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Philosophical issues related to risks and values

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ABSTRACT
This paper begins with the assumption that the concept of risk implies an entanglement between facts and values. This is not an arbitrary assumption since it can directly be deduced from the standard notion of risk. The value-ladenness of risk raises at least two further issues: the first one concerns the scales adopted to evaluate the severity of risks; the second concerns the commensurability/comparability of risks to human health and the environment. Some additional light is shed on those issues by asking what would happen if the models used in risk analysis were understood as fictions limited by the values that they can include. From this point of view, controversies on the limited scope of standard risk assessments are not only descriptive but also evaluative.

Keywords: commensurability, comparability, fiction, models, risk, values.

Are risks value-free?

Risk is a polysemic word usually associated with the general idea of danger, harm or loss resulting from actions whose consequences cannot be completely foreseen. Its etymology is uncertain because similar words can be traced back to Greek, Latin and Arabic, but there is enough evidence on its Mediterranean origin and its specific relatedness with maritime voyage hazards such as strong storms, hidden reefs, pirate attacks, etc. (Knutsen *et al*., 2012). This ancient nautical slang was incorporated into economic and legal jargon with the rise of merchant capitalism and the increasing demand for maritime commerce insurance[2]. Today the word risk is employed in multifarious theoretical and practical contexts – for instance, statistics, decision theory, finance, medicine, engineering, ecology, climatology, sociology, etc. – which contributes to the plurality of its meanings.

In order to address the initial question, it is necessary to begin with one of the available definitions of risk, and it seems reasonable to choose the standard technical definition usually adopted by risk analysts: risk is the *expectation value* of an unwanted event defined as the product of the probability of the event – expressed as a number within the interval [0, 1] – by a quantitative estimate of its severity – that is, the magnitude of the harm (cf. Hansson, 2013, p. 9-10). It is important to note that, according to such definition, risk varies as a function of both the probability of the event and the amount of damage it may cause. For instance, supposing the probability of an earthquake in Alaska and in California were the same, the latter would pose a higher risk due to the significant difference in both the material losses and the number of people potentially affected. Thus, even for this technical definition, risk cannot be value-free since one of the equation terms must imply some measure of a value (human lives, material goods, etc.)

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[2] For more comprehensive accounts on the history of insurance contracts and life annuities, see Franklin (2015, chapter 10; 2016); Fressoz (2012, chapter 1) and Hacking (1990, chapter 6).

under risk. The philosopher Sven Hansson (2004, 2005, 2009, 2012, 2013) has often emphasized that "risk always refers to the possibility that something undesirable will happen. Due to this component of undesirability, the notion of risk is value-laden" (Hansson, 2013, p. 10).

Such value-ladenness does not mean, however, that risk is then a fact-free concept grounded exclusively upon human value judgements. Risk assessments may be seen as *socially constructed* in the same trivial sense that any human inquiry depends on social cooperation, linguistic conventions, etc., but, although it is true that people actually have very different risk perceptions about, say, earthquakes, it is beyond any reasonable doubt that strong seismic events are really much more frequent along the boundaries of tectonic plates, which in turn justifies investments in building design, evacuation alarm systems and other socially constructed safety mechanisms in cities located near geological faults. For Hansson,

> *In this way, risk is both fact-laden and value-laden […] A notion of risk that connects in a reasonable way to the conditions of human life will have to accommodate both its fact-ladenness and its value-ladenness. The real challenge is to disentangle the facts and the values sufficiently from each other to make well-informed and well-ordered decision processes possible (Hansson, 2013, p. 11).*

The fact-value distinction played an important role in early philosophical works on risk analysis since it made possible to detect hidden value assumptions usually overlooked by scientists, engineers and risk analysts.[3] More recently, Möller (2012) reframed this issue by considering the concept of risk as a *thick ethical concept*. Thick ethical concepts are concepts that have both descriptive and evaluative contents such as, say, "cruel", "brave" and "selfish" (cf. Williams, 2006). These concepts are hardly reducible to *thin ethical concepts* like "right" or "bad" because they exhibit descriptive features absent in the latter. As an illustration, to say that a certain person is selfish does not only mean he or she behaves badly but denotes a specific way he or she gives priority to himself or herself over others. Thick concepts, in short, belong to a grey zone where descriptive and evaluative aspects, related to a given state of affairs, merge into each other. According to Möller, "that something is safe is a positive feature of the entity, and that something carries a risk is a negative feature of it. But it is not simply positive or negative, it is positive or negative *in a certain way*; it has certain descriptive shape" (Möller, 2012, p. 75, original italics).

For Möller, risk should be considered a thick concept since to affirm that the situation S is risky involves both a descriptive dimension about the potentially harmful event, which amounts to the likelihood of S coming about (e.g., the probability of an earthquake and the estimated distance of its epicenter from highly populated areas), and an evaluative dimension related to a precise forecast of its severity (e.g., the number of residents probably affected, the existence of chemical industries or nuclear plants in the area). This thickness of risk involves a functional distinction less committed to the ontological assumptions present in the traditional dichotomy judgements of facts versus values judgements. Importantly, Möller reframed the discussion with an approach resistant to reductionist views: "there is an essential interdependence between the natural-descriptive aspects and the normative aspects [...] The output of recent moral philosophy is skepticism of the reductive claim for thick concepts such as risk and safety" (Möller, 2012, p. 76).

Risks and value comparisons

What is the role played by values in risk analysis? If we begin with the preliminary question "what are values?", the usual answer includes a huge variety of desirable things worthy of pursuance by human beings, from personal needs, wants and pleasures to more objective goods such as health, wealth and, above all, the preservation of our own lives. The field of axiology, understood in a broad sense, includes a constellation of further questions such as "what is the nature of values?", "are values subjective or objective?", "are there intrinsic values?", "can values be compared?", and so on. The last question, about value comparisons, is decisive to clarify how risk analysts measure and compare the severities of potential harms.

In standard risk assessments, the quantity of deaths (casualties) is a widespread evaluative measure of severity. In order to calculate the expectation value of a risk, each life is valued the same and therefore can be arithmetically added to other lives, making it possible to construct an interval scale where positive integers (1, 2, 3, …, n) define degrees of severity. So, the value of life is disposed into an interval scale because "for the expected value of harm to be well defined [...] we must be able to decide not only that harm A is more severe than B, and that B is more severe than C, but also the relative severity between them" (Möller, 2012, p. 63). In other words, if each life is valued the same, then it is possible to say that "five deaths are five times worse than one death". More importantly, this assumption takes for granted value commensurability: casualties become a cardinal unit to measure severity.

One may say that risk analysis cannot rely only on such quantitative measure. Suppose a risk that does not cause death but instead leads to limb amputation. For this case, is losing one leg equal to losing one arm? If so, is losing two legs twice worse than losing one arm? In short, is it reasonable to

[3] According to Hansson, works such as Thomson (1985), MacLean (1986), Shrader-Frechette (1991) and Cranor (1997) had as their "main purpose to expose the value-dependence of allegedly value-free risk assessments" (Hansson, 2012, p. 29).

measure the severity of limb amputation by an interval scale? One may say that the (dis)value of limb amputation depends on personal preferences: for example, for Admiral Nelson the lack of an arm was not significant for the victory in the Battle of Trafalgar, but probably a naval officer without a leg would be very much limited in his ability to command (due to ship instabilities, decks with lot of stairs, etc.); on the other hand, for the aviator Captain Douglas Badler, the lack of both legs did not jeopardise his performance in the Battle of Dunkirk, but he would hardly be a fighter ace without an arm. Although it does not sound reasonable to propose an interval scale to measure the severity of limb amputations, severity may be *comparable* by ordinal scales of preference: for Admiral Nelson, a leg was more valuable than an arm; for Captain Badler, an arm was more valuable than a leg.

The value-ladenness of risk involves the issue of commensurability/comparability of the unwanted outcomes. According to Ruh Chang, "two items are incommensurable just in case they cannot be put on the same scale of units of value, that is, there is no cardinal unit of measure that can represent the value of both items" (Chang, 2015, p. 205). As to incomparability, "two items are incomparable just in case they fail to stand in an evaluative comparative relation, such as being better than or worse than or equally as good as the other" (Chang, 2015, p. 205). From a logical point of view, incomparability entails incommensurability but the reverse does not hold. In what specifically regards risks, Nicolas Espinoza describes those relations in the following way:

> *I shall say that two risks are evaluatively incommensurable if and only if there is no cardinal scale with respect to which the severity of both risks can be compared. In addition, two risks are evaluatively incomparable if and only if it is not the case that they can be ordinally ranked, which is to say that is not the case that one risk is better, worse or equally as good as the other. Note that incommensurability thus defined does not necessarily imply incomparability; the failure to compare two risks cardinally, for instance the failure to say that risk A is, say, three times more severe than B, does not automatically imply that we cannot say that risk A is more severe than risk B. It may be helpful to view the distinction between incommensurability and incomparability,* ***namely that between ordinal and cardinal measurement****, as analogous to the distinction between quantitative and qualitative comparison (Espinoza, 2009, p. 129, emphasis mine).*

In order to point out a problem concerning risk comparisons, let's denominate as *cardinalizable* those values which can be arranged into interval scales (e.g. cardinal utility, money, number of casualties, etc.), and let's denominate as *ordinalizable* those values which can be arranged into ordinal scales (e.g. ordinal utility, preferences, rankings). This distinction is usual in statistics, economics and related disciplines: for instance, the notion of cardinal utility has a long history going back to Bentham and it was further developed by neoclassical economists and by Von Neumann and Morgenstern; regarding the notion of ordinal utility, it is widely used by contemporary economists and Bayesian statisticians.

Nevertheless, there is a background question on whether every value can be adequately disposed into interval or ordinal scales. There is no impediment to suppose that certain values could not be arranged into any type of scale, resulting in their incomparability. For example, there are discussions about value incomparability in ethical debates concerning *incompensable harms*[4] (e.g. Thomson, 1986; Shrader-Frechette, 1991) and in empirical studies on the so-called *protected values*[5] (e.g. Baron and Spranca, 1997; Tetlock *et al*., 2000). As a matter of fact, "some people think that some of their values are protected from trade-offs with other values" and they hold those values "as possessing infinite or transcendental significance that precludes comparisons, trade-offs, or indeed any other mingling with bounded or secular values" (Espinoza, 2009, p. 130-131). And in addition, "laypersons often feel that it is unethical to assign monetary prices to risk imposed upon humans or the environment" (Espinoza, 2009, p. 130). This issue embarrasses the method of cost-benefit analysis (CBA), which tries to compare risks using assignments of a monetary price as a common measure for their severities:

> *In a typical CBA, two or more options in a public decision are compared to each other by careful calculation of their respective consequences. These consequences can be different in nature, e.g. economic costs, risk of disease and death, environmental damage etc. In the final analysis, all such consequences are assigned a monetary value, and the option with the highest value of benefits minus costs is recommended or chosen [...] Cost-benefit analysis is controversial and has repeatedly been subject to*

[4] For Thomson, "Now if you cause me an incompensable harm, you cause me a harm which (by definition) no amount of money in damages will compensate me" (1986, p. 158). In the same line, for Shrader-Frechette, "If we consider Judith Jarvis Thomson's notion of 'incompensable harms,' harms so serious that no amount of money could possibly compensate the victims (e.g., for a loss of a species or habitat), then it appears that extinction and death, at least, are obviously 'incompensable harms'" (1991, p. 115).

[5] For Baron and Spranca (1997), "Protected values are those that resist trade-offs with other values, particularly economic values. We propose that such values arise from deontological rules concerning action. People are concerned about their participation in transactions rather than just with the consequences that result. This proposal implies that protected values, defined as those that display trade-off resistance, will also tend to display quantity insensitivity, agent relativity, and moral obligation".

severe criticism not least from philosophers. Most of this criticism has focused on two practices. One of these is the assignment of a monetary price to (the loss of) a human life. The other is contingent valuation, in which the prices of non-market goods such as environmental assets are determined by asking people what they are willing to pay for them (Hansson, 2007, p. 163-164; cf. Espinoza, 2009, p. 130).

Against such criticisms, experts and decision-makers tend to argue that cost-benefit analysis permits to estimate how much should be spent in actions of risk prevention and risk management, with the intention of allocating finite resources to minimize harms of different sorts and magnitudes. From this point of view, sacred and protected values may be of interest to psychologists and philosophers, but "if incomparability is widespread, then what we do in most choice situations fall outside the scope of practical reason" (Chang, 2015, p. 206). Cost-benefit analysis takes for granted that values under risk can be measured (by means of interval scales) or compared (by means of ordinal scales) because without "accurate comparisons in terms of severity, we will not be able to perform accurate and cost-effective trade-offs between risks and their associated benefits" (Espinoza, 2009, p. 131). As stated above, the procedure of comparing values disposed into interval or ordinal scales is also taken for granted in several other fields of scientific inquiry. Risk analysts just follow the same established path, despite the worry on the part of some laypersons and philosophers.

Limitations of standard risk assessments

Technological risks are particularly problematic for standard risk assessments. The main problem concerns the lack of statistical data to estimate the objective probability of potential harms. Standard risk assessments have been successfully applied to natural catastrophes, occupational accidents, shipwrecks and traffic accidents, etc., for which there are immense statistical recordings. The potential harms of technological innovations cannot be estimated in the same way for an obvious reason: they never occurred before. Risk assessments on technological innovations require models based on conditional probabilities subjectively estimated by engineers and risk analysts. Indeed, due to the lack of previous statistical data, technological risks are not risks properly speaking, but uncertainties.

There is voluminous literature on the distinction between risk and uncertainty according to the type of probabilistic knowledge available. The distinction involves several complications which have been extensively discussed in decision theory, in economics, in statistics and in philosophy (see Hájek and Hitchcock, 2016). But besides the type of probabilistic knowledge available, the values involved also influence our choices. Roughly speaking, the epistemic uncertainty related to our limited probabilistic knowledge comes accompanied by an evaluative uncertainty related to our value judgements. Such evaluative limitation should not be disregarded in matters such as, for example, biotechnological innovations whose large-scale side effects can be irreversible (Garcia and Martins, 2009; Lacey, 2005, 2009; Mariconda, 2014; Martins, 2012). Consider the following passage about risk assessment of transgenic agriculture:

Standard risk assessment has kept some potentially harmful varieties of transgenics from being marketed. Nevertheless, it is unable to address, among other things, (a) potential social risks – e.g. monopolization of the world's food supply, undermining the conditions for other forms of farming, impoverishment and dislocation of small-scale farmers – and (b) potential risks to the environment occasioned by transgenics in virtue of the fact that usually they are commodities and integral to current projects of large corporations, and (c) ecological and long-term environmental risks that arise because of social mechanisms, e.g., the failure (or inability) of farmers to adhere to regulations that are assumed to be in place when judgments of risk in practice are based on standard risk assessment (Lacey, 2009, p. 853-854).

Lacey has detailed the controversies on transgenics in dozens of works, but here I can only briefly outline the general lines of his argument presented in "The interplay of scientific activity, worldviews and value outlooks". For Lacey, biotechnologists confine their research within a *decontextualized approach* (DA) in which values related to social well-being and environmental safety are excluded and "empirical data are selected, sought out [...] and reported using descriptive categories that are generally quantitative, applicable in virtue of measurement, instrumental and experimental operations" (Lacey, 2009, p. 843). Consequently, standard risk assessments tend to focus only "on the *quantitative and probabilistic study of (anticipated) hazards* for health and the environment over the relatively short time scale of laboratory and controlled field studies, deploying categories acceptable within DA" (Lacey, 2009, p. 853, italics mine). The decontextualized approach goes hand in hand with a materialist worldview deeply informed by the values of technological progress. Nevertheless, for Lacey, materialism and the values of technological progress are insufficient "to justify adopting the decontextualized approach virtually to the exclusion of conducting research under competing strategies" (Lacey, 2009, p. 851). In addition, one may argue that socio-environmental values are extremely important and indeed strongly preferable to the values of technological progress, up to the point that no further benefits from transgenics could balance the risks imposed on health and on the environment by their use. In the last years such an argument against transgenics, which evokes the precautionary principle, has begun to inform an increasing number of restrictive policies in the European Union.[6]

I wish to conclude with the suggestion that some additional light is shed on this issue if we consider that risk analysis, like other scientific practices, requires the construction of models which must be assumed to be *fictions*. Several authors such as Cartwright (1983, 1999, 2010), Contessa (2010), Fine (1993), Godfrey-Smith (2006, 2009), Frigg (2010a, 2010b, 2010c), Leng (2001), Morgan (2001), Rahman and Redmond (2015) have discussed such approach – usually called fictionalism in philosophy of science[7] – according to which "scientific textbooks and journal articles abound with passages that appear to be meaningful plain descriptions of physical systems […] but which do not describe *actual* systems and which would not be taken to do so by any competent practitioner in the field" (Frigg, 2010b, p. 257, original italics). The analogy between models and fictions is controversial (see Giere, 2009) but, in the context of risk analysis, how could we anticipate potential harms without constructing risk models which are assumed to be fictions? Could we make more realistic experiments intending to know the real extent of risky situations? From a descriptive point of view, fictionalism does not require from risk analysis more than the latter can offer, namely, imaginary risk scenarios.

More important, however, is the claim that "we will have to distort the true picture of what happens if we want to fit it into the highly constrained structures of our mathematical theories" (Cartwright, 1983, p. 139). For Cartwright, "a model is a work of fiction" in the sense that "some properties ascribed to objects in the model will be genuine properties of the objects modelled, but others will be [...] introduced into this model as a convenience, to bring the objects modelled into the range of the mathematical theory" (Cartwright, 1983, p. 153). Specifically concerning standard risk assessments, it is important to realize how they are decisively constrained by the way in which risk analysts take values into account. Risk analysts take for granted some idealized assumptions on value measurement, commensurability, and comparability, which have been usual in contemporary social sciences and economics; nevertheless, the point is that those idealized assumptions limit the scope of standard risk assessments. So, significant potential harms from technological innovations may not be anticipated by models/fictions constructed to find out only the risks whose severity measures fit in the equations of standard risk assessments.

To regard risk models as fictions does not mean they are useless mathematical tools. The intention is to keep in mind how deceptive they may be in virtue of the limited range of values which they include. The value-ladenness of risk implies issues which indeed affect every field of scientific inquiry that demands some procedure of value measurement. The models used in standard risk assessments are fictions, like other scientific models, in the sense that they take for granted some idealized assumptions on values that define which potential harms we will anticipate and which ones we will not. This is particularly relevant in controversies about technological innovations, not only because determining the probability of those potential harms is a hard task, but mainly because we can fail to evaluate the severity of those harms.

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[6] See the legal report of Theresa Papademetriou (2014), Senior Foreign Law Specialist: "The European Union (EU) has in place a comprehensive and strict legal regime on genetically modified organisms (GMOs), food and feed made from GMOs, and food/feed consisting or containing GMOs. The EU's legislation and policy on GMOs, based on the precautionary principle enshrined in EU and international legislation, is designed to prevent any adverse effects on the environment and the health and safety of humans and animals, and it reflects concerns expressed by skeptical consumers, farmers, and environmentalists".

[7] According to Frigg, "The core of the fiction view of model-systems is the claim that model-systems are akin to places and characters in literary fiction. When modeling the solar system as consisting of ten perfectly spherical spinning tops physicists describe (and take themselves to be describing) an imaginary physical system; when considering an ecosystem with only one species, biologists describe an imaginary population; and when investigating an economy without money and transaction costs economists describe an imaginary economy. These imaginary scenarios are tellingly like the places and characters in works of fiction like Madame Bovary and Sherlock Holmes. These are scenarios we can talk about and make claims about, yet they don't exist" (2010c, p. 101).

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