Reliability Engineering and System Safety 140 (2015) 116–121

Contents lists available at ScienceDirect

Reliability Engineering and System Safety

journal homepage: www.elsevier.com/locate/ress

On the allegations that small risks are treated out of proportion to their importance

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ARTICLE INFO

Article history:
Received 14 March 2014
Received in revised form
31 March 2015
Accepted 2 April 2015
Available online 10 April 2015

Keywords:
Risk
Over-estimation
Uncertainties
Misconception
Terrorism risk

ABSTRACT

Many authors argue that we suffer from a lack of ability to treat small risks; we either ignore them completely or give them too much emphasis. An example often referred to is terrorism risk, the reference being the number of fatalities observed due to terror compared to for example deaths in traffic accidents. The thesis is that the risk is over-estimated. However, these assertions, that the risks are over-estimated and we give them too much emphasis – they are treated out of proportion to their importance – cannot be justified in any scientifically meaningful way when there are large uncertainties about the consequences of the activity considered. Over-estimation is a value judgment, as is the phrase "far too much emphasis". In the paper the author argues that the statements represent some serious misconceptions about risk. The purpose of the present paper is to point to these misconceptions and provide some guidance on how they can be rectified.

1. Introduction

The point of departure for this paper is the book, *Thinking Fast and Slow*, of Daniel Kahneman [15], for sure one of the most influential researchers on risk and decision analysis in the last 30–40 years. The response to this book has been overwhelming, with words like 'brilliance' and 'masterpiece' frequently used to describe it.

The book is based on a dichotomy between two modes of thought: *System 1* which operates automatically and quickly, instinctive and emotional, and *System 2* which is slower, more logical, and deliberative. The book identifies cognitive biases associated with each type of thinking, using several decades of academic research on the issue, to large extent linked to Kahneman's own research.

The book also relates to risk. Kahneman asserts that we have a basic lack of ability to treat small risks: we either ignore them completely or give them too much weight. The main thesis put forward is that we over-estimate small risks [15, p. 324].

Kahneman is not alone in thinking along these lines. The literature is filled with contributions where the same type of reasoning prevails. Authors lampoon the way society deals with security issues – the terrorist risks are over-estimated; very small risks are treated out of proportion to their importance.

The purpose of the present paper is to point to these views and to argue that they represent some serious misconceptions and consequently need to be refuted. They are serious, as they could have a great effect on the way we manage risk, whether it relates to security, technology and engineering, environmental impacts and natural disasters, health, or financial risk management. All areas are concerned with managing small risks.

The remainder of the paper is organized as follows. Firstly, in Section 2, more details about the above theses are provided and it is pointed to the problems of their use in light of common ways of looking at risk and probability. It is not possible to provide a meaningful discussion of this issue without being precise on what these terms – risk and probability, and over-estimation – mean. Then, in Section 3, some perspectives on how we should in fact think regarding small risks and large uncertainties are presented and discussed. The key is to acknowledge that when it comes to risk, uncertainty is a main factor and there is no way of measuring, at the point of decision, what is over-estimation of risk. Finally, Section 4 provides some conclusions.

2. The misconceptions

Kahneman [15] provides many examples to illustrate his message. One is related to suicide bombings in buses in Israel in the period 2001–2004:

> I visited Israel several times during a period in which suicide bombing in buses were relatively common - though of course quite rare in absolute terms. There were 23 bombings between December 2004, which had caused a total of 236 fatalities. The number of daily bus raiders in Israel was approximately 1.3 million

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http://dx.doi.org/10.1016/j.ress.2015.04.001

at that time. For any travelers, the risks were tiny, but that was not how the public felt about it. People avoided buses as much as they could, and many travelers spent their time on the bus anxiously scanning their neighbors for packages or bulky clothes that might hide a bomb.

I did not have much occasion to travel on buses, as I was driving a rented car, but I was chagrined to discover that my behavior was also affected. I found that I did not like to stop next to a bus at a red light and I drove away more quickly than usual when the light changed. I was ashamed of myself, because of course I knew better. I knew that the risk was truly negligible, and that any effect at all on my actions would assign an inordinately high "decision weight" to a minuscule probability. In fact, I was more likely to be injured in a driving accident than by stopping near a bus. But my avoidance of buses was not motivated by a rational concern for survival. What drove me was the experience of the moment: being next to a bus made me think of bombs, and these thoughts were unpleasant. I was avoiding buses because I wanted to think of something else [15, pp. 322–323].

One view on this example by Kahneman is as follows – to be further substantiated and discussed in the coming Section 3:

However, the individual risk is not determined by hindsight, observing historical fatality rates. At a specific point in time, an objective risk metric for this person does not exist. The statement by Kahneman that the individual risk is minimal lacks a rationale, as risk relates to the future and the future is not known. Thus the associated behavior cannot be said to be irrational (in a wide sense of the word), as there is no way to determine the truth about risk at the decision point. We can make the same considerations concerning probability. Kahneman seems to link probability to historical observations, not to the future and to judgments about the future. He refers frequently to the "exact probability level" – for example he writes on page 323: "… The emotion is not only disproportionate to the probability, it is also insensitive to the exact level of probability." However, there exists no objective probability that can be used as a basis for a proper decision weight. His thinking fails to take into account the uncertainty dimension. He refers to risk and probability as being objective quantities for which rational comparisons can be made. Such concepts do not exist in the example addressed here or in most other real-life situations. Note that the critique here relates to what Kahneman writes about risk and probability in this particular case, not his work in general.

Kahneman goes on with another example, linked to Lotto. He points to a similarity: buying a lotto ticket gives an immediate reward of pleasant fantasies, as avoiding the bus immediately is rewarded by relief of fear. According to Kahneman, the actual probability is inconsequential for both cases; it is only the possibility that matters [15, p. 323]. However, the two situations are not comparable; in the latter case there exists an objective probability that we can relate to, but not in the former case. It is this lack of objective reference values that makes risk so difficult to measure and handle. Kahneman and his school of thought have for decades conducted research that shows that people (and in particular laypersons), are poor assessors of probability if the reference is an objective, true probability, and that probability assignments are influenced by a number of factors [24]. It has been shown that people use rather primitive cognitive techniques when assessing probabilities; these are *heuristics*, which are easy and intuitive ways for specifying probabilities in uncertain situations. The result of using such heuristics is often that the assessor unconsciously tends to put too much weight on insignificant factors. The most common heuristics are the availability heuristic, the anchoring and adjusting heuristics, and the representativeness heuristic.

If it is not possible to relate the probability assignment to a true value, how can we then speak about biases and poor assessments? For an individual taking the bus in the above example, the research framework of Kahneman and others may be questioned as the event is a unique event for this person. Of course, he or she may benefit from the general insights provided by the research of biases and heuristics, for example the availability heuristic, which means that the assessor tends to base his probability assignment on the ease with which similar events can be retrieved from memory; events where the assessor can easily retrieve similar events from memory are likely to be given higher probabilities of occurrence than events that are less vivid and/or completely unknown to the expert. There exists, however, no reference for making a judgment that this heuristic leads to a bias. Care has to be shown when applying the results from the research framework of Kahneman and others into unique events. It can lead to what the author of the present paper considers to be unjustified conclusions, as in the above example where the "true" probability of being killed in a bus bombing was said to be negligible. The discussion in the coming section will give further arguments for this view.

The above discussion has the recent book by Kahneman as a point of departure, but the literature and media are filled with examples where this type of ideas prevails. As an example from the public discourse, let us go back to a newspaper article in Norway from 2009 [20], which refers to a book by the philosopher Joakim Hammerlin [13]. The topic is again terrorism risk, but now we have a focus on the authority perspective.

The message from these authors is that the terrorist risk is fictional. It is argued that there is a greater risk of drowning than being hit by terror. They point to research showing that there is no scientific basis for claiming that the security controls at airports make it safer to fly, and that the statistical probability of dying in a terrorist attack in the West is 0.0000063; after 11 September 2001 more people have drowned in the bathroom in the U.S. than are killed in terrorist attacks. Terror is not something to fear, says Hammerlin, as the risk is microscopic. The population is frightened by a fictitious danger and risk. Is it any wonder that the authors are upset and lampoon the authorities?

Again the reference seems to be some underlying true risk which is provided by the observed historical numbers. The authors take a blinkered view of what has happened. But there is a big leap from history to the future. And it is the future that we are concerned about. What will happen tomorrow, what form will an attack take, and what will be the consequences? We do not know. There is uncertainty associated with these events and their consequences.

Numbers expressing the risk can be given, but they will always be dependent on the available knowledge and the assumptions made. The historical data referred to by Hammerlin say something about the risk, but the most important aspect of risk is not addressed, namely uncertainty; we do not know what is next. We hope that the security measures implemented can prevent a terrorist attack, but they are also motivated by a need to reduce uncertainty and make people feel more secure. However, if the underlying perspective is that the risk is objectively described by a risk number, such arguments will be of little interest.

This discussion may at a first glance seem to be closely linked to the distinction between Kahneman's two Systems, 1 and 2, mentioned in Section 1. However, the main point made in the present paper is not to give increased weight to the System 1 when assessing risk – the importance of highlighting the uncertainties can be solely based on the System 2 thinking. The logical and deliberative features characterizing System 2 can be the basis also for the uncertainty assessment highlighted here although there are more methodological challenges when we have to see beyond the traditional historical data case, as will be clear from the following discussion.