PRIO

Security and the ethics of uncertainty

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Horseshoes and precaution

There is an often-repeated story about Niels Bohr, the Danish Nobel Prize winning physicist and nuclear bomb maker. He kept, it seems, a lucky horseshoe mounted above his office door at the University of Copenhagen. A colleague, seeing this expression of superstition by one of the world's foremost scientist, asked 'Do you really believe that horseshoes bring good luck?' Bohr is said to have replied, 'Of course not, but they say it works even if you don't believe in it'.

The logic of Bohr's reply is both amusing and profound. It asserts a difference, a distinction, between two kinds of knowledge. On the one hand it invokes knowledge about the future, knowledge, which can be either certain, or uncertain; on the other hand it refers to certainty about our knowledge of the future, itself object to doubts about its certainty.

Bohr is not a superstitious, to be sure. He doesn't believe that horseshoes bring good fortune. But he is wise enough to understand that this disbelief in the power of horseshoes is only belief. It is not certainty. In fact, he is far more certain that he is not certain about his knowledge of the power of horseshoes, than he is in his knowledge of horseshoes themselves. About these he knows very little. He knows that he does not *know* whether or not horseshoes bring good fortune. He holds evidence, direct, objective, scientific evidence, neither that they do nor that they do not. He has knowledge, in other words, about the status of knowledge, meta-knowledge if you like.

Bohr's attitude expresses a variation on what we today call the 'precautionary principle'. It is away of acting, in full awareness that the action is carried out dependent upon a possible future. The future structures, determines, even causes the present in a complex way that we only understand in a very rough way.

Bohr's experience of the horseshoe can be linked historically to what is called 'Pascal's Wager'. The French mathematician, physicist and religious philosopher Blaise Pascal (1623–1662), famously suggested that even though the existence of God cannot be determined through reason, we are prudent to carry on as if God did exist, since we have nothing to lose and potentially everything to gain if she does exist and we carry on as if she didn't

Here again we have a kind of proto-precautionary principle. The prudent, precautionary approach to an unknown future of the universe, is to take action by allying oneself the benefit of certainty, without actually have certainty. Through the precautionary principle, in religion as in superstition, certainty is not at all a requirement, as long as an effect of certainty is possible.

Indeed, in not a few cases, certainty effects are far superior to certain certainty.

Furthermore, It is probably—no certainly—not an accident that Pascal was also central in developing what we today understand as the science of probability. The aim of his theory—just as it is the aim of

probability theory altogether, as we will see, not to better use reason, but to understand how to make the best use out of the collapse of reason, how uncertainty is the norm and how to best manage it. Pascal was history's first risk manager.

Understanding risk and making decisions about how to manage it, means understanding how to deal with uncertainty. It means understanding a certain event or situation in the face of inadequate information, taking action in the face of the unknown, and reassuring the public equipped with uncertain information.

What is exactly certainty? What does it mean? How can we derive appropriate and effective actions from the absence of certainty?

What is certainty?

The notion of *certainty* occupies a remarkable position in our understanding of what *knowledge* is. It is remarkable because, even though we would most often associate it with *truth* or *facts*, it is actually has a more complex relation to these than we might expect. Certainty is never just about the facts, never just about what is true about the world, what is in the world, etc. Certainty is always somehow different than the truth.

Four points about certainty:

First, As we know, it is possible to be entirely certain and at the same time entirely wrong. Therefore, as a first conclusion, we can say that certainty is not bound by the facts, by the world, by the truth. A good first conclusion, but it produces a new question. Why is it that risk analysts and risk managers are so concerned with certainty, when it, in objective terms, is so undependable?

Second, a more important for our concerns here, the concept of certainty is closely connected to the absence of *doubt*. A perfectly certain state is one in which doubt absence. Doubt is the enemy of certainty, but it is always lurking, always close by. Moreover, as we all know, doubt takes us down another road all together. It links the analysis to emotion, confidence, even spirituality or even religion.

Third, certainty implies knowledge *about* the knowledge, meta-knowledge, a way of saying that, not only is what is true true, but my knowledge of that knowledge is true.

Finally, certainty involves a certain conception of *perfection* in knowledge. It carries with it some aspect of completeness or of wholeness. Certainty means without imperfection. Certainty is related not only to true knowledge, but to full or complete knowledge. It is knowledge that from one objective point of view or another is true, and it is not this truth or true-ness that lies at its core. Certainty has in this sense both an *outer* existence and an *inner* core.

Certainty is (most certainly) about truth, about getting it right, about knowing or saying what is true. But it is neither merely about the facts, about what or how the world is, nor about me and you who are interested in the facts. It is somewhere in between.

In other words, what characterizes 'certainty' in Western languages is a close proximity between a state of the world and a state of the mind, the soul, the person.

Moral certainty out of probability

In today's understanding of risk and risk management probability is central. The most commonly accepted basic formula for the assessment of risk involves linking two dimensions of any potential event: (1) some measurement of the *negative consequence* of the event and (2) some measure of the *probability* of occurrence of the event. Thus, most commonly we have a formula that looks something like this:

Negative consequence x Probability = Risk

While probability is different form certainty, and yet the two are linked in an unexpected way.

Certainty, we have seen, suggests something about the fullness or completeness of knowledge, it speaks to the necessity of something, and about the absence of doubt about the truth or reality of knowledge.

Probability, as we all know, is a quantitative description of the likely occurrence of a given event. Probability addresses the happening, the occurrence

Even probability has a kind of certainty. Even though probability is a science of things that can potential happen, and have, empirically speaking, not happened. It is a usually construed as a hard science, as a way giving purely logical or mathematical meaning to random events.

By the same token, the key supposition of probability is *randomness*. Probability does not seek to chart determinism, relations of cause and effect, processes with input or output. The key to carrying out probability analysis is that all things must be equal. Indeed, a central task of the art of probability analysis is to eliminate or bracket or endogenize any input or potential input that may have a deterministic effect. **[graphic here]**

Certainty and *uncertainty* seem to have an opposite function. Certainty is not the product of *purifying* the analysis of all forms of determinism, but rather of focusing on them, cultivating their characteristics, drawing out their consequences.

How can we understand the link between these two modes of understanding the unknown? Probability and certainty, it seems, have a common origin. Our approach to them must thus be to turn back to the emergence of these concepts in the evolution of the mathematical sciences

The extraordinary turning point in the history of the notion of certainty comes through the posthumous publication of a disjointed work by the Swiss-born mathematician Jacob Bernoulli (1654-1705). Bernoulli was a contemporary of the great mathematician and philosopher Gottfried Leibniz and it was through a famous correspondence between the two that Bernoulli's contribution emerged.[1] The relationship between Bernoulli and Leibniz is often discussed in the history of science, but its consequences for today's perspectives on risk is frequently overlooked.

Bernoulli's originality was to determine the meaning of certainty for probability, to distinction Classical probability, then as now, takes the *basis* of evidence in any calculation of probability as a given, focusing instead on the ways that evidence can be combined in order to form a variety of likelihoods of outcome. In his book *The Art of Conjecture*, Bernoulli claims that 'probability', 'is *degree* of certainty and differs from absolute certainty as the part differs from the whole'. The key word here is *degree*. For Bernoulli's friend and correspondent over the years, Leibniz, had also published a breakthrough claim in a pamphlet called *On Estimation* (1698), arguing that certainty is not absolute, but rather graduated. Certainty was not yes or no, truth or falsehood. It was varied. But according to what? Bernoulli answers by asking what the notion of certainty implies for probability.

Bernoulli suggests that we need differentiate between *subjective* and *objective* certainty.[2] *Objective certainty*, he says, should be understood as necessity or, in more religious terms, destiny. In a perspective of *objective certainty* if what happens does not happen with certainty, then there is no determinism. Bernoulli, however, is not interested in causal determinism, just as we, in today's atmosphere of risk management, today, should perhaps be less interested in causality.

Bernoulli focuses on the observation that individual judgements are opposed to objective certainty. While probability, it is true, can tell us in absolute terms about the degree of objective certainty. In

contrast to the objective assessment of certainty operated by probability is a subjective certainty that Bernoulli, again following Leibniz, calls 'moral certainty'.

It is true, as Hacking points out, that the concept of 'moral certainty' can be understood as a general variety of subjectivism.[3] Many risk managers would even call it, pejoratively, 'relativism'. Yet by thinking more historically in terms of the emergence and development of the concept of *individuality,* Bernoulli not only links to future risk conceptions, but past historical experiences.

Put in a simple and direct way, the *The Art of Conjecture* aims at demonstrating where the art of thinking—understood as objective analysis—ends and where conjecture begins. In effect, Bernoulli raised the question of the *quality* of information used to make probability calculus.

It is hard to understate the shift from classical to contemporary conceptions of probability (Or rather, I mean to say that the most popular treatments of the subject today actually do underestimate it.

When the classical formula for risk is used today: Negative consequence X Probability = Risk, it is still based on a traditional conception of likelihood, but increasingly used to draw conclusions about a future, which is comes to us through filtered by a wide range of graduated factors that determine likelihood.

It is uncontroversial to claim that the 'potential damage' component of the equation is linked to the values, preferences or dispositions, variable ac

A common risk management schema, for example the one articulated by Ortwin Renn,[4] plots these two axes in order to conceptualize levels of risk. **[graphic here]**

Moral certainty corresponds to those dimensions of the risk that are not quantifiable, not reducible to the numerical calculation of probability

Ian Hacking, in his analysis of Bernoulli, approaches this problem by drawing a distinction between 'aleatory probability' and 'epistemic probability'.[5]

Aleatory probability corresponds to what we would commonly understand as ordinary or pure probability, based on randomness and driven by pure chance. It is, of course, a purely theoretical idea, but an essential one to theoretical probability.

Epistemic probability, on the other hand, is probability based on tacit knowledge. Epistemic probability is, in Hacking's analysis, meant to account for what Bernoulli calls 'moral certainty'. It is the dimension of the calculus of chance that draws on inherent knowledge or experience.

Where aleatory probability is a quality of the world, epistemic probability is a quality of the mind.

'Moral certainty' has only survived in a somewhat dilute form. The most remarkable version of it is perhaps Keynes's *Treatise on Probability* from 1921, in which he discusses the 'weight of argument'. By this he means essentially the force of evidence supporting or weakening a logical (or 'aleatory') probability. [6]

Conceptual consequences

I want now to make two claims about the place of the concept of 'moral certainty' in these issues, then conclude by suggesting what consequences these should have about how we understand security.

First, both Leibniz's discovery, in *On Estimation* (1698), that certainty is graduated and Bernoulli's follow-up in the notion of 'moral certainty' caused a significant problem for the evolution of the

notion of probability. They represented the discovery within the field of probability of dimensions relevant for the outcome of probability analyses, which could not be assimilated into the pure science of probability. They were non-mathematical foreign entities within the body of probability science. The natural pathological reflex of any science is to eject them by redefining the limits of the science. Hacking's distinction between aleatory and epistemic probability is only one late step in this process.

Yet this opposition is, in my opinion, untenable.

On the one hand, in order for the purely mathematical notions of probability to have meaning, they must impact upon the non-mathematical notions of probability, on the non-mathematical world. The one is thus deeply involved in the other.

On the other hand, the notions of 'gradation of certainty' or 'moral certainty' are both derived from an understanding of purely logical or mathematical certainty. They make no sense with out it.

In short, the opposition between mathematical and moral certainty is a false one.

Second, the nature of this opposition between the mathematical and moral will have consequences for the way we understand risk today.

We recall again the standard equation of risk analysis (cited earlier)

$$\text{Negative consequence} \times \text{Probability} = \text{Risk}$$

According to its logical rules, probability expresses logical and mathematical principles that follow from a certain conception of randomness. The probability of an undesirable event is an external or independent variable. It does not vary according to anything else in the equation. Most importantly it is entirely independent of the both the negative consequences and the risk itself.

The notion of moral certainty *disrupts* the ideal autonomy of the probability analysis.

$$\text{Negative consequence} \times (\text{Aleatory probability} + \text{Moral certainty}) = \text{Risk}$$

If we follow this reasoning, then the probability that lies inherent the standard risk model can no longer be understood as an independent variable.

If Bernoulli is right, then moral certainty should have a decisive role in the way we understand, calculate, manage and communicate risks. Moral certainty represents the human in the equation, something, as we know, that does not at all sit well with equations. Moral certainty, if such a think is valid, builds upon all the moral, human dimensions that contribute to our overall faculty of judgement: experience and foresight, culture and education, tradition and customs, capabilities, strengths and weaknesses, hopes and fears. In this perspective probability is not founded solely upon randomness, but on human-ness, something that, ironically enough, will be at best unwelcome for experts probability.

This implies that human values and human judgement not only have a role to play in setting the value of the negative consequence of formulations of risk, but also in the way understand and evaluate the likelihood of such events.

Certainty, risk and ethics

A long tradition in philosophical thinking insists on the difference between epistemology and ethics as a sub-set of the distinction between what is and what should be.

The basic premise of this distinction is a metaphysical insistence on the distinction between what is and what is not, even if what is not, actually exists in the form of a judgement about the future or the formulation of a normative claim.

Risk thinking in our time transcends this notion. Risk analysis, management and communication today more than ever before is confronted with a future that lives itself out fully and powerfully in the present.

More than ever before, value judgements involved in risk calcuations not only reflect our past and characterize our present. They reach into our future, link not to what we know and what we should do.

Transformation between certainty and ethics. In other words, how the status of knowledge about the world seems to give us indications about how we should act in the world.

I am *not* referring to certainty *about* normative statements (for example, what is it that I should do if I acquire knowledge that I should clean the garage). I am talking about the certainty or uncertainty of knowledge itself, which has normative effects, which mobilizes action. The force of the not knowing something has itself enormous power, power of a kind that is more forceful than what we do know. As Taleb argues, it is not the case, as our grandmothers told us, that 'what we don't know can't hurt us'. On the contrary: what we don't know can indeed hurt us. It forces us to act.[7]

(How my uncertainty about the weather in Stockholm encourages me to act.)

Thus, *on the one hand*, human affairs are never pre-determined, never pre-set, never pure necessity. There is always some degree of chance, of uncertainty, we always see 'through a glass darkly'. This is the very nature of consciousness.

On the other hand, our lives are not governed by randomness, falling upon us in a purely accidental way.

This is the space where ethics 'happens': between necessity and randomness. Ethics, from a certain point of view, is nothing other than making decisions in the absence of certainty. If there were certainty about our actions, if we actually knew without doubt what to do, than this could be many things, but it would not be called ethics.[8] It might not even be called human.

Ethics lives in the world of inadequate knowledge and randomness. *This* is also the home of risk analysis.

For risk analysis, ethics is not an alternative. We are not saying that it would be advantageous to incorporate ethics into risk analysis. Risk analysis *is* ethics from start to finish. If we define ethics, as I do, as making decisions under conditions of inadequate knowledge, decisions where it is the incalculable, the entirely human, that takes responsibility.

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[1] Well documented by Hacking (1975), Bernstein (1996) and others.
[2] (Hacking, 1975: 145-46).
[3] (Hacking, 1975: 147).
[4] (Renn, 2008).
[5] (Hacking, 1975: 149-53).
[6] (Keynes, 2008).
[7] (Taleb, 2007)
[8] (Derrida, 1987)