Safety-Critical Systems Development: Open Assessment 2002-2003

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http://www.dcs.gla.ac.uk/~johnson/teaching/safety/open_assessments/assess2002.html

A. Introduction

Risk homeostasis is a controversial theory. It suggests that individuals have an implicit, preferred or target level of risk. One consequence of this theorem is that any safety improvements that reduce the risk exposure of an indiviudual will potentially lower the perceived threat below the target level. This creates the opportunity for people to alter their behaviour. In particular, they may trade performance objectives for a slightly increased level of risk. For example, car drivers that have access to advanced braking systems and other protection mechanisms may drive faster and brake later than drivers whose cars do not offer this higher degree of protection. Many people disagree with the basic ideas behind risk homeostasis theory. Does anyone really have an implicit target level of risk? Is anyone calculating enough to identify performance benefits that can be precisely traded off against safety improvements? Your task is to select an appropriate analytical technique to gather evidence about this theory. Gerald Wilde provides an on-line introduction to Risk Homeostasis. Be aware, however, that there are different perspectives on this issue and that you should also read more widely about the subject.

B. Your Task

Your task is to find evidence that will support or weaken the arguments made about risk homeostasis. You can use any method that you think is justified to support your arguments. The only caveats are that the evidence MUST be original and that at no point should you endanger anyone who may be connected with the project. The following paragraphs identify some of the techniques that can be used to provide evidence for and against risk homeostasis.

C. Methodologies for Examining Risk Homeostasis

There are many different ways in which you can provide or disprove assertions about risk homeostasis theory. These are summarized in the following paragraphs.

Experimental techniques. A number of objections can be made about the use of experimental techniques to examine issues in risk and decision-making. In particular, expressed preferences in the laboratory may provide poor predictions of individual behavior in the 'real world'. However, many researchers have simulated situations in which people make 'risky' decisions under laboratory conditions. These laboratory experiments are used to provide insights into elements of risk homeostasis theory. In order for these experiments to be valid you must consider the experimental design, including issues such as identifying dependent and independent variables, counterbalancing etc. You must also choose an appropriate statistical test with which to analyze any results that you might obtain. Some of these issues are mentioned in Chapter 9 of Wilde's book but you will also have to read more widely into experimental design. For example, there is an introduction to experimental design at William Trochim's site at Cornell and another by Paul Cohen at Colorado State In particular; you should note that Chapter 9 of Wilde's book covers the ways in which primitive (and more advanced) forms of computer games are commonly used to examine risk homeostasis theory. One way in which you could actively extend research in this area would be to write a computer game to test risk homeostasis theory under laboratory conditions. Do NOT simply copy the games in the Wilde book.

Epidemiological techniques. One way of finding evidence for and against risk homeostasis is to gather data about incidents and accidents before and after some safety innovation is introduced. For example, if cycle helmets are made compulsory then we can look to see what impact that has on injuries to cyclists who wear these hats. Problems arise in trying to interpret the statistics. If injuries rise does this support the homeostasis theory and show that cyclists misjudge their target level of risk, In other words, they do more dangerous things beyond the benefits provided by a helmet. Alternatively, we might see that they types of injuries changes. The helmets have the effect of increasing the frequency of incidents because cyclists ride more recklessly but that the outcomes are less severe because the helmets intervene to prevent head injuries. In any event, if you choose the epidemiological approach you must find a NEW data soure General pointers to this data are available via

OSHA, the HSE and other regulatory organizations via the course links page. Gerald Wilde's book has several examples of this approach being applied to safety data, especially Chapter 5.

Other approaches. This assessment is deliberately open-ended. It is intended to provide scope for individual initiative and research. I would strongly encourage any other ideas about techniques that might be used in this open assessment. However, I would also urge you to email me or discuss them after a lecture to ensure that they will provide credible evidence about risk homeostasis.

D. Transferable Skills

It is important to stress that this assessment will provide number of generic skills. Although we are focusing on evidence that might support or weaken arguments about risk homeostasis in general, the methods that you are using are identical to those that safety-critical organizations might use in order to assess the risks that are associated with particular products or designs. Statistical surveys or epidemiological studies can be used to identify benchmark figures for the performance of existing safety-critical systems. The existing frequency of injuries involving particular types of devices provides a target for development; any new systems must at least be as safe as previous applications. Experimental studies of risk taking behavior provide means of assessing the actual performance of system designs prior to their full operational use. The same empirical methods that you might employ in this project can also be used on a commercial setting. The same criticisms can be raised about these methods as well. Epidemiological or experimental work can often be compromised by problems of under-reporting and gathering raw information about previous incidents involving particular devices. Similarly, operator behavior in lab-based studies may have little relationship to their real-world performance.

E. Assessment Criteria and Submission Details

This exercise is degree assessed. It contributes 30% to the total marks associated with this course. The body of the report should not exceed fifteen A4 pages. The report must be printed out and must be submitted in a secure binder (i.e., one that will keep the pages together and in the correct order). It must include:

- A title page containing your student as well as your contact details (email address etc);
- A table of contents and appropriate page numbers;
- A section on the methodology that you used. This should begin with a statement of the hypothesis that you chose to prove or disprove. Please note that your project might look only at a specific aspect of risk homeostasis, such as the existinace of implicit risk targets rather than behaviour changes. This should include some consideration of alternative approaches and a considered justification of the reasons why you chose the method that you did.
- A results sections. This should describe the findings that you obtained. It should also discuss any problems that arose during the study that might make it difficult to interpret your findings.
- Conclusions. You must provide a clear statement about whether or not your study supports the ideas behind risk homeostasis. If your study indicates a mixed set of conclusions then you should state which aspects of the theory you are willing to support. You should also identify the limitations of the theory as it currently exists,

In addition to the fifteen pages associated with the body of the report, you may also include appendices. These should contain: the listing of any code used during the study together with suitable acknowledgements for the source of code that has been borrowed from other programmers; source data for any statistical study. The intention is that another analysts should be able to recreate your results in order to validate your findings. If the source data comes from the web or is available in another electronic form it is acceptable to simply provide a reliable URL or a disk.

It should be handed in at the start of the lecture on Wednesday 11th December 2002. Extensions will only be granted in exceptions circumstances and they should be requested prior to the deadline. Extensions for medical reasons should be reported as soon as possible and should be supported by forms from a medical practitioner. Extensions for equipment failures may be granted provided that you let me know as soon as they occur; so that I can make sure they get fixed as soon as possible. Please make sure that you keep back-up copies of all of your work towards this exercise. The following marking scheme will be applied: 15 for the method; 10 for the results; 15 for the conclusion; 10 for the technical documentation. All solutions must be the work of the individual submitting the exercise. If any code or design ideas are borrowed from course notes, books or other students then those sources MUST be clearly acknowledged. All questions about this exercise should be addressed to Chris Johnson (Johnson@dcs.gla.ac.uk).