# Risk: a fiction

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> Alice laughed. “There's no use trying,” she said: “one *can’t* believe impossible things.”
>
> “I daresay you haven't had much practice,” said the Queen. “When I was your age, I always did it for half-an-hour a day. Why, sometimes I've believed as many as six impossible things before breakfast. …” (Carroll 1939 p.184)

**Abstract**

*Uncertainty creates anxiety so attempts have been made to reduce it using mathematical techniques. In the electronics industry the very large quantities of devices processed have provided reliable statistics and the opportunity to employ statistical methods. However, in fields such as decision-making and risk assessment there are strong criticisms of the probability calculus that have been triggered by discrepancies between the analysis of experts and non-experts. A radically different alternative is to view risk assessment and decision-making as exercises in rhetoric centred on storytelling language games. And to see the risk assessors as part of a political network attempting to influence action.*

## Uncertainty

Greek legends are littered with episodes endured by victims of the contingencies of the world — contingencies attributed to volatile and angry or jealous gods. In Aeschylus’s tragedy, Agamemnon, the chorus tells of the vulnerability of people and the unruliness of the gods:

> “Things are as they are.
> What must happen, must happen.
> No offering, no tears
> Can turn aside the anger of the gods” (Aeschylus 1991 §70–80)

People were unable to divine details of the plans of the gods and only had access to partial reports of what the gods intended. As the chorus asks,

> “Clytemnestra
> …
> Tell us what you can,
> As much as the gods allow.”(Aeschylus 1991 §80–100)

Thus the legendary Greek people struggled in a climate of uncertainty. They saw omens, but could only speculate about their interpretation as when Calchas, the prophet, read foreboding into the killing of a pregnant hare and her unborn young (Aeschylus 1991 §110–140). Such prophesies transform omens into mysterious stories then the legend’s unfolding narrative resolves the mystery by replacing uncertainties by accounts of worldly events.

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An inability to construct an account of the future can become a debilitating pre-occupation as people face an 'intolerable torture of uncertainty' (Orczy 1905 Chap.31) which grows into an obsession about imaginable dangers. Uncertainty is a feeling and a fount of anxiety that can also stir anticipation and promote excitement so 'risk becomes as necessary as the dram to the drunkard' (Eliot 1900 p.243) and 'wonderful in retrospect' (Chesterton 1927 p.281). Contingency can lead people to express 'a fondness for risk' and add piquancy. Thus, uncertainty, anxiety and its distractions Goldhaber 1997; Lanham 1994) generate social forces, which in political and domestic contexts can be deliberately manipulated to afford control.

## *Control*

The Thirty Years War was a struggle for religious supremacy; it devastated Central Europe and set intellectuals on a quest for certainty and rational consensus (Toulmin 1990 pp.89–117). Descartes, for instance, separated rational choice from causation while Liebniz sought a language to 'reveal the reason in all things with the … certainty … hitherto possible only in arithmetic' and to offer 'mastery of … morals … according to an infallible method of calculation' (Liebniz 1951) . Later Laplace reinforced these seventeenth century views so that ignorance of causes or of the state of the world could be portrayed as primary sources of uncertainty.(Laplace 1951) Engineered systems developed from scientific models, have sustained the view that 'science … given enough information and powerful enough computers … could predict with certainty'.

In this setting any political action that proceeds without a proper degree of knowledge looks reckless.

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Powerful criticisms have been launched against determinism that point out the unending regress arising from attempts to make predictions. Karl Popper exploited Gödel's famous theorem to illustrate that solved problems simply 'beget new and deeper problems' (Popper 1982 p.162). Similarly the Nobel Laureate, Herbert Kroemer, concluded that his most important message is about the 'Futility of predicting applications' (Perry 2002) for a technology.

Inevitably any prediction, even if based on perfect laws must be cut short. Wittgenstein expressed the consequences succinctly by writing 'We just *can't* investigate everything, and … we are forced to rest content with assumptions' (Wittgenstein 1962 §343).

Any analysis exploring prospective actions will be bounded, and based on assumptions about the situations in which action will be taken. Outside of these imagined situations and actions, the analysis may have nothing to say. The assumptions may be quite arbitrary but their explicitness simplifies and makes analysis feasible.

A common strategy in engineering is to transform the bounds placed on the analysis into physical or social barriers that limit the scope for legitimate action. In electronics manufacture, atmospheric purity is regulated, positions of photographic masks are controlled and personnel are asked to follow rules, for example, about their clothing. Testing and rejection eliminate deviant materials and components.

In a particular semiconductor plant a faulty etching tool caused the scrapping of nine hundred wafers. Afterwards the managers realised that their explanation of factory operations embraced assumptions that were not necessarily valid. Their response was to carry out routine checks to detect when their assumptions were breached so they had a warning of when faults might be introduced. (DePinto 1996)

The strategy is to externalise uncertainty, or ignorance, and physically, contractually or rhetorically set it outside the boundary of a project. It is an attempt to create an idealised deterministic system. But the necessary degree of control is not always acceptable or achievable, and a culture of blame then forms around unanticipated or uncontrollable uncertainties falling within the system boundary which are described as the results of ignorance or faulty reasoning. It was suggested, for example, that ‘over-confidence and faulty reasoning caused the Three Mile Island and Chernobyl disasters’(Sutherland 1992 p.252).

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Cities are archetypes of large technological systems, which are intended to protect people from the vagaries of the world. In the tragedy, Antigone, Creon, the king, treats his city metaphorically, as a ship that protects its voyagers from stormy seas. Creon sees the enforcement of rigid laws as the way in which the city will make progress, and he proclaims,

> Our city is a ship that steers us home.
> Strong laws will once again puff out her sails.(Donnellan 1999 p.28)

But Antigone is a tragedy partly because Creon is enraged by disorderliness and measures everything in terms of loyalty to the city.

Externalising the disorderly elements by killing or exiling the offenders is Creon’s only strategy for dealing with breaches of rules. He is unwilling to amend the laws or reinterpret them. Creon does not seem to recognise that a city encapsulates a tangle of relationships between individuals with different often conflicting, inconstant, inconsistent interests. Tragedy emerges from Creon’s impoverished view (Nussbaum 1996 p.60) and his grotesque ‘ambition to simplify and control the world’(Nussbaum 1996 p.53).

## *Probability*

The probability calculus allows people to calculate distributions of possibilities and to derive statistics about populations of objects and events and yet admit to the unpredictability of individual events. Recourse to the probability calculus provides an illusion of determinism and causality by dealing in statistics and relationships between statistics. Physicists have confidentially adopted the mathematics of probability and treat ‘the most fundamental microphysical processes’ as ‘probabilistic in nature’ (Paulos 1989 p.134). Individual electrons or photons are assumed to be unpredictable while the outcomes of repeated experiments form an envelope of possibilities that can be calculated to an astonishing degree of precision and lend credibility to the use of probability to describe uncertainty.

For one advocate,

> The only satisfactory description of uncertainty is probability (Lindley 1982)

Maxwell emphasised the utility of probability when he wrote the ‘Calculus of Probabilities … is the only ‘Mathematics for Practical Men,’ (Maxwell 1850). A ‘failure to use elementary probability theory and statistics’ is regarded as a contribution to ‘human irrationality’ (Sutherland 1992 pp.320–321), consequently, an unwillingness to use the probability calculus appears misguided.

David Hume(Hume 1748) presumed the mind anticipates ‘various possibilities’ and if several seem to lead to the same event then that event ‘begets … the sentiment of belief’ and will have an ‘advantage over’ those events that recur ‘less frequently to the mind’. This interpretation makes probability a measure of a ‘degree of belief’ (Bigün 1995; Aven & Pörn 1998) and depends on what individuals imagine is possible.

Hume also assumed our knowledge of causes is gained through experience. But where similar causes generate different effects, all the effects must be considered 'when we determine the probability of the event'. He offers as examples the uncertain effects of rhubarb and opium and concludes that confronted by a variety of effects 'we … must assign to each of them a particular weight and authority, in proportion as we have found it to be more or less frequent'

Linking probability to the frequency of occurrence of events gives it an empirical basis and some people take the historical frequency as the measure of probability. Hume thought that we customarily 'transfer the past to the future' and therefore transfer experience of the frequency of particular consequences into our imaginings about the future.

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An attraction of probability theory is that it provides a calculus for combining probabilities and deriving statistics. Savage (1972) created a model for decision making that aggregated the product of probability of an outcome and the consequence of the outcome which has provided the basis for mathematical approaches to risk analysis(EPA 1997 p.1; Palmer, Carlstrom & Woodward 2001).

The point of calculating risk is to influence action. An agenda might be set. Speculate about actions; imagine situations in which action might occur; estimate the likelihood of each situation; work out the consequences of the actions; identify the preferred combination of likelihood and consequences; select, execute and monitor the preferred action. In other words, derive a model of what is intended to happen and attempt to control the circumstances so that the model remains valid.

## *Electronics*

Because manufactured products rarely comply with their designer's idealised descriptions, expectations are shaped to tolerate variations. Specifications are commonly expressed in statistical terms. A current specification, for instance, asks that 99.99% of a batch of semiconductor devices continues to function, over a period of ten years. (Alam, Weir & Silverman 2002)

The semiconductor industry, which has operated for fifty years, produces wafers each containing dozens of chips and each chip containing perhaps millions of transistors. Such extensive experience builds trust in empirically corroborated theories.

Broadly, defects are occasionally detected in individual circuits. But a single fault could have a myriad of causes. However, theoretical statistical relationships coupled with data from a number of circuits can identify likely causes of failure in the past or the future.

For instance, the insulating layers in some transistors are around eight atoms in width and faults arise as various processes attack these layers. Theoretical and experimental work has shown that this type of failure operating at elevated voltages accumulate in a batch of transistors faster than with transistors operated at normal voltages. Thus statistics obtained from accelerated tests with a sample batch are extrapolated using theory to estimate the accumulation of long-term failures in normally operated transistors. (Alam, Weir & Silverman 2002)

Crucially, the relationships embedded in such predictions are statistical, although explanations often retain the customary linguistic framework of causality.

The rate of development of the electronics industry encourages others to adopt the same analytical techniques but extrapolation to other domains is not always feasible. Testing, especially destructive testing it is not always acceptable and dealing with batches rather than individuals especially where remedial action involves potentially damaging processes is often unacceptable.

## *Critique*

Subjective probability has had its critics; R.A. Fisher, the renowned statistician, wrote that it reduces probability to a measure of '[p]sychological tendencies' and is consequentially 'useless for scientific purposes' (Fisher 1951). A subjective probability is just a compact way of expressing an opinion that has the appearance of a measurement. However, although some features of the scale of measurement are often described, many details are omitted. There are therefore few assurances that consistent values of subjective probability can be derived or calculated. In many situations people simply do not agree on the probability values to be assigned and consequently there are pleas for 'rules' that can help the analyst to assign the 'right' numerical values'(Aven & Pörn 1998) or for the 'calibration of expert's assessments' (Bigün 1995).

The interpretation of probability as a frequency is also vulnerable since an imaginative leap of faith is required to use experience of frequencies as a guide to the future. With extensive experience, probability estimates might be considered to be reliable but with rare or imagined events accurate figures for frequency of occurrence cannot be derived from experience.

In spite of the apparent rational basis for risk assessment it is reported that 'there is no consensus on how the risk should be expressed and interpreted'(Aven & Pörn 1998). The primary constituent of risk calculations, probability, also lacks definition since '[p]rofessional probabilists have long argued over what probability means' (Cosmides & Tooby 1998). Researchers often assume probability is 'immediately translatable into mathematical probability … however, probability has more than one meaning' for example, non-specialists construe probability as 'possibility, believability, credibility'(Hertwig 2000).

Unfortunately, some commentators have also concluded 'there is no rational way for choosing a particular probability measure' (Cooke 1991 p.87) and besides 'people do not appear to follow the calculus of chance or the statistical theory of prediction'(Kahneman & Tversky 1973) and as a result there is a difference between 'human responses' and the 'various models of decision making and rational judgement'(Stankovich 2001) .

According to Stanovich and West, 'people assess probabilities incorrectly, … they do not calibrate degrees of belief, they overproject their own opinions … and they display numerous other information processing biases'. People's miscalculations have been blamed on 'systematic irrationalities', 'processing mishaps' or 'computational limitations'(Stankovich 2001). Discrepancies in experiments may also be due to experimenters who are using 'inappropriate norms' (Vanas 2000) or put more bluntly, the wrong answers, or perhaps the blame is to be 'put on the human mind, not the statistical model'(Gigerenzer 1991). Even the specialists will 'make contradictory claims about which answer is normatively correct'(Cosmides & Tooby 1996). No conclusion can be drawn except that 'different probabilistic theories, or different applications of the same theory to a situation, may produce different norms, and there is no universal law to dictate which one is right' (Goodie & Williams 2001) .

Carrying out a risk assessment requires time and effort and this inevitably means that it is impractical to adopt idealised models of reasoning. Indeed it is likely that a rational analysis of decision-making that takes into account bounds on resources would not impose the full rigour of probability theory on the decision maker. Todd and Gigerenzer(2000), for instance, propose a framework of simple and efficient heuristics that emphasise the value of simple yes or no decisions in making judgments.

Conversations about risk are aimed at asserting which is the best course of action, thus questions of risk are ethical questions. Once risk analysis is exposed as a branch of ethics, it becomes clear that matters of risk are liable to controversy and demand a practical politics to resolve disputes in good time and not mathematics.

### *Difference*

In the course of taking a decision people are liable to disagree over which actions are feasible, what circumstances may pertain, the relative likelihood of these situations and the outcomes

As a study has shown, there are differences in 'risk perception' between 'ethnic groups … for a variety of environmental, health, and technology-related issues'. The differences in 'worldview', for example, mean that even if people from different groups agree on the probabilities and outcomes, they are liable to disagree on how they are combined. (Palmer, Carlstrom & Woodward 2001)

Views change. As Wittgenstein remarked, 'At certain periods men find reasonable what at other periods they found unreasonable' (Wittgenstein 1969 §336). The dynamics of knowledge and language means people weighing up risk in different times and places will call upon different knowledge claims and are liable to disagree about what are acceptable choices.

Experiences reveal possibilities. So it is unsurprising that the response to a researcher's question: 'How likely is it that you will be assaulted?' was affected by 'personal experiences …, accounts from friends and relatives … or graphic episodes reported by the news media' (Kverno 2000). Familiarity, though, can make people callous. In the Threepenny Opera, Mr. Peachum says,

> '…few things … stir men's souls … but … after repeated use they lose their effect … Suppose , for instance, a man sees another man … with a stump for an arm; the first time he may … give him tenpence, … the second time … fivepence, and … a third time he'll hand him over to the police'(Brecht 1994 p.95)

Differences also occur between people situated in different roles; between, for example, decision-making bureaucrats and individuals affected by the decision. The bureaucrat may have an impoverished model of the affected people and may see individuals simply as objects in a category bounded in time. If the outcome is tragically, 'loss of sight' this may close the matter for the bureaucrat but it is far from the end of the matter for the victim. The bureaucrat may measure his success in terms of the aggregate effects of the planned actions however individuals will have different preoccupations from, for example, their insurers who seek 'better data on probabilities' in order to 'reduce their chances of insolvency'(Moreau 2001).

Bureaucrats may have access to assistants and technological aids and may use one of the 'many models of rational inference' which assume the mind is boundless, but even the well-supported bureaucrat will be confronted by limitations. Nevertheless a rational theory may help to plan, execute and manage the decision-making, while a model of risk assessment that uses 'the laws of probability to describe or prescribe sound reasoning, judgement and decision making' (Todd & Gigerenzer 2000) may be beyond the capacity and experience of an individual. Thus a scheme for the efficient organisation of a team of decision makers may not be relevant for an individual forming an opinion, and their different methods may lead them to different conclusions.

In the process of performing a risk assessment categories are chosen, data is collected for people or objects fitting the category and statistics about the population is derived from the data. Engineers and scientists, it is reported, are trained to see probability as something that 'exists — independent of the analyst' (Aven & Pörn 1998) as a property of the thing being analysed. In this way the individual objects or people can become misleadingly stereotyped with the properties of the group. Statistics thus become a means of labelling existing categories rather than a means of characterising uncertainty and hence differences. This is convenient for those whose objects of interest are communities and mass markets — people who describe themselves as manufacturers, service providers and public servants — but is liable to alienate individuals.

## *Fiction*

Studies of rational and objective means of decision-making have largely demonstrated people's tendency to provide subjective responses. Arguments based on quantitative assessments are not always influential and dramatists are well aware that people will often react in a disproportionate and individual way to threats. Within a framework of storytelling, the probability calculus and risk analysis techniques provide a severely limited way of compiling and telling stories that may nevertheless inculcate strong beliefs amongst experts but leave non-experts cold.

When you talk about risk and probability you are saying, following Hume, that from your point of view there are many possible prospects. The description that you might provide for each potential outcome is a fiction in which you appear as a character. If a characterisation brings satisfaction, you may wish that the story was integral with accounts of you life.

A fiction may offer a desirable outcome, while similar, derivative fictions may furnish unattractive outcomes. If the fictions are plausible alternatives then you cannot be sure which is the account that you might apply to your future experiences and you are uncertain about the stories that will prove relevant. Where there are alternatives and one of the stories has an undesirable outcome then people are inclined to refer to risks. When you are certain of an unpleasant outcome there is no risk only tragedy. Discussions about risk, therefore, are sustained by an anthology of stories with good and bad outcomes. When the little boy, 'Aaron shrank back a little, and rubbed his head against his mother's shoulder, but still thought the piece of cake worth the risk of putting his hand out for it.'(Eliot 1885 p.83), he was facing the alternatives of having no cake, having cake, being punished and having the cake taken away with each option providing a potentially different narrative.

The consequences and options are not always spelled out but presented in a schema for constructing a selection of fictions. An array of scenarios could, for example be derived from a sentence that says: '[b]ecause of the risk to the airplane's digital flight control systems, some airlines have banned the use of personal computers with mice, because the mouse cables … emit potentially disturbing radiation'(Winer 1993 p178).

You can construct or validate stories by exploiting a theory. This applies to the application of science, to literary formulae and to machines, which are embodiments of formulae or designs and which constrain the future. Theories, tradition and common sense impose constraints on what are considered to be legitimate stories and help you construct accounts that sometimes match memories of your experiences, but theories also help you create satisfying accounts caused only by an encounter with theory. Where the fiction is plausible and told with authority, you may come to believe that it is a potential account of events that you have yet to experience.

With a theory you can project your stories into the future constructing for example a rhetorical pathway between an undesirable outcome and its causes. You might then act to change the world in order to validate the telling of a different story. There was a suggestion that '[c]omputers at banks … could be disrupted if the Dow Jones Industrial Average tops 10,000' (Taylor 1998) and 'their systems interpret it as 1,000 or 0,000' (Kyte 1998). It is anticipated that '[t]his could prompt computers to launch programmes that would automatically sell their portfolios or make mistakes in their calculations' (Taylor 1998). An obvious counter-action would be to reprogram the computers and thus validate a desirable alteration to the narrative.

If a story augurs a good future then you might prefer to keep it secret while you act to secure your position as the beneficiary.

Novels often create tension by describing the unfortunate fate that could happen to their characters and offer prototypes of risk stories. Characters have faced ‘the risks of marriage’ (Eliot 1900 vol.I p.41) and have risked losing ‘egoism’(Eliot 1900 vol.II p.54), their ‘life alone upon the moor’(Doyle 1901–2 p.127), their ‘scientific reputations’(Doyle 1919) or their ‘happiness’(Austen 1926 p.107). In these circumstances we find it appropriate to use the word risk although in the event no harm may befall the imagined victims. Embarrassment is an adverse feeling that Sherlock Holmes set against the reward of solving a crime, as he recounts

> “At the risk of becoming the laughing-stock of my own servant, I again slipped my key under the door, imprisoning myself for the night” (Doyle 1895 p.84)

In each risk story, there must be particular actions that make particular options plausible so the outcomes in retrospect are seen to have a specific cause. Sherlock Holmes thought it best, for example, to risk a climb although the waterfall roared beneath him. He remarked, “A mistake would have been fatal”(Doyle 1903 p.367) so it is clear that his attempt to climb above the waterfall might have lead to his death. A presumption that Dr. Watson made and shocked on seeing Holmes said, “Is it possible that you succeeded in climbing out of that awful abyss?”(Doyle 1903 p.366)

Advertisements present simplified risk anthologies. An American wartime advertisement by the Pullman Company shows a photograph of a family comfortably sitting at home. An accompanying picture shows a smiling young man on a train who is on an important war mission. Another pair of photos shows the family eagerly waiting with their suitcases to go on holiday followed by an image of a frustrated head of the household waiting with his family for a train back from his holiday who, the advertisement notes, will not be offered extra train services. The risk, a picture caption announces, is of being stranded (Pullman 1945).

A tale with a good outcome implies the complementary story, which can go untold. A bad outcome is hinted at by the headline, ‘Don’t risk inferior TV’. The advertisement from 1951 continues, ‘your safest buy is the TV of known quality’, that will give ‘long years of carefree pleasure’. You could according to the advertisement be ‘sure of costlier engineering’ and the resulting implied quality means ‘Long years of trouble-free performance’. These claims are supported by the information that ‘Zenith products have served their owners for 10-20 yeas or more’ (Zenith 1951). In this example the risk is that you could have an unreliable TV, but there is a course of action that the advertisement implies will obviate this.

## *Language games*

Risk is embedded in language games that trigger action, apportion blame, or construct identities. These language games involve forming anthologies of stories (or schematic stories with an implied collection of endings). Crucially in risk games stories are accounts of the future.

Bravado, which can help to construct identity, can cross the boundary between creating fictions and lying — creating a fiction that the blusterer finds implausible.

Risk games, including those intended to apportion blame, must securely identify people or groups of people with events in the their stories. Characters in a story are individuals and each is treated differently from the others. People may agree on the stories to be told but identify with different characters and thus prefer only the versions of the risk stories in which their character benefits. People identifying themselves with potential victims will see things differently from those who see themselves as decision makers or those who see themselves as experimental subjects.

Risk games that are intended to trigger action have to incorporate convincing stories and moves that seek to establish authority. The authority of story can be enhanced, for instance, by supportive reports from third parties perhaps triggered by incidental events or parallel actions deliberately taken to make the risk stories credible. Authority is signalled in part by the way in which the story is presented including the choice of language. The probability calculus has a role in presentations to audiences that accept the authority provided by a scientific style.

The risk, revealed in a deodorant advertisement, of anxiety and embarrassment can be avoided by ‘taking a minute to dust on Deodo’. This particular advertisement gained some authority because it was presented in the same style as the magazine articles. Additionally, it names the author (Deodo 1926), who lent her weight to the standing of the advertisement.

A succession of experiments that tested the effect of the phrasing of probabilistic problems showed that rewording problems in terms of frequency of events rather than probability radically altered the solutions that people gave. Small modifications such as the replacement of percentages by numbers in a population also altered the results (Cosmides & Tooby 1996). Another study noted that ‘virtually all participants’ were only able to solve the problem set when probabilities were represented as chances (Girotto 2002). A particular phrasing of questions can therefore lead a majority towards a particular conclusion although to an expert the different formulations may seem equivalent.

A researcher tacitly acknowledged that the choice of terms can trigger different emotional reactions when he distinguished ‘physically threatening’ and ‘neutral’ words (Kverno 2000). And just as the novel about Dr. Frankenstein promoted fears about technological developments so phrases like ‘Frankenstein foods’ (Lewis 2002) heighten, or at least popularise fears. Particular technical terms have a history that also carries a rhetorical force. For example dioxins, ‘implicated in war’ gained a reputation after the Seveso incident as ‘invisible’ agents that poisoned and propagated ‘like a dread disease’ (DeMarchi & Jerome 1999). Accordingly, mention of dioxins, even as a simile (Atthakor 2002), brings a sense of danger and dread to a text.

One study concludes that ‘some common warning words are not well understood’ and although ‘standards … recommend … that ‘Danger’, ‘Warning’ and ‘Caution’ are used to denote decreasing levels of hazard’ the study showed that the interpretation of these words by fifteen to twenty year olds is different from other age groups (Hellier 2000). Thus a story exploiting these words would affect one age group differently from another.

Some of the reported anomalous results of studies can be accounted for by recognising that participants in psychological experiments are playing different kinds of language games from those who are concerned with risk. Also the logic problems set by experimenters ‘typically require one to ignore vast amounts of real-world knowledge to focus entirely on abstractions’ (DeKay, Haselton & Kirkpatrick 2001), and experimental subjects, unfamiliar with the researcher’s logic game is likely treat the puzzle differently and thus surprise the researcher with their conclusions. (Tognetti 1999) A language game therefore needs a protocol to ensure that the participants are aware of the game that they are playing.

## *Conclusion*

Risk is about events that might occur in the future. It is about choices and therefore about action. Changes following action are products of political activity. Risk games that provoke action are thus political tools, which can be honed for particular tasks by shrewd handling of language and skilled storytelling.

A risk game requires an anthology of stories that circulates amongst those to be influenced — those who are to act and those who might obstruct action. It is the role of the novel, the drama, the docudrama, the stories and advertisements in the newspapers and on television screens to present possible accounts of the future. That is they circulate risk stories and provide templates for new generations of stories. The stories might be fashioned by a political master or produced collaboratively. Actors have to be able to identify with characters in the stories and the stories must resonate with the actors beliefs about the world.

Confusion and misunderstanding can be a product of risk stories including those that adopt a scientific style incorporating the probability calculus. This may be of value to less scrupulous politicians and hence risk games are not necessarily benign. Attempts to conquer uncertainty have sometimes become ways of oversimplifying the description of the world and thus creating excuses for tyranny.

Probability theory has a place in situations where ample empirical data is available. It can also, in some circles, add authority to stories that are told. Formal risk assessment cannot eliminate the unexpected and does not prevent tragedies but it does provide a systematic way of building anthologies of risk stories which may not be comprehensive but are often extensive and do reveal some situations that might be better avoided. However the political repertoire of risk stories is much richer than those that mathematical probabilities inspire.

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