute silence all over Europe.

Other examples:

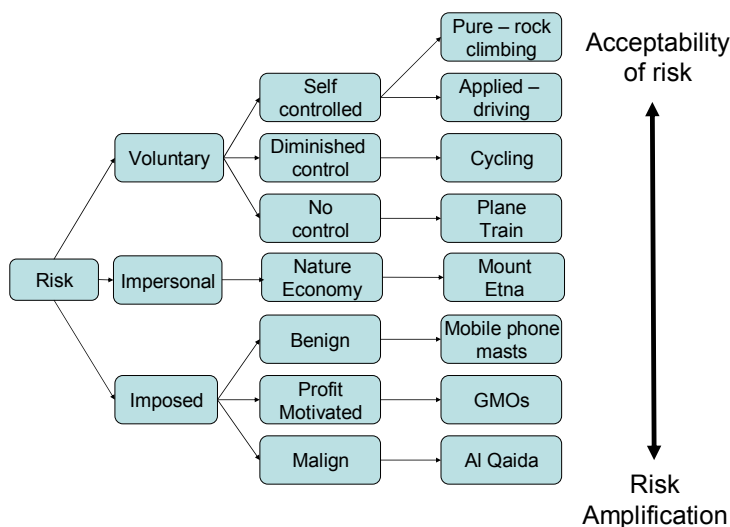
- In the 25 “busiest” years of “the troubles” in Northern Ireland twice as many people died in road accidents as were killed by terrorists. Most people in England have never seen a report on television or in the press about a road accident in Northern Ireland.
- In Israel between 27 September 2000 and 26 September 2003 622 civilian Israelis were killed by Palestinian terrorists. The *annual* road death toll over this period was about 550.

⁶ A. Burgess (2004) *Cellular Phones, Public Fears, and a Culture of Precaution*. Cambridge UP.

- In the first half of October 2002 two people per day were killed in Washington and its suburbs. They were killed suddenly and without warning by a stranger they had never met. There was no discernible pattern in their age, sex or ethnicity. Their families and friends grieved, but otherwise their fates attracted virtually no media attention. They were victims of road accidents. Over the same period someone was killed every other day by the Washington Sniper. Again there was no discernible pattern amongst the victims chosen by the anonymous killer. Their fates attracted massive media coverage all around the world and led, far beyond the vicinity of their occurrence, to extraordinary changes in behaviour – ranging from a massive policing operation to people jogging to their cars in zigzag patterns with their groceries in supermarket car parks.
- In 2003, worldwide, 23 Americans were killed by acts of terrorism (compared with 25 in 2002 and about 2800 in 2001). In each of these years about 42000 were killed on American highways.

Figure 3 suggests the way in which acceptance of a given actuarial level of risk is likely to vary with the perceived level of control an individual can exercise over it and, in the case of imposed risks, with the perceived motives of the imposer. With “pure” risks, the risk itself, and its associated challenge and rush of adrenaline, is the reward. With an applied risk such as driving, the reward is getting expeditiously from A to B. Cycling from A to B (I write as a cyclist) is done with a diminished sense of control over one’s fate. The popular reaction to plane and train crashes, in which the passenger is a passive victim, suggests that the public demand a higher standard of safety in circumstances in which they voluntarily hand over control to another.

Figure 3 Amplification of perceived risk



Risks imposed by nature or impersonal economic forces – such as those endured by those living on the San Andreas Fault or the slopes of Mount Etnas are placed in the middle of the scale because they have a wide variance. They are usually seen as motiveless and responded to fatalistically – unless or until the threat appears imminent.

As noted above reactions to risks imposed by others vary according to the perceived intent of the imposer. Intermediate between radio masts and murderers are risks perceived as motivated by greed. Big biotech companies, especially in Europe, are suspected of putting profit ahead of possible threats to the environment and consumers.

However malign intent alone cannot account for the enormous resources devoted to countering the terrorist threat. In 2002 in the United States 16,110 people were murdered, a statistic that evoked much less official concern than the threat of terrorism – a phenomenon to which I return below.

Virtual risk and perceptual filters

At the time of Britain's BSE inquiry in 1998, Stanley Prusiner who was awarded a Noble Prize for the discovery of prions, when asked whether he had changed his diet since learning about BSE said:

“I have worked in this field for 25 years ... did I go out and eat lamb chops, did I go out and eat lamb brain, sheep brain? The answer was ‘no’, but it was not based on scientific criteria, it was based on just emotion. ... At a scientific level I cannot give you a scientific basis for choosing or not choosing beef, because we do not know the answers.”

The fact that Prusiner had been trying and failing for many years to establish the reality of this risk was reason enough for me to place it a long way down my personal list of things to worry about. Perhaps I like steak more than Prusiner? Perhaps he is more alarmed about the potential damage that would result should the hypothesis linking BSE to vCJD be confirmed. The less conclusive the science, the more influential become the perceptual filters through which evidence about the rewards and risks must pass (Figure 4). These filters consist of two types of perceptual biases: one related to the type of risk (as in Figure 3), and another embodied in the cultural predispositions of the perceivers.⁷

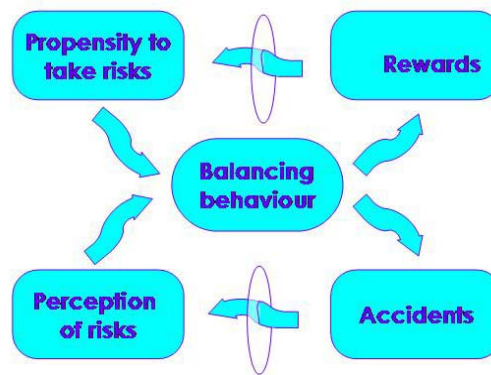
Figure 5 presents, in cartoon form, a typology of cultural filters.

- Hierarchists are committed to the idea that the management of risk is the job of *authority* – appropriately assisted by expert advisers. They often cloak their deliberations in secrecy or technical mumbo-jumbo because the ignorant lay public cannot be relied upon to interpret the evidence correctly or use it responsibly. They are extremely uncomfortable in the presence of *virtual risk* because they are, supposedly, in charge of events; unpredictability makes them nervous.⁸

Figure 4. The Risk Thermostat with Perceptual Filters

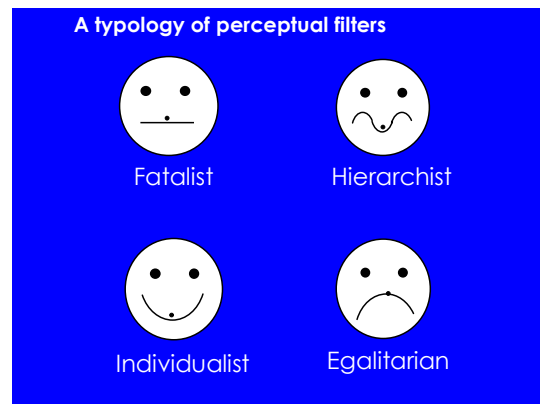
⁷ For more on this theme see J Adams, *Risk*, UCL Press 1995, and *Risky Business*, Adam Smith Institute, 1999; on line at <http://www.adamsmith.org/policy/publications/pdf-files/risky-business.pdf>.

⁸ Most of the solutions and responses to threats of terrorism discussed during the conference, in terms of this typology, can be characterized as hierarchist, i.e. measures devised for, and to be implemented by, state authorities.



- Individualists scorn authority as the "nanny state" and argue that decisions about whether to wear seat belts, drink, smoke or eat beef should be left to individuals and settled in the *market*. If science cannot settle the issue they advocate publishing everything that is known and letting the shopper decide. They are gamblers and optimistic pragmatists - if you cannot prove it's dangerous, assume it's safe.
- Egalitarians focus on the importance of *trust*; risk management should be a consensual activity; consensus building requires openness and transparency. They are advocates of the precautionary principle – if you cannot prove it's safe, assume it's dangerous.
- Fatalists (most of us most of the time) take whatever comes along. We buy lottery tickets and duck if we see something about to hit us. *Que sera,sera*.

Figure 5



These caricatures can be found in recognizable form in numerous debates about risk. Britain's Health and Safety Executive, for example, is a statutory Hierarchist charged with making and enforcing rules relating to health and safety at work. It is routinely under attack from Individualist leaders of industry for its bureaucratic strangling of free enterprise, and from consumer protection groups and environmental NGOs for not providing the public with enough protection.⁹

⁹ See Health and Safety Executive report on "Taking Account of Societal Concerns about Risk: <http://www.hse.gov.uk/research/rrpdf/rr035.pdf>

The military recognize them¹⁰. Armies, navies and air forces are inherently hierarchical institutions. In the top right-hand corner can be found Eisenhower and the General Staff concerned with discipline and logistical efficiency. Down the lower left-hand corner we find the individualistic mavericks of military history – the Nelsons, Pattons and Montgomerys – routinely at odds with the hierarchy, but rewarded with heroic status by history when their brilliance is accompanied by good luck – Napoleon famously preferred lucky generals¹¹. The fatalist corner has by far the greatest number of occupants; here we find the conscripts, the poor bloody infantry, the refugees and the civilian flotsam and jetsam of war. Finally the Egalitarians. As their label suggests, they are motivated by a communitarian ethic that places a high value on justice and fairness. Here we find conscientious objectors and freedom fighters – and terrorists.

Policing in a hypermobile world.

We now live in a hypermobile world in which unprecedented numbers of people routinely cross historic jurisdictional boundaries. Five characteristics of such a world that are relevant to a discussion of terrorism are: social polarization, anonymity, low-trust, paranoia and fatalism¹².

In societies where few people know their neighbours, or the people they pass in the street, the strained relations between haves and have-nots generate more crime or fear of crime. Policing becomes more Orwellian. *Orwellian* is the only adjective that can be applied to the vision of the UK Department of trade and Industry's Foresight Directorate. The Directorate's consultation document entitled "Just Around the Corner" surveys the potential for new technology to "create new opportunities for crime and crime prevention."

It concludes with two scenarios. The first, "TECHies" (Teleworking Executives Co-Habiting) is the Directorate's *optimistic* scenario, in which advances in crime-prevention technology out-pace advances in crime-promotion technology. It might best be described as *1984* with a *Brave New World* gloss – but which appears oblivious to Huxley's satirical intent. It depicts a world in which *identity theft* is kept in check by all-pervasive surveillance technology, DNA fingerprinting, odour detectors and probabilistic profile matching. The second "socially exclusive" scenario is less cheerful – *1984* without the gloss: most people live in walled estates and don't venture out much because "all public space is potentially hostile." With the rising tide of refugees and the destruction of the World Trade Center by terrorists the Foresight Directorate's grim vision is acquiring a global reach. Gated communities are being

¹⁰ Available on request: a PDF file of a PowerPoint presentation - *Does the Royal Navy have enough accidents?* The Modern Warship - management of safety in war and peace International Conference, London 24 - 26 November 1999.

¹¹ Also found in this quadrant of the typology is the "corporate warrior". With the growth of this phenomenon the ethics of big-business and the market place have become entwined with security issues on an unprecedented scale. See P.W. Singer (2002) **Corporate Warriors: The Rise of the Privatized Military Industry**, Cornell University Press.

¹² *Hypermobility for Royal Society for the Arts*
<http://www.rsa.org.uk/acrobat/hypermobility.pdf>

superseded by gated nations. This high-tech policing, decried by civil libertarians, is an inescapable cost of hypermobility. The alternative is ineffectual policing. If terrorists and criminals avail themselves of modern means of mobility – physical and electronic – and the forces of law and order do not keep pace, the latter become impotent. Low-trust, and its partner paranoia, foster an attitude toward Big Brother that is at best ambivalent. We are fearful of the lurking, anonymous suicide bomber, yet resentful of the FBI reading our emails and having access to our library borrowing records.

Hypermobility generates fatalism. As we spread ourselves ever wider and thinner in our social and economic activities, the geographical scope of political authority must expand in order to keep pace with the growing size of the problems that require governing, or government becomes impotent. Political authority migrates up the hierarchy from Town Hall to Whitehall, to Brussels and ultimately to completely unaccountable institutions like the World Bank and the World Trade Organisation. Individuals have diminishing influence over the decisions that govern their lives. Fewer bother to vote.

Fatalism can generate very different kinds of behaviour. The apathy of the non-voter in the affluent West might be called comfortable fatalism. There is a less comfortable form. The conditions of life for most displaced and dispossessed refugees render them fatalistic – but also resentful. Here we find potential recruits to terrorist causes.

In terms of the typology presented in Figure 5 we can find involvement in terrorism in each of the other quadrants. There are state sponsors of terrorism (Hierarchists) and cynical entrepreneurs who deal in contraband arms (Individualists). But it is the ideologically driven inhabitants of the Egalitarian quadrant who provide most of the leaders, planners and foot-soldiers of terrorist movements.

They are not, characteristically, the most deprived and disadvantaged of those they claim to represent, but identify strongly with the injustices suffered by their fatalistic constituents. A faith that can offer the rewards of martyrdom to those who sacrifice their lives for a cause that promises to right grievous wrongs provides them with a potent means of empowering the downtrodden fatalistic majority.

Terrorist targets

Until recently terrorists could be relied upon to choose iconic targets. But as these have become better protected, they have begun conferring iconic status on more mundane targets – such as bars in Bali and commuter trains in Spain. This makes the selection of victims more random, as in road accidents, or murder. If random acts of terror continue, or increase, might we become more fatalistic about them, and begin to treat them with the same indifference with which, as a society, we react to road accidents? The contrast between the response of Britons who have lived through the blitz and many years of the threat of the IRA, and that of more anxious Americans who are new to such threats – with their draconian suppression of traditional human rights at Guantanamo Bay and with the Patriot Act – provides some support for the hypothesis.

Terrorism confronts target governments with the challenge of devising a proportionate response. Risk aversion is not cost free. The Patriot Act, the US Department of Justice proclaims “has played a key part in a number of successful operations to protect innocent Americans from the deadly plans of terrorists dedicated to destroying America and our way of life.” But as the American Civil Liberties Union observes “Many parts of this sweeping legislation take away checks on law enforcement and threaten the very rights and freedoms that we are struggling to protect. For example, without a warrant and without probable cause, the FBI now has the power to access your most private medical records, your library records, and your student records... and can prevent anyone from telling you it was done.”¹³

The contrast referred to above between the response of the American Government to terrorists, and to other killers, such as motorists and murders who claim far more victims, would appear, at least in part, to be explained by the threat that terrorists pose to the social order – *and* to those who purport to maintain it. Murderers and careless drivers are not seen as threats to the ability of the government (the Hierarchy) to govern.

Terrorism: can the risks be quantified?

Risk is commonly defined in the literature on quantitative risk assessment as the product of the probable frequency of a particular event and the magnitude of its consequences, sometimes discounted by economists to allow for the distance in time before which the event is thought likely to happen. This is the approach with which companies who offer insurance against damage inflicted by terrorists are currently struggling. They are responding to the enormous uncertainties inherent in the task by spreading the risk as widely as possible¹⁴, charging greatly increased premiums, capping their liability or withdrawing from the market.

But the insurance industry's task is easy compared to the challenge of quantifying all the other non-monetizable risks – social, political, macro-economic, military, religious – embodied in the word terrorism. *Risk* is inherently subjective. It is a word that refers to the future, and that exists only in the imagination. *Terrorism* is, above all, a virtual risk. It comes with no adequate actuarial databases to assist the process of estimating the frequency of its future occurrence, and no agreed set of units by which its imagined consequences might be measured.

Can the risks of terrorism be quantified? No.

¹³ <http://www.aclu.org/SafeandFree/SafeandFree.cfm?ID=12126&c=207>

¹⁴ The quantification of risk group proposed aggregating scenarios of low-probability high-consequence events by way increasing the probability of such events happening “somewhere sometime”. This is equivalent to the risk-spreading measures adopted by the international re-insurance industry. It is a method of limited utility for problems that are not reducible to a single metric, such as cash, and in the absence of international agreements to share losses. **For self contained low-probability high-consequence terrorist events the estimated probability will be little more than a quantified expression of belief unconfirmable by subsequent events. And any attempt to estimate magnitude of the consequences will be frustrated by the lack of an agreed metric.**

Terrorism and the role of science

Peter Medawar in *The Art of the Soluble* observed

“If politics is the art of the possible, research is the art of the soluble. Both are immensely practical minded affairs. Good scientists study the most important problems *they think they can solve* (my italics). It is, after all, their professional business to solve problems, not merely to grapple with them.”

For both politicians and scientists terrorism would appear destined to remain in the grappling category. *Our* terrorists are *their* freedom fighters, and *they* also employ scientists. Terrorism is a *reflexive phenomenon* whose future course will depend on vast numbers of interactions, and reactions, in a complex web that, in a hypermobile world, contains all the world's people, who view terrorism and its threats – *and promises* – through a variety of incompatible perceptual filters.¹⁵

¹⁵ The summary of the working group on challenges to the quantification of risk observed “we must avoid being the drunk who looks for his keys under the lamp post even though he dropped them a quarter of a mile away.” Figure 1 might be re-drawn to illustrate this sentiment. Quantifying science can illuminate only a small part of the terrain over which the keys to the problem of terrorism must be sought. Our report included a diagram of “the data types that can be estimated in undertaking these [risk] assessments.” The diagram included, under the heading “motivation”, variables labelled “political, social, economic ... cultural”. It is not clear how these variables might be estimated in quantitative form. **It is the view of this conference participant, reinforced by events currently unravelling in Iraq, that the most important keys - an understanding of cultural conflicts and the motives of terrorists, and the development of the means of peaceful co-existence - are unlikely to be found under the quantitative/scientific lamp post.**

Terrorism: searching for the keys

