

Valuation of health and safety benefits

Dread risks

Prepared by the **University of Newcastle upon Tyne,**
University of East Anglia, Durham University,
University of London and **NERA Economic Consulting**
for the Health and Safety Executive 2007

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Valuation of health and safety benefits

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It is by now well-known that people typically fear the prospect of premature death by some causes considerably more than others – see for example Slovic, Fischhoff and Lichtenstein, 1981; Thomas, 1981; Mendeloff and Kaplan, 1990; McDaniels, Kamlet and Fischer, 1992; Savage, 1993; Tolley, Kenkel and Fabian, 1995; Jones-Lee and Loomes, 1995 and Sunstein 1997.

In the light of this, the UK Health and Safety Executive (HSE) commissioned a research programme comprising three separate studies.

In the first study, by the University of Newcastle upon Tyne, the focus was principally on causes that typically result in instant (or near-instant) death, such as road or rail accidents. In addition, individual attitudes were viewed primarily from the perspective of people's 'self-focused' preferences concerning personal safety.

By contrast, the second study, carried out by a team drawn from the University of East Anglia, Durham and Queen Mary, London, considered – amongst other issues – causes of death typically preceded by protracted periods of pain and discomfort, such as lung or breast cancer. In addition, the second study sought to investigate the public's attitudes to factors such as the victim's age and the question of blame or responsibility for the cause of death concerned. As a result, the focus was directed more towards people's preferences in their role as citizens, expressing their views and attitudes with respect to general principles of social decision-making concerning life-saving interventions.

Finally, the third study - carried out by Michael Spackman of National Economic Research Associates (NERA) – was aimed at summarising and evaluating the extensive body of work undertaken to date by sociologists, psychologists, philosophers and economists on the important but arguably somewhat elusive and nebulous concept of 'Societal Concerns', to which extensive reference is made by various regulatory agencies including the HSE itself.

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Executive Summary

1. *Introduction*

It is by now well-known that people typically fear the prospect of premature death by some causes considerably more than others – see for example Slovic, Fischhoff and Lichtenstein, 1981; Thomas, 1981; Mendeloff and Kaplan, 1990; McDaniels, Kamlet and Fischer, 1992; Savage, 1993; Tolley, Kenkel and Fabian, 1995; Jones-Lee and Loomes, 1995 and Sunstein 1997.

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Finally, the third study - carried out by Michael Spackman of National Economic Research Associates (NERA) – was aimed at summarising and evaluating the extensive body of work undertaken to date by sociologists, psychologists, philosophers and economists on the important but arguably somewhat elusive and nebulous concept of "Societal Concerns", to which extensive reference is made by various regulatory agencies including the HSE itself.

2. *The Newcastle Study*

Given the "own safety" focus of the Newcastle Study, following Viscusi et al (1991), it was decided to employ the so-called "risk-risk" methodology. Essentially, this methodology relies on the basic theoretical result that for any individual whose preferences satisfy the "betweenness" property¹ (including expected utility maximizers), then denoting the marginal rate of substitution (MRS) of wealth for risk of death by cause A by M_A and the corresponding MRS for risk of death by cause B by M_B , it follows that if the individual is indifferent between a reduction (increase) in the risk of death by δp_A for cause A and a reduction (increase) in the risk of death by δp_B for cause B then:

¹ Consider two probability distributions X and Y over a given set of consequences and suppose that X is strictly preferred to Y. Then betweenness requires that any probability mixture $pX+(1-p)Y$, $p>0$, will be strictly preferred to Y.

$$\frac{M_A}{M_B} = \frac{\delta p_B}{\delta p_A} \quad (1)$$

Earlier work had suggested that responses to risk-risk and other relative valuation questions typically reflected two factors, namely a) the baseline level of risk by the causes concerned and b) the respondent's relative fear or "dread" of dying prematurely by the causes concerned. In particular, the findings reported in Chilton et al (2002) suggest that in some cases, such as rail or fires in public places, dread effects may to all intents and purposes be offset by the relatively low levels of baseline risk for these particular contexts. In view of this it was decided to develop a focus group protocol that essentially proceeded in three stages. In the first stage focus group participants were introduced to the general nature of the study and the risk concepts that they would be dealing with. They then indicated whether they regarded themselves as being at below average, average or above average risk for the various causes that would be considered. Next, they were presented with a mock risk-risk question and discussed the type of strategy they each had employed in answering it.

The focus group protocol then moved on to its second "contextless" phase in which respondents – on an individual rather than group basis – answered six "risk-risk" questions which in all cases involved choices between increasing the risk of what was labelled "cause C" by x in 50 million² or increasing the risk of the other cause (eg labelled "cause E") by x in 50 million with x set at either 10 or 30 for each pairwise choice depending on the magnitude of the actual baseline risk. However in the second phase the *nature* of the cause concerned was deliberately *not* identified so that responses would in principle reflect *only* respondents' attitudes to baseline risk levels rather than dread. In addition, respondents were provided with baseline risk information that had been "tailored" to their earlier responses to the question concerning their perceived exposure to the cause which (unknown to them at that stage) in fact underpinned the baseline risk level concerned.

Having selected the cause which they would prefer to have the increment of x in 50 million added to the specified baseline risk, they were then asked how large the increment would have to be before they would switch to a preference for having an increment of x in 50 million added to the specified baseline risk for the other cause.

Finally, the focus group protocol proceeded to its third "contextual" phase which took the same basic form as the contextless phase, but now involved not only providing respondents with personalised baseline risks but also informing them of the context concerned. By comparing the responses to the contextual questions with those to the contextless questions for each context concerned it was then possible to establish the extent to which context *per se* – and in particular the degree of dread associated with that context – drove responses to risk-risk questions.

In the event, it transpired that murder, train accidents, fires in public places and drowning can all clearly be regarded as dread risks in the eyes of the public. In the case of hazardous production plants, domestic fires, car driver/passenger accidents and accidents in the home the picture is more mixed, while pedestrian accidents relatively speaking display no, or at least very little, dread.

² A rounded, rough approximation to the population of England, Scotland and Wales.

In order to investigate the offsetting baseline risk hypothesis, in the Newcastle study the implied VPFs from the pre and post – Ladbroke Groves studies were regressed on baseline risk and the estimated dread effects. Essentially, the fit of the regression equation and significance of the estimated coefficients were very encouraging and substantially confirmed the offsetting baseline risk effect.

Thus the findings of the Newcastle Study, together with the original valuation relativities reported in Chilton et al (2002) suggest that, at least for the contexts considered in this study, in spite of clear dread effects for some of these contexts there should be *no differentiation* in the VPFs concerned, with a uniform figure equal to the roads value (currently £1.38 x 10⁶ in 2004 prices) applied in all cases.

3. *The UEA/Durham/Queen Mary Study*

Given that in the UEA/Durham/Queen Mary Study respondents were to be asked to express their views and attitudes on the general principles of social decision making in the role of citizens, it was decided to ask them first to prioritize and then to choose between pairs of scenarios that differed in their mix for four basic attributes which comprised:

- Number of deaths prevented, namely 10, 15, 25 or 50
- Age group of typical victim ie under 17 year olds, 17-40, 40-60 and over 60
- Length of period of illness and quality of life in period leading up to death
- Individual or agency most responsible/to blame for the event causing death.

This exercise was conducted first on a “contextless” basis without the specific cause of death being identified and then effectively repeated in a “contextual” format with the causes identified, where appropriate, as car drivers; car passengers; rail passengers; smoking cancer victims; asbestos cancer victims; pedestrians; breast cancer victims; work-related cancer victims and accidents at work.

From the results of the pairwise choice questions it is then possible – using the methods of so-called “Discrete Choice Experiment” (DCE) analysis – to estimate statistical models which allow one to predict the impact of the various different characteristics such as number of fatalities, age of victims, degree of blame etc. on the “disutility” of an event resulting in accidental death. While such a relatively complex statistical estimation procedure is inevitably fraught with various difficulties and its results therefore subject to some uncertainty, it does seem clear from the UEA/Durham/Queen Mary Study findings that, viewed from a “citizen” perspective, age (specifically, those below age 40), blame and responsibility for a fatal accident and duration of the period of suffering prior to death (particularly serious pain/discomfort over a 3-5 year period) are regarded as being the key factors in prioritizing preventative measures.

More specifically, given that the questions were structured in such a way that rail accident victims bore no responsibility for their own demise, whereas car drivers were in all cases described as being themselves principally to blame, it is perhaps not surprising that respondents gave the prevention of rail fatalities clear priority over the prevention of car user

deaths. However, when estimated statistical relationships (with these estimated relationships based exclusively on the “contextless” data) were used to predict the degree of prioritization in the case in which people other than the car-drivers were not to blame, the implied valuation of preventing a rail fatality relative to the corresponding value for a car user fell to 1.16:1 which is very close to the post-Ladbroke Grove study figure.

4. *The Spackman “Societal Concern” Review*

This section of the Report provides a very thorough and comprehensive critical review of the existing literature concerning societal concerns and related issues, including reports and papers by Adams and Thompson (2002); Ball and Boehm-Christianson (2002); Jaeger, Renn, Rosa and Webler (2001); Wolff (2002); Elliott and Taig (2003; Hirst and Carter (2002); Bandle, Golob and Bristow (2003); Hood, Rothstein and Baldwin (2001,2004) as well as various HSE and related documents. As Spackman notes, as well as covering basic economic issues, this literature can usefully be viewed as covering four broad disciplinary perspectives, namely: sociology, philosophy, engineering/risk assessment and public administration/public law.

While it is acknowledged that, taken as a whole, this literature highlights a number of very important risk-related issues that can reasonably be regarded as falling outside the narrow purview of individual aversion to physical risk, some doubts are raised about the extent to which some of the contributions actually move us forward in terms of practical policy formation. Particular reservations are expressed concerning the practical usefulness of the Adams and Thompson contribution which it is suggested, in relation to what the authors themselves refer to as the “ocean of risk”, provides no navigational aid. It is perhaps worth remarking that this essentially negative view of Adams’ contribution in particular, is shared by many others working in this area, including other authors of this Report.

Having reviewed the societal concerns literature, Spackman then argues that three main conclusions stand out with respect to the role of cost-benefit analysis in decisions affecting public safety, namely:

- While an important input to decision making, cost-benefit analysis can never capture all of the important considerations, some of which may be inherently incapable of precise numerical quantification or monetary valuation
- Nothing of substance in the literature reviewed can sensibly be viewed as lessening the role of cost-benefit analysis in the appraisal of public safety projects
- Some of the factors that might reasonably be viewed as falling under the general heading of societal concerns – such as the wellbeing of children or the mentally infirm – control, with careful consideration, actually be included within the cost-benefit analysis framework.

Finally, Spackman also emphasises the importance of the “user/citizen” distinction, arguing that some issues that may be regarded as having some importance when viewed from the citizen (or indeed media) perspective – such as voluntariness, controllability or the scale of accidents – may not be so central when considered from a largely self-interested, user point of view.

**VALUATION OF HEALTH AND SAFETY BENEFITS : DREAD RISKS
FINAL REPORT ON THE NEWCASTLE STUDY**

1. *The Focus Group Protocol*

By following the procedures in the focus group protocol to be described below we attempt to identify how both the degree of risk exposure and a respondents' feelings towards the type of accident affect their choices over the level and type of risk they are willing to expose themselves to. This method has the advantage of determining the degree to which each of these two factors affects a person's final choice. It is applied to a set of risks of immediate death that are characterised by two common features – a broadly similar baseline risk and, to at least some degree for some people, an element of dread or fear.

The procedure employed in the focus group sessions – which typically involved four participants selected on a quota basis from Newcastle, Norwich, Edinburgh and London (total sample size = 78) during November and December 2003 by a professional sample survey organisation and were moderated by two of the Newcastle research team members (Sue Chilton and Hugh Metcalf) and two trained moderators (Kelly Ellis and Diana Buckley) – was as follows.

Phase 1 Introduction

This provides an overview of the objectives of the group/project, giving participants the framework within which they would be working. Participants were informed about the role of the HSE and why they had commissioned this project in very broad terms and were then introduced to the six types of accident that would form the basis of the study. Regarding the accidents, two things were stressed to respondents. Firstly, the phrase (common to all accidents) “die immediately or fairly soon after” should be taken to mean the brief time leading up to the incident and the minutes or hours after. Importantly, there is no chance of survival or death preceded by weeks or months of prolonged suffering. Secondly, our description was deliberately vague since their decisions were meant to be based on their own individual perceptions, or dread, of what dying in a particular type of accident might be like.

Phase 2 Baseline and Perceived Risk

Respondents completed a personal risk assessment sheet. For each of the six types of accident, respondents were told of the risk to the average person in England and Wales(Scotland) of dying each year from each of the accident types. An alternative analogy was also given as an additional explanation i.e. “imagine a bag of 50 million balls, XXX of which are black and the rest are white – if you randomly draw out one of the XXX black balls then you would die”. Based on their own perceptions, respondents indicated whether they thought they were one of: “much higher than average”, “slightly higher than average”, “about average”, “slightly lower than average”, and “much lower than average”.

The sheets were immediately collected and used as the basis on which to personalise the “contextless” Risk-Risk (R-R) tradeoffs (see Phases 4 and 6).

Phase 3 Practice “Contextless” Risk-Risk Trade Offs

By a “contextless” R-R trade off we mean one in which the only information on which the respondent has with which to make their choice is the risk level to the average person and their own relative risk (in qualitative terms).

Due to the obvious unfamiliarity and complex nature of the task, two different types of “warm up” contextless R-R trade off exercises were carried out.

The first was based around a so-called thought experiment accompanied by an open discussion. The main aim of this was to introduce participants to the notion of risk increases, switchover points and the implications of different strategies and switchover points on their total risk of death (the two risks added together). Care was taken to ensure that all participants were exposed to at least three different strategies (“expected utility maximization”, “absolute risk equalization” and “incremental risk ratio equalization” – see Section 2 for details) if they did not come up naturally in the discussion. Another important aim was to provide a forum within which misunderstandings, mistakes and problems with the conceptual aspects of the task could be discussed and resolved, at least to some extent.

Participants were asked to imagine that they had to choose between a 10 in 50 million increase in death in two accidents and, further, the only information they had was their personal risk of dying in each accident. The two risks involved corresponded to two actual risks (accident 1 Bus Passenger, Accident 2 Car Passenger). For the purposes of this exercise, respondents were given a personal risk corresponding to the average risk of dying in the accidents. Each participant was asked to indicate which accident they would choose the risk increase in and asked to explain why. They were then asked to consider how big a risk increase they would accept in their chosen accident before it became too big and they would instead prefer the 10 in 50 million increase in the other accident i.e. their point of indifference. Once again, they were asked to explain how they had arrived at this answer i.e. their strategy.

Inference of the ratio of marginal rates of substitution (MRS) of wealth for risk of death for the two causes is then a straightforward matter. Thus, denoting the MRS of wealth for risk of death by cause A by M_A and the corresponding MRS by cause B by M_B then provided the respondent’s preferences satisfy the “betweenness” property (including expected utility maximizers) if he/she is indifferent between a reduction (increase) in risk of death by cause A by δp_A and a reduction (increase) in risk of death by cause B by δp_B then:

$$\frac{M_A}{M_B} = \frac{\delta p_B}{\delta p_A}$$

The second practice question was designed to provide a forum within which misunderstandings, mistakes and problems with the practical aspects of the task could be discussed and resolved. Participants were asked the same type of question as above but were asked to fill in their answers in a table identical to the ones they would use in the real questions. In addition, the two risk levels they were asked to consider were much closer (400 in 50 million and 300 in 50 million), in contrast to the above where the risk levels were further apart. Again, participants all faced the same allotted personal risk, which, along with the parameters for average risk, were deliberately chosen in the expectation that most people’s indifference point would fall within the table and that most people would find the

closeness of the two sets of parameters meant that the decision problem was quite finely balanced and thus harder than if there had been an obviously dominant choice, thus allowing any potential problems with the trade off to be brought up unprompted.

Phase 4 “Contextless” Risk-Risk Trade Offs (1)

Respondents completed two personalised “contextless” R-R trade-offs. This means that each respondent’s choice was personalised according to the average risk and their assessed personal risk in each for the 6 accident types elicited in Phase 2 (though no reference was made to the context i.e. type of accident). For example:

<i>Accident C³</i>	<i>Accident E</i>
<i>Average Risk = 250 in 50 million</i>	<i>Average Risk = 30 in 50 million</i>
<i>Personal Risk = As for Murder Incident</i>	<i>Personal Risk = As for Fire in a Public Place</i>

Phase 5 Effect of Age on Choice of Programmes

Due to the potential for fatigue and/or automation, the “contextless” R-R trade-offs were separated by an open ended discussion on a neutral (i.e. one with no bearing on choices over risk) based on choosing between programmes that favoured one age group over another.

This discussion served to provide respondents with a (perhaps welcome) relief from the abstract R-R questions, allowing them to complete the remaining three with a “refreshed” mind. Subsequent empirical data suggested that this discussion did not influence their abilities in respect of the subsequent R-R trade-off questions.

Phase 5 “Contextless” Risk-Risk Trade Offs (2)

Respondents completed three more personalised “contextless” R-R trade-offs to complete the set of contextless R-R trade offs corresponding to the five contextual R-R tradeoffs to be asked later.

Phase 6 Feelings Towards the Different Risks/Types of Accidents

The previous phases involved participants concentrating only on their response to the level of exposure they faced in respect of the accident types. Phase 6 was designed to encourage them to concentrate only on their feelings towards dying in the different types of accident. An open ended discussion was followed by a ranking exercise in which each participant ranked the accidents from “worst” (i.e. the one they most dreaded) to “best” (i.e. the one they least dreaded).

Respondents were then handed back their first sheet (Average and Personal Risk) and were asked to fill in something that reflected (a few words or a sentence) their feelings towards the different risks.

³ Accident C (Murder Incident) was chosen as our “peg” context from which to judge the extent of dread premia in the other contexts. This was chosen as it was a sufficiently large risk to be included in the set of higher risks (Set B – see Section 3) and sufficiently small enough to be included in the set of smaller risks (Set S – see Section 3) and thus fulfilled the role of a common accident by which accidents from the two different sets could be compared if desired.

This completed sheet summarised for respondents three key pieces of information which they might then wish to consider when making their choices in the contextual R-R trade-offs i.e. the risk to the average person, their own personal risk and their feelings towards dying in that accident.

Phase 7 “Contextual” Risk-Risk Trade-offs

By a “contextual” R-R trade off we mean one in which the respondent is informed of the nature of the accident as well as the risk level to the average person and their own relative risk (in qualitative terms). Thus, respondents may use all of this information when making their choice. In all the following R-R trade-offs, respondents were once again asked to choose between an increase of 10 in 50 million in two accidents.

The Accidents considered were separated into two separate groupings⁴. Each focus group only considered one set.

Set “S”:

Accident C (Murder Incident) vs Accident E (Domestic Fire)

Accident C (Murder Incident) vs Accident F (Hazardous Production Plant)

Accident C (Murder Incident) vs Accident G (Car Driver/Passenger in a Road Accident)

Accident C (Murder Incident) vs Accident H (Pedestrian in a Road Accident)

Accident C (Murder Incident) vs Accident B (Drowning)

Set “B”:

Accident C (Murder Incident) vs Accident E (Fire in a Public Place)

Accident C (Murder Incident) vs Accident F (Accident in the Home)

Accident C (Murder Incident) vs Accident G (Car Driver/Passenger in a Road Accident)

Accident C (Murder Incident) vs Accident H (Pedestrian in a Road Accident)

Accident C (Murder Incident) vs Accident B (Train Accident)

This procedure identifies the choices respondents made when they knew the types of accident. These choices can be compared directly with the corresponding (in terms of statistical risk) “contextless” choices based on exposure alone to demonstrate the presence or otherwise of any “dread premium” and, more importantly, the extent of its impact on the contextual choice.

⁴ As well as containing a common accident (Murder Incident) by which accidents from the two different sets could be compared, two other accidents were also common to both sets - Car Driver/Passenger in a Road Accident and Pedestrian in a Road Accident – allowing an in-built consistency check on responses to the same trade of using two different sets of tables (“S” risk increases of 10 in 50 million and “B” risk increases of 30 in 50 million).

2. *Inferring the “Dread” Effect from Contextless and Contextual “Risk-Risk” Responses*

Early in the study it became clear that in answering the contextless risk-risk questions in particular, respondents were, broadly speaking, employing one of three heuristics (or at least variants thereof). Thus suppose that we have two contexts, A and B, with baseline annual risks of 400 in 50 million and 10 in 50 million respectively. Faced with a choice between an increase of 10 in 50 million in the risk of A or B the extreme variants of the three heuristics would then be as follows:

- *Expected utility maximization* might appear to entail indifference between the two increments, so that the initial choice would be made on a random basis. However, it transpires that this is almost certainly not the case and that a rational individual would have a strict preference for the increase in risk to be applied to the lower baseline risk ie context B, but that with a very large risk denominator (in our case 50 million) indifference would require only a *minute* increase above 10 for the incremental risk for B. For a full explanation of these points see Appendix A.
- *Absolute risk equalization* would entail that the initial choice would be an increment of 10 in 50 million to the risk of B. Only when the incremental risk of B had risen to 400 in 50 million would the two incremental risks be judged indifferent (ie an increment of 10 in 50 million to the risk of A and an increment of 400 in 50 million to the risk of B resulting in absolute risk equalization at 410 in 50 million for both risks)
- *Incremental risk-ratio equalization* would entail that the initial choice would be an increase of 10 in 50 million to the risk of A. Only when the incremented risk of A had risen to 400 in 50 million would the two incremental risks be judged indifferent on the grounds that an increment of 400 in 50 million would double the risk of A just as an increment in 10 in 50 million would double the risk of B.

Now suppose that context A is low-dread while context B is high-dread. Further suppose that we have a society of six people of which individuals 1 and 2 are expected utility maximizers, individuals 3 and 4 are extreme absolute risk equalizers and individuals 5 and 6 are extreme incremental risk-ratio equalizers.

In the contextless case, faced with an initial choice between an increase of 10 in 50 million in the annual risk of either A or B, with the chosen option then having its risk increased up to the point of indifference, given that the other risk increase is held constant at 10 in 50 million, the indifference risk increases would then be:

<i>Individual</i>	<i>A</i>	<i>B</i>
1	10	10
2	10	10
3	10	400
4	10	400
5	400	10
6	400	10

In turn, suppose that once the contexts are identified, given that the dread factor for B substantially exceeds that for A, then the indifference risk increases alter to:

<i>Individual</i>	<i>A</i>	<i>B</i>
1	20	10
2	20	10
3	10	200
4	10	200
5	800	10
6	800	10

Intuitively, two things are immediately apparent from these figures.

- At least in the contextless case, the response patterns are symmetrical as between A and B so that however the data are processed one would not expect a derived valuation ratio that differed greatly from 1, assuming that all six individuals' preferences are weighed equally.
- Comparing the contextless responses with those following contextual identification, it seems plain that there is indeed a substantial dread effect at work in the case of context B relative to context A, so that however the data are processed one would want this effect to show-up.

Denoting individual context indices by R^A and R^B (where, for example, the contextless

indices for individuals 3 and 4 would be $R^A = \frac{10}{10}$ and $R^B = \frac{10}{400}$) in the contextless case these would be:

Contextless Indices

Individual	R^A	R^B	R^A/R^B
1	1	1	1
2	1	1	1
3	1	0.025	40
4	1	0.025	40
5	0.025	1	0.025
6	0.025	1	0.025

In turn, the contextual indices would be:

Contextual Indices

Individual	R^A	R^B	R^A/R^B
1	0.5	1	0.5
2	0.5	1	0.5
3	1	0.05	20
4	1	0.05	20
5	0.0125	1	0.0125
6	0.0125	1	0.0125

Prima facie there would appear to be three primary candidates as a means of processing these data.

Approach 1 As in our earlier analysis of the matching data from the HSE/DETR/Home Office/HM Treasury study – See Chilton et al (2002) and our initial analysis in the Dread Risk Study, take the valuation ratio V^A/V^B to be the ratio of the mean of R^A to the mean of R^B (or equivalently, the ratio of the sum of R^A scores to the sum of R^B scores).

Approach 2 Take the valuation ratio V^A/V^B to be the mean of the individual R^A/R^B ratios.

In either of these two cases it would then seem appropriate to measure the pure “dread” effect by dividing the contextual V^A/V^B ratio by the contextless V^A/V^B ratio.

Approach 3 Under the third approach one would derive individual V^A/V^B ratios from individual R^A/R^B ratios and then compute individual contextual vs contextless ratios by dividing the individual contextual V^A/V^B ratio by the individual contextless V^A/V^B ratio and finally taking the arithmetic mean of individual contextual vs contextless ratios as the measure of the pure “dread” effect⁵.

Applying each of these three approaches to the analysis of the hypothetical data for our four-person society then yields the following results:

Approach 1

$$\begin{aligned} \text{Contextless } \frac{V_A}{V_B} &= \frac{4.05}{4.05} = 1 \\ \text{Contextual } \frac{V_A}{V_B} &= \frac{3 \cdot 3.025}{4.1} = 0.7379 \\ \frac{\text{Contextual}}{\text{Contextless}} &= \frac{0.7379}{1} = 0.7379 \end{aligned}$$

Approach 2

$$\begin{aligned} \text{Contextless } \frac{V_A}{V_B} &= 13.675 \\ \text{Contextual } \frac{V_A}{V_B} &= 6.8375 \\ \frac{\text{Contextual}}{\text{Contextless}} &= \frac{6.8375}{13.675} = 0.5 \end{aligned}$$

⁵ In fact, in a recent journal article – see Chilton et al (2006) – we focused principally on a variant of Approach 3, with overall dread effects estimated on the basis of the *geometric* (rather than the arithmetic) mean of individual contextual vs contextless ratios. We proceeded in this way a) because it transpired that the resultant estimated dread effects did not differ dramatically from those estimated under, say, Approach 1 and b) in the interests of brevity and simplicity of exposition.

Approach 3

Individual	contextual V_A/V_B	÷	contextless V_A/V_B	=	0.5
1	0.5	÷	1	=	0.5
2	0.5	÷	1	=	0.5
3	20	÷	40	=	0.5
4	20	÷	40	=	0.5
5	0.0125	÷	0.025	=	0.5
6	0.0125	÷	0.025	=	0.5

$$\frac{\text{Contextual}}{\text{Contextless}} = 0.5$$

Next, consider the approach used by Hugh Metcalf (at Graham Loomes suggestion) under which the sample is split into, on the one hand, absolute equalisers (individuals 3 and 4) and on the other, expected utility maximizers and risk-ratio equalisers (individuals 1,2,5 and 6) with the first sub-sample being analysed by Approach 1 and the second subsample by Approach 3. This then yields:

Subsample 1

$$\text{Contextless } \frac{V_A}{V_B} = \frac{2}{0.05} = 40$$

$$\text{Contextual } \frac{V_A}{V_B} = \frac{2}{0.1} = 20$$

$$\frac{\text{Contextual}}{\text{Contextless}} = 0.5$$

Subsample 2

Individual	contextual V_A/V_B	÷	contextless V_A/V_B	=	0.5
1	0.5	÷	1	=	0.5
2	0.5	÷	1	=	0.5
5	0.0125	÷	0.025	=	0.5
6	0.0125	÷	0.025	=	0.5

$$\frac{\text{Contextual}}{\text{Contextless}} = 0.5$$

If we then take the mean of the two separate subsample estimate we get:

$$\text{mean} \left(\frac{\text{contextual}}{\text{contextless}} \right) = 0.5$$

Finally, if we conduct the analysis with $\frac{R_B}{R_A}$ and $\frac{V_B}{V_A}$ (rather than $\frac{R_A}{R_B}$ and $\frac{V_A}{V_B}$ as above)

then the results are:

Approach 1

$$\begin{aligned} \text{Contextless } \frac{V_B}{V_A} &= 1.00 \\ \text{Contextual } \frac{V_B}{V_A} &= 1.3554 \\ \frac{\text{contextual}}{\text{contextless}} &= 1.3554 \end{aligned}$$

Approach 2

$$\begin{aligned} \text{Contextless } \frac{V_B}{V_A} &= 13.675 \\ \text{Contextual } \frac{V_B}{V_A} &= 27.35 \\ \frac{\text{contextual}}{\text{contextless}} &= \frac{27.35}{13.65} = 2.00 \end{aligned}$$

Approach 3

Individual	contextual $V_B / V_A \div$	contextless V_B / V_A	
1	2	1	= 2.00
2	2	1	= 2.00
3	0.05	0.025	= 2.00
4	0.05	0.025	= 2.00
5	80	40	= 2.00
6	80	40	= 2.00

$$\frac{\text{contextual}}{\text{contextless}} = 1.975$$

Hugh/Graham Approach

Subsample 1

$$\text{Contextless } \frac{V_B}{V_A} = \frac{0.05}{2} = 0.025$$

$$\text{Contextual } \frac{V_B}{V_A} = \frac{0.1}{2} = 0.05$$

$$\frac{\text{contextual}}{\text{contextless}} = \frac{0.05}{0.025} = 2.00$$

Subsample 2

Individual	contextual $V_B / V_A \div$ contextless V_B / V_A
1	$2 \div 1 = 2$
2	$2 \div 1 = 2$
3	$80 \div 40 = 2$
4	$80 \div 40 = 2$

$$\frac{\text{contextual}}{\text{contextless}} = 2.00$$

Mean of two separate subsamples

$$\text{mean} \left(\frac{\text{contextual}}{\text{contextless}} \right) = 2.00$$

As far as the first of the two *desiderata* of the data analysis (that the overall $\frac{V_A}{V_B}$ ratio for the contextless hypothetical data set should be close to unity) is concerned it is plain that only Approach 1 comes anywhere near the mark. In particular, under Approach 2 the overall contextless $\frac{V_A}{V_B}$ ratio is 13.675 while the overall contextless $\frac{V_B}{V_A}$ ratio is 13.675, results which taken both separately and together are simply absurd. In turn, Approaches 3 and the Hugh/Graham Approach do not yield a

stand-alone contextless $\frac{V_A}{V_B}$ or $\frac{V_B}{V_A}$ ratio.

However, when we turn to the second of our two desirable features of the data analysis (namely that the pure “dread” effect for our hypothetical data set should be substantial) the picture is rather different. In this case Approach 1 produces a pure dread effect (contextual \div contextless) for the ratio $\frac{V_A}{V_B}$ of 0.7379 and for the ratio $\frac{V_B}{V_A}$ of 1.3554 both of which indicate a marked dread effect for context B. In turn, Approaches 2, 3 and the Hugh/Graham approach all produce a dread effect for the ratio $\frac{V_A}{V_B}$ of 0.5 and for the ratio $\frac{V_B}{V_A}$ of 2 which again indicate a marked dread effect for context B relative to context A.

3. Quantitative Findings of the Focus Group Study

Before proceeding to report the findings of the study it is important to appreciate that Approaches 2, 3 and the Hugh/Graham approach are capable of producing very large “context” effects given particular patterns of response on the part of just a few people. In particular, suppose that the contextless and contextual R_A/R_B ratios are as follows:

Contextless R_A/R_B Ratios

Individual

1	x
2	y
3	z

Contextual R_A/R_B Ratios

Individual

1	X
2	Y
3	Z

Approach 2

compute $\frac{X + Y + Z}{x + y + z}$ as the “dread” effect.

Approach 3

compute $\frac{1}{3} \left(\frac{X}{x} + \frac{Y}{y} + \frac{Z}{z} \right)$ as the “dread” effect.

It is then easy to see how Approach 3 can produce a *very* large “dread” effect eg suppose $X, Y, Z > 1$ and any one of x, y or z is very small eg $x > 0$, but close to zero, so that person 1

does a major “turn around” when context is introduced. In this case $\frac{X}{x}$ will be *very* large.

However, it is *not* so easy to see how Approach 2 can produce a much larger “dread” effect than Approach 3. But suppose that

$$\frac{X + Y + Z}{x + y + z} \gg \frac{1}{3} \left(\frac{X}{x} + \frac{Y}{y} + \frac{Z}{z} \right)$$

(where \gg means very much larger than)

$$\text{ie } \frac{X + Y + Z}{x + y + z} \gg \frac{1}{3} \frac{yzX + xzY + xyZ}{xyz}$$

or $3xyz(X+Y+Z) \gg (x+y+z)(yzX+xzY+xyZ)$

or $3xyzX+3xyzY+3xyzZ \gg xyzX+x^2zY+x^2yZ+y^2zX+xyzY+xy^2Z+yz^2X+xz^2Y+xyzZ$

$$\text{or } 2xyzX+2xyzY+2xyzZ \gg x^2 zY+x^2 yZ+y^2 zX+xy^2 Z+yz^2 X+xy^2 Y \text{ yzx}(2x-y-z)+xzY(2y-x-z)+xyZ(2z-x-y) \gg 0$$

A sufficient condition for this strong inequality to hold would be:

$$X \gg Y, Z, 1$$

and $x > y, z$ but $x \approx y \approx \delta$

Or (even more so):

$$X \gg Y \gg Z, 1$$

and $x > y > z$ but $x \approx y$ and $y \gg z$

Finally, consider Approach 1 and suppose that the basic contextless and contextual indices R^A and $R^B = (\text{all} \leq 1)$ are as follows:

Contextless Indices		
Individual	R^A	R^B
1	a	d
2	b	e
3	c	f

Contextual Indices		
Individual	R^A	R^B
1	A	D
2	B	E
3	C	F

Approach 1

$$\text{Compute } \frac{\frac{A+B+C}{D+E+F}}{a+b+c} \text{ as "dread" effect}$$

For this approach to produce a very large "dread" effect we would need

$$\frac{(A+B+C)(d+e+f)}{(a+b+c)(D+E+F)} \gg 1$$

or $(A+B+C)(d+e+f) \gg (a+b+c)(D+E+F)$

Under these circumstances, it would appear that *no* small subset of respondents could produce a very large "dread" effect by doing a major "turn around" when context is introduced and that such an effect would require that a substantial *majority* of respondents should do this.

In view of the possibility of “freak” results concerning “dread” effects, especially under Approaches 2 and 3 and the Hugh/Graham approach, it was decided to analyse our data using *all four* approaches.

In reporting the findings of the study we employ the following abbreviations:

fpp - fire in a public place
aih - accident in the home
cdriver - car driver/passenger accident
ped - pedestrian accident
train - train accident
dfire - domestic fire
hpp - hazardous production plant accident
drown - drowning

In answering the contextless risk – risk questions it turned out that 53 respondents employed some variant of the absolute risk equalization heuristic, 13 some variant of the incremental risk-ratio equalization heuristic and only 5 the expected utility heuristic. It is reassuring that the qualitative follow-up study (see below, Section 4) confirmed the main study interviewers’ impression that the vast majority of participants employed the same heuristic in answering the contextual risk-risk questions as they had employed in answering the contextless questions.

Mean “dread” effects relative to murder were computed under each of Approaches 1, 2 and 3 and the Hugh/Graham (H/G) Approach. These effects were then normalised with respect to the dread effect for pedestrian accident relative to murder, as *prima facie*, pedestrian accident appeared to be the least dreaded context. The results are reported in Table 1, the first column of which shows the mean ranking of the contexts from 1 (least dreaded) to 5 (most dreaded). As a result of the normalization, murder does not appear in Table 1. However, focusing on the original “dread” effects relative to murder computed under Approach 1 (which, it will be recalled, is arguably the least susceptible to distortion by aberrant responses) it transpires that *none* of the other contexts has a “dread” effect greater than 1, indicating that at least under that approach murder is the most dreaded of all of the contexts considered in the study.

Table 1 : Mean “Dread” Effects Relative to Pedestrian Accidents

	Ranking	Approach 1	Approach 2	Approach 2 (Trim 1 extreme outlier)	Approach 3	Approach 3 (Trim top and bottom 2)	Approach 3 (Trim top and bottom 4)	Approach 3 (Trim top and bottom 6)	H/G Approach	H/G Approach (Trim top and bottom 2)
Set S										
ped	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
aih	1.00	1.00	33.07	33.07	12.14	12.20	1.69	1.45	5.46	1.00
cdriver	1.22	1.58	1.06	1.06	0.47	2.86	1.57	1.38	0.87	6.16
train	1.33	3.54	2.76	2.76	18.25	18.77	5.18	3.92	0.52	6.70
fpp	2.32	2.79	3.22	3.22	55.21	35.97	17.63	9.82	0.49	6.94
Set B										
ped	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
cdriver	1.10	1.06	2035.78	1.03	15.18	4.00	3.19	0.97	2.75	5.79
hpp	1.39	1.56	2.40	2.40	0.38	0.34	1.00	1.54	0.74	0.71
drown	1.53	1.54	3.49	3.49	2.44	1.99	2.88	2.93	0.09	0.45
dfire	2.00	1.29	1.78	1.78	0.55	0.86	1.31	1.41	0.68	1.54

While these “dread” effects initially appear to convey a rather unclear and indeed confusing message, it should be borne in mind that Approaches 2, 3 and the H/G Approach are potentially susceptible to the influence of a few rogue outliers, particularly those who do a major “turn around” as between the contextless and contextual questions.⁶ However, on closer inspection – and placing rather more weight on Approach 1 than the other approaches – a fairly clear pattern does emerge. The first and rather encouraging point to note is the close correspondence between the means of respondents’ initial ranking of the contexts in terms of dread and the mean “dread” effects produced by Approach 1 and Approach 3 with the top and bottom 4 responses trimmed out. In turn, bearing in mind that the original “dread” effects relative to murder computed under Approach 1 clearly indicated that the latter was the most dreaded of all contexts, it seems clear that murder, train accidents, fires in public places and drowning can all clearly be regarded as dread risks in the eyes of the public. In the case of hazardous production plants, domestic fires, car driver/passenger accidents and accidents in the home, the picture is mixed, with some approaches showing a clear “dread” effect and others not. Finally, the only context which fairly constantly shows up as having no “dread” effect – or at least a very small effect relative to the others – is pedestrian accidents.

The kind of thought processes that underpinned the quantitative results reported in Table 1 are discussed in the next section.

4. *The Qualitative Follow-Up Study*⁷

Objectives

The objectives of the qualitative component were as follows:

1. To gain an insight into:
 - respondents’ understanding of ‘risk- risk’ questions
 - their appreciation of three possible response strategies, and
 - their explanations for their own responses.
2. To examine the effect of context on response strategies and switchover points, whether a consistent strategy is used throughout contextless and contextual questions, and how any context effect is understood by respondents.

Methods

A small sample of respondents undertook a sub-set of questions selected from the larger study protocol (see Section 1). Thirteen semi-structured interviews, guided by an interview schedule, were conducted. The interview schedule was essentially driven by the main focus-group study and was devised to explore the reasons behind responses to ‘risk-risk’ questions. As such the structure of the interview mirrors the

⁶ It is also worth remarking that Approaches 2, 3 and the H/G Approach all violate the Risk-Risk counterparts to conditions 1, 2 and 3 laid out in Appendix B of Chilton et al, 2002 as essential requirements of any procedure for using matching data to infer VPF relativities.

⁷ The qualitative study data analysis was carried out by Dr Rachel Baker

group work but respondents were encouraged to make additional comments if they chose to.

Interviews were tape recorded and transcribed verbatim⁸. The transcripts were then imported into NVivo qualitative analysis software {QSR 2000 934 /id}. This software allows indexing, searching and retrieval of data for qualitative analysis. Basic thematic analysis involved the systematic coding of all transcripts, using an evolving coding frame. (This means that as new themes emerged the coding frame was altered to incorporate them.) Themes are described and illustrated with verbatim quotation from the interviews.

Because of the small qualitative sample there is no attempt at statistical generalisation and so quantification is generally unhelpful; this is the role of the main quantitative study. The aim here is to examine, in-depth, the responses given in a small group of participants, in order to gain insight into the meaning of quantitative findings. However, where themes were common to many or all respondents, this is indicated.

Interviews

Interviews were conducted following the qualitative group sessions. During the individual interviews, reference was made to the group session, and to individuals' own responses. The interviews were organised in three main sections:

Firstly, following a brief reminder of three possible strategies (absolute risk equalisation, incremental risk ratio equalisation and expected utility maximisation), respondents were asked if each strategy in turn "made sense" to them, and whether they understood why some respondents might answer in each way (even if they had not followed the strategy themselves). They were then asked to comment, similarly, on the consideration of total risk in responses.

In the next section the interviewer referred directly to the exercises respondents had completed and asked about their own responses to the questions, for each of the contextless and contextual questions. Respondents were asked to explain the strategy they had adopted and how they arrived at their "switchover" point.

Contextless questions were then compared with responses to contextual questions and respondents were again asked to consider their strategies and switchover points and explain any changes either to strategy or switchover point as a result of the introduction of context. Finally, the ease of the task for both question types was discussed.

Findings

Following some brief introductory comments, the qualitative findings are presented in four main sections. Firstly, respondents' views of three possible strategies for answering the questions are described, in particular whether or not they can appreciate the rationale behind each strategy regardless of whether they themselves had adopted

⁸ In one case the tape was faulty and the findings of this interview were recorded by the interviewer in brief field notes

those strategies. The second section describes the strategies used by respondents to arrive at their own responses and how they articulated and justified their strategies. Thirdly, the effects of context on both strategy and switchover point is considered and how any context effects are explained by respondents. Finally, themes which reveal misconstrual of questions or particular aspects of the exercises are presented and the validity of responses is discussed.

Introduction to findings

Respondents were generally able to articulate a rationale for their responses. None of the respondents failed to provide an explanation for their answers and most answered in full, using examples to illustrate their points. It was apparent from the interviews that they had engaged with the tasks presented to them. Answers were considered and respondents asked interviewers to clarify when they were unsure of the question asked of them. Although one respondent admitted to some confusion, changing his responses when asked to explain them during interview, most respondents demonstrated good comprehension and were prepared to discuss and verify their responses.

Section 1: Alternative Strategies

In the first part of the interview, interviewees were reminded that there are several possible strategies which can be adopted in response to risk- risk questions. Absolute risk equalisation, risk ratio equalisation and expected utility maximisation strategies were described by the interviewer, with reference to the group work preceding the interviews. Respondents were asked, for each strategy, whether they could appreciate such a rationale, irrespective of whether or not they themselves had selected to use it.

Absolute risk equalisation strategy

Absolute risk equalisation, as the most common strategy adopted, was unsurprisingly well understood and supported in the 'thought experiment'. All respondents could see why such a strategy would be employed.

“Q. OK. And how about your one where we added 10 in 50 million to 1, someone chose Accident 1 and then decided to keep increasing the risk of Accident 1 until it was sufficiently big to go back to ‘2’, a 10 in 50 million on Accident 2 to make it 560. Why might people want to do that? What do you think about that? Does it make sense?”

A. Yeah, I mean to me I think you get to a almost level it off but you would think well probably get to a point just short of level and think enough’s enough here and go back and concentrate on the other one again.” Respondent 12

When asked if they could understand an absolute risk equalisation strategy, many respondents referred to their own choices and explained why this type of equalising made sense to them. Terms such as “balancing up”, “evening up” and “levelling out” were commonly used.

Q. OK and when we were talking about how big would the risk have to be on Accident 1 to make you swop, can you remember what X you chose?

A. I think I balanced them out to be 530.

Q. So that's what you were doing?

A. Yes. What I did was even them up.

Respondent 02

Absolute risk equalisation was a strong theme when interviewees were asked to explain their own choices and is dealt with in more detail in the next section.

Incremental risk ratio equalisation strategy

Next, a strategy in which respondents selected to increase the risk of the accident with the higher initial risk (Accident 2 in the example), was described to respondents. Most could appreciate a logic in this strategy in terms of the proportionate increase in risk – i.e. the same increase of 10 in 50 million added to an already relatively high risk such as 550 in 50 million, was seen as a smaller increase in relation to the initial risk level, when compared to 10 in 50 million added to a smaller number where the increase might be as much as 50%. Reword this definition based on definition in main report

Q. Now I'm just going to talk through the different kinds of strategies that people can use just to make sure you have them in your head. So first of all, adding 10 in 50 million to increase Accident 2 until it's sufficiently big and then changing the risk to Accident 1. So does that kind of strategy make sense to you, what do you think about that, although you might not have chosen it, can you understand why someone else would?

A. Yes I can understand.

Q. How do you think they were thinking when they were doing that?

A. Because you're adding 10 to the higher figure there, and percentage wise there's not much difference. Whereas adding 10 to the shorter figure, sometimes you're actually doubling the percentage. Respondent 06

Others rejected the 'percentage strategy' as a poor strategy but recognised nevertheless that other respondents might choose to follow it.

Q. So, say you added it onto 550 and carry on increasing that until you felt comfortable, what do you think of that as a technique as a way of doing it? Good, bad?

A. Bad, no I wouldn't do that.

Q. So you wouldn't want to increase the big one?

A. No.

...and from the same respondent slightly later in the interview

A. Fine, because that's a bigger number anyway so if you're increasing the 10, is it 10%?

Q. No it's 10 in 50 million.

A. Right. Well that would be OK.

Q. It's OK but it's not something that appeals to you?

A. No.

Respondent 09

Another respondent admitted to failing to see the logic in alternative strategies, such as an incremental risk ratio equalisation strategy.

Q. Why might they choose to do that? What might they be thinking when they look at these 2 figures, bearing in mind that an increase in 10 is 50% of that when it's only 5.5% of that. I know you didn't choose it, it's not you're logic but can you understand the logic behind it?

A. Actually, no, because it's just increasing a bigger percentage of people that died, from whatever it is that they died from or at risk.

Respondent 03

Expected Utility maximisation

The Expected Utility maximising strategy (cross reference with earlier definition) was understood by a few respondents but others had difficulty appreciating why individuals might respond in this way.

Example of good understanding

Q. Right. How about the next one which is the idea of 'you don't mind': You can add 10 in 50 million to either of those but if it goes higher you go back. You choose the other one. So for example you might choose Accident 1 and add the 10 on. If it was 11, you'd go no just add it onto 2.

A. Yes, 'cause you're increasing your multiples by the way its going up so if you're starting to go 11 instead of 10 you'd switch back because you are trying to keep the increase lower.

Q. Right. So you didn't do that but you could see why someone would?

A. Yes, see why people would do it. Going up and down then makes it the actual number of incidents is going to actually increase by a number each time so you'd swap back to keep it down to 10. Respondent 12

And..

Q. The second one is that you just didn't mind where you put the risk after all you've got a 10 in 50 million risk increase so they put it on Accident 1, and as soon as you increase that again they put it on Accident 2 so it's just the switch like that.

A. *Backwards and forwards.*

Q. *And you understand that strategy?*

A. *Yes. Respondent 04*

Example of questionable understanding

Q. *OK. So let's take another strategy. Another strategy is to say "I don't actually mind which accident is increased by 10 but immediately one of the accidents is increased more than 10 I'll switch the one that's increased by 10. Remember that's what <interviewer > was talking about?"*

A. *Yes.*

Q. *So what do you think of that?*

A. *Personally I think it's more of a percentage kind of risk so if you say it's going to increase by 11 but there's only a very small risk of it happening to people, I think that marginal 1 is not important. I think say it's 3 people and say it increases by the extra one, I think that's much more crucial because if there's 550 people for example and 1 it's relatively negligible that it's going to make much of a difference." Respondent 07*

Summary

Whilst the most comprehensive understanding was associated with the strategy respondents had adopted themselves, and whilst the nuances of alternative strategies had differing resonance for different respondents; all of the respondents appreciated that there were several alternative strategies, three of which had been presented to them, and that they might also select to use a strategy that had not been described.

Q. *He was just saying if that goes up by 10 and that goes up by 10, I might pick that one, but if that one goes up by 11, I will definitely pick the other one, or if the other one goes up by 11 I'll pick the other one. That's what he was saying.*

A. *Yes I agree.*

Q. *I'm not asking you to do it, but you understand what he was saying and it's sensible as well?*

A. *Yes definitely. Respondent 08*

In the following quote, respondent 01 accepts the logic in an alternative strategy whilst choosing to adopt an absolute risk equalisation strategy in his own answers:

A. *I can understand conveying an Accident 1 and Accident 2 you could increase your risk factor but I don't think I'd consider Accident 1 and 2 together, I considered them separately*

Q. *That's fine. Some people consider them together.*

A. I never thought of considering them together but I think there was a good point. Respondent 01

Total risk

Total risk was explained in the group session and repeated later in the interview and respondents were asked to consider the importance of total risk. Respondents variously focussed on individual and total risk or some combination of the two:

Q. So how important if at all was this total risk of death to you when you were choosing the switch over point in either of the thought experiments or in any of the questions?

A. I didn't really think about it that much just each X. Respondent 05

Q. So was that important to you?

A. Yes it was.

Q. You considered the total risk?

A. Yes. Respondent 03

This respondent recognises that total risk is an issue of importance stating that "somebody has got to work out what an acceptable level is":

Q ...So how important do you think this total risk is as opposed to the individual risks?

A. It's figures again, that total risk has got to be kept down to a reasonable level. Somebody has got to work out what an acceptable level is. At the end of the day I don't think you can keep on increasing things without the total risk getting too disproportionate

Q. OK, but when you were choosing either 1 or 2 would you think of the total or focus more on 1 and 2?

A. Since <interviewer> mentioned it, no I was looking individually at the totals. Then when you stop adding it up and then realising it's your total risk factor that you have to look at" Respondent 11

The qualitative data suggests that during the thought experiment all respondents understood that there are various possible response strategies, which may or may not include their own. Furthermore, several respondents were able to articulate an understanding of several strategies in detail. The potential importance of total risk was noted, and while some described the inclusion of a consideration of total risk in their own responses, others described a response strategy which regarded the risk levels entirely separately.

Section 2: Response strategies: contextless questions

This section describes the explanations given for responses to four ‘risk-risk’ questions. In contrast to the first section of interview where strategies were mainly discussed in the abstract, here respondents were asked to go through the questions they had answered and explain the strategies they had taken in selecting, firstly, for which accident to increase the risk and secondly, at what point to stop increasing the risk of that accident and instead to increase the alternative by 10 in 50 million (their ‘switchover point’). The effect of context on those strategies is presented in section 3, here the data relate to the contextless questions i.e. the strategies adopted at the outset and before the type of accident was stated. In these questions respondents were simply dealing in terms of Accidents ‘C’, ‘E’ and ‘G’.

Most respondents used a variation of an absolute risk equalisation strategy when presented with the contextless questions. In doing so they selected to increase the relatively low risk accident, raising that figure either to a point of (near) equivalence, or to a point at which they became ‘uncomfortable’ with raising it any further.

Absolute risk equalisation

‘Levelling out’ or ‘evening up’ the risk by raising the lower figure was the most common strategy used and some respondents followed this through to the choice of switchover point, aiming to make the two risk levels equivalent, described in the quotes below:

Q. Can you just briefly say a little about how you arrived at that number and why?

A. I think it was just once again an evening up of the risk factor and because once again I didn’t know what type of accident it was going to be it didn’t really make any difference. I didn’t want to increase the 250 so I consequently thought I would increase the 50 which is Accident E and level it out, so the 190 plus 50, 240 round about the same risk, so not an issue. Respondent 01

Q. So what did you think about that as a strategy?

A. I would go with that as well but I’d change to Accident 2 as soon as Accident 1 got to the same level. Respondent 08

Approaching absolute risk equalisation

Others began with the same strategy, opting to raise the lower figure, but rather than allowing it to increase until the two were equal, they chose to switch to raising the risk of the alternative accident at some other point. When asked about how they arrived at their switchover points, interviewees described becoming ‘uncomfortable’ with raising the risk higher. Respondent 07 specifically establishes a decision rule allowing the risk to rise to a threshold of half the risk of the alternative in selecting his switchover point.

Q. OK. And then you increased that amount to 490 on the next sheet, so can you explain what you were thinking about at that point?

A. I was thinking here more of what the accidents were in terms of how I was perceiving them and I was prepared to get up to about somewhere by near half of the Accident C to Accident G, just in my own mind I was feeling quite comfortable with it being half but not much more. Respondent 07

Q. Again when we asked you how far you would go you said you would increase it by 1000, so that would take your total risk to 1200 and a bit. So what were you thinking about when you did that?

A. Keeping it less than the other one, but letting it increase.

Q. So you let it increase at some point?

A. Keeping it down a bit. Respondent 11

On the other hand, respondents could select the lower figure and raise it to a value higher than the risk of the alternative accident. Respondent 05 faces a choice of increasing accident C with a personal risk of 255 in 50 million or accident E associated with a personal risk of 32 in 50 million. She opts to increase E (the lower figure) by 10 in 50 million and continues until X (the increase) is 460 in 50 million. On face value this does not appear to be consistent with one strategy in particular. One possibility is that this respondent begins with an equalisation strategy and then changes strategy, adopting an EU maximising strategy (which is perhaps what is being described in the quote below as 'leap frogging').

Q. So you chose to increase Accident E when we had to choose which one to increase by 10 and 50 million. Can you just tell me a bit about why you chose to do Accident E, why did you choose to increase the risk of E?

A. Because it was the lower, if something is 250, the average of it happening is increased you may as well as well choose your lower one and increase on that.

Q. What was your aim when you were doing that?

A. I suppose you're looking to make everything about the same average across the board of being in most accidents. I mean really, it doesn't matter what way you die, I don't think it matters to be all the same.

Q. Then the X, the switch over point that you identify was 460 in 50 million before you would choose to switch to C, could you just explain why you chose that number and how you arrived at it.

A. I think because I had no strategy really I just kept thinking you may as well go above the average and then a bit because when you switch, the other one's going to be lower so you are playing a bit like leap frog all the time. Respondent 05

Expected Utility Maximisation

One respondent in the qualitative sample described an expected utility maximisation strategy in his responses. Unfortunately a malfunction with the tape recording equipment for this interview means that no verbatim transcript is available for this individual. However, field notes were recorded by the interviewer and the respondent's comments summarised.

In adopting this strategy the respondent focussed on the increase in total risk. He showed little interest in which accident incurred the initial increase in risk of 10 in 50 million, but when asked to raise the risk of either the same accident by 20 in 50 million, or the alternative accident by 10 in 50 million, he showed no hesitation in switching his selection immediately to the alternative. He explained his choice in terms of the total risk of death, irrespective of cause of death. Whilst he did not use the language of expected utility theory to articulate his choice, his rationale was clearly consistent with this strategy.

Other strategies

There were no examples in the qualitative sample of respondents taking an incremental risk ratio equalisation strategy and only one example of Expected Utility maximisation in answers to contextless risk-risk questions. There was some evidence, however, that in selecting an absolute risk equalisation strategy, respondents gave some consideration to the proportion of the increase.

Consideration of proportion in switchover point:

Q. OK. So you chose to increase C, and it was 10 in 50 million, can you tell me why you chose C?

A. Lower figures again, bringing them up to a percentage of the high figure.

Q. OK. Then you chose to bring it up to 190 so it would be 390 for C until you switched to G, so why did you choose that number?

A. 190 is just under 100% increase, do you know what I mean? Respondent 04

Q. (describes equalising strategy). So what do you think about that one?

A. Once again it's obviously a smaller number but if you double that, once again you're doubling your personal, so if you go from 40 you've still got a 550 but you haven't increased your odds so obviously you are more prone to being like doubling. If you increase that to 60 you've gone up by 200% so your risk is in actual fact greater than it is on the 550 because you haven't increased it even though the general number is bigger in the first place. But from my personal point of view your personal risk would be greater. Does that make sense? Respondent 10

The effect of context on responses

Following the contextless questions in which accidents were represented only by alphabetic labels and risk statistics, the risk-risk questions were then repeated, this time identifying the type of accidents as: fire in a public place, murder and car driver/passenger accident. Interviewees were asked about to explain their responses to these contextual questions, as they had the contextless questions before, and to explain any changes in their responses with the introduction of context.

Respondents answered in different ways with the introduction of context, some retained their focus on the risk statistics, maintaining their strategy from the earlier questions, whilst for others the context of the accident altered their approach. In the quote which follows, the respondent is unaffected by the feelings attached to the risk context and focuses only on the statistics.

Q. OK. So you chose murder again there, can you tell me why you did that?

A. Lower figure.

Q. What did your feelings play a part in this one or not as much?

A. Not feelings no, just lower figures, just statistics. Respondent 04

For those who explained their responses in terms of the statistics (i.e. whose answers were not affected or only slightly affected by the contexts of the accidents) there was, at times, a tension between their 'loyalty' to a strategy which made sense to them when the accidents were not specified, and their own preferences between types of accident when they were specified.

A. I chose J but I found it difficult to choose because my perception was that it would be worse to die in a fire, so it was a hard one to choose from, even though the waiting is less, it wasn't as straight forward, I had to think about, it wasn't a straightforward decision.

Q. So if you could summarise for me why you chose J, what would you say?

A. It was still a lower risk, in the end, even though it would be worse for me personally because the risk was still lower.

Q. So you did consider your feelings towards these accidents?

A. Yes.

Q. But in the end the risk statistics won for you?

A. Yes they won because there is a greater chance of survival, or less chance of getting killed. Respondent 02

- A. *I had big trouble with this one and ummed and ahhed because once again I was confronted by my least favourite way being murder, so to actually wanting to increase my risk was slightly puzzling. But I thought the value of a car driver 1500 was quite high as well, so I still chose to increase the murder one even though it was my least favourite one. What I had big difficulty with was I couldn't even up on this one, and I couldn't easily decide where I would stop on this one. It wasn't just a matter of taking 250 from 1500 and I would even them up, I actually thought how far am I prepared to go and I found this difficult. Because what I was faced with was my least favourite way and my favourite way and its hard to balance the two out. Respondent 01*

The most common response to the introduction of context was a change in respondents' choice of switchover point, whilst maintaining a strategy of selecting the lower risk figure and increasing it to a point. This change was explained in terms of the impact of thinking about the mode of death as well as the risk of death, about 'feelings' as well as 'statistics'.

Differences in switchover point were explained in terms of personal responses to, and individual understandings of the nature of the accidents. Individuals' perceptions of the accidents and their reactions to them differed. Many expressed a dread of one particular mode of death. Their responses related to both anticipation of their own suffering, and (especially in relation to murder) the effect of a particular means of death on others who were important to them. Boxes 1 and 2 show the range of interpretations of and reactions to the accidents in question.

Box 1: murder versus car accident

Duration of suffering

Q. OK so again you have spoken about the statistical risk, what about your feelings, in terms of the type of incident?

A. Once again, I think if you were going to be murdered, the chances are it could be quite quickly say if someone shot you with a gun. But in a road accident you could suffer, say if it happened on a lonely road at night, you could suffer until the medical services got there which could take 20 minutes to half an hour, you could be in immense pain, bleeding to death. I couldn't imagine, it's not very nice. Respondent 10

Effect of means of death on others

A ...There is also the risk of who is left behind, I think that would be worse to come to terms with for the people left behind.

Q. So was that in your mind when you were bringing figures in?

A. When I filled the increases in yes, because I was thinking whoever is left behind has got to come to terms with it and it must be ... I don't know how you would cope with losing somebody like that, (murder) you would always be wondering why. Respondent 11

Awareness and anticipation

Q. How did the feelings about those two accidents play if at all?

A. Er, I think the chances of being more aware of the death in the car than you would by a murder because it's going to come out of the blue. Most people suddenly come from behind or whatever so the chances are you're not going to see it so you're gone. The car accident, I could see it coming front, side or from behind. There's a chance I'm going to see it, be trapped. Die at the scene but I could be crushed. Obviously wouldn't want to do because I've suffered a bit from claustrophobia when I was younger. I'd hate to be crushed in a car. Respondent 12

Box 2: murder versus fire

Murder and ethics

A. Because I work with victims of crime and part of that is murder and I've seen the damage that murder does and to me although fire is probably the worst way that I can probably think of dying, in reality it's probably not, you know like you're breathing the smoke and you're probably dead after about 30 seconds. So to me although fire is a horrible way to die, in relation to what I think the public should be protected from, I would rather they were protected from murder than fire, because fire is accidental and there's not one person wanting to kill someone else. It's more ethical.

Q. You said that you would keep increasing fire and you wouldn't change, so is that at no point because in the end you are definitely going to die by fire where it's only going to be 250 in 50 million chance of dying in a murder. So you wouldn't really change until it got really high?

A. Yes I suppose it's just the ethical thing I think that fire is a risk and it's just the menace behind murder and I think it is probably a really horrible way to die, in reality to what my fears are .Respondent 05

Fear of fire

Q. Right. The Accident C and Accident E and then murder and fire they had much the same personal risk and you had a bit of a difference between the switchover points.

A. Yes.

Q. Can you say a little bit about why that was slightly lower.

A. Because of the fear of fire. The pain involved in a death by fire as opposed to a murder incident of a Accident C or whatever. Respondent 12

In many examples, respondents maintained their strategy from contextless to contextual questions, a point which respondent 01 explicitly recognises:

Q. But when you knew the accident types you still kind of thought that but then thought...

A. Yes I didn't go as far. I had the same strategy, I wasn't prepared to crank it up as much, does that sound right? Respondent 01

For others their initial strategy (i.e to increase the lower figure) was altered by the context. Four respondents (04, 05, 08, and 11) switched from choosing the lower figure to the higher figure in one of the contextual questions. This was explained by the strength of feeling some respondents related about dying as a result of a specific accident.

A. The fire terrifies me.

Q. OK, you were frightened of the fire so therefore even though murder had a higher risk it was simply your feelings towards that?

A. Yes it was the feelings. Respondent 11

Ease of questions

Lastly respondents were asked to comment on which type of questions they found easier to answer, the contextless questions, or the questions with accidents identified. Both possible responses were given. Those who found the contextless questions commented on the complexities involved in the contextual questions:

Q. OK. So finally what kind of questions did you find it easier to think about your switch over point for, the one's where you knew just your level of risk or where you knew the accident as well, which one did you find easier to decide for a switch over point?

A. I actually found that a bit harder because the way I was just evening numbers up when I knew what the accident was it stopped me in my thoughts and I didn't know whether I was prepared to accept your offer to murder incident, how much would I like that to be increased, before I said no I don't want to increase that any further because that's my least favourite way of dying in a murder incident. So how much am I prepared that to go up, I suppose on second thoughts I probably would not like that to go up at all, if I think about that for 5 minutes. Respondent 01

The potential for tension between a strategy which seems sensible in the first instance, and the introduction of moral and ethical issues or emotional responses was also noted earlier in this section.

A. The risk without the accident.

Q. Why was it particularly difficult for the one where it's context?

A. Well if you don't know what the crime is than it's just numbers isn't it, so it's easier to think well that's practical and that's economical or that's the best thing. But what's best is not always ethical. Respondent 05

Those who found that the addition of some context made the exercise easier discussed the meaning attached to their responses. Contextless responses were seen as more arbitrary.

Q. OK. One final question, did you find it easier to fill in the sheets when you were just looking at the letters or when you were looking at the actual incidents?

A. I think the actual incidents because you can take more of a personal, if this happened to me type thing. Whereas it's a bit to hypothetical if you've got the letters because you haven't got the whole picture to make an informed decision. Respondent 07

Summary

The introduction of context in the risk questions had different effects for different respondents. For some the statistics 'won-out' – they persisted with their response strategy and gave similar explanations for their responses in both sets of questions and in spite of the additional information provided in the contextual questions. Others maintained their response strategy but deliberately altered their responses to reflect their relative preferences between the specific accidents presented to them. This group still sought to increase to the lower risk figure but changed their switchover point and explained that change in terms of their personal interpretation of what it means to die in a particular way. Four respondents switched from increasing the lower figure to adding risk to the higher figure when presented with specific accidents. They justified this modification to their responses by their anxiety to avoid one mode of death in particular. There were, once again, mixed opinions with regard to the relative ease of the contextual and the contextless questions. Contextual responses were viewed both as more meaningful and more complex.

Misconstrual and Validity

The qualitative data also reveal some minor points of potential misunderstanding among participants. One respondent realised his own confusion and corrected his responses during interview. However, confusion about personal versus population risk was observed at some point during three different interviews and is worth noting.

Population versus personal risk

Respondents were presented with population risks as part of the group exercises. They were later asked to assign personal risk values as part of the risk-risk questions. It is important to the validity of their responses that they proceed to construe the questions in terms of their own personal risk. However some responses revealed misunderstanding, or reinterpretation of the risk statistics.

The following interviewee considers the factors affecting individuals' personal risk of each accident, stating in particular that murder is more likely to happen to people "in the wrong circles" who "live by the sword and die by the sword". He perceives his own personal risk of murder to be very low and uses this argument to justify a lower than average risk statistic for himself. However, when the risk-risk question is posed, he continues to reinterpret the risk information.

Q. ... You chose to increase murder, the smaller one?

A. Yes

Q. You took murder through to 1500 so what were you thinking of when you did that?

A. Well once again you are thinking on a personal point of view. I drive on average about 10,000 miles a year which is more or less average now. People don't do as many miles as they used to due to the price of fuel.

Q. Absolutely.

A. So once again you are thinking 1500 to be murdered, I wouldn't want to increase my odds on a road accident because I do drive, do you know what I mean? Respondent 10

Similarly respondent 12

Q. ... why you chose to add the 10 in 50 million to murder?

A. Well, the risk of the car death is quite considerably higher than the murder risk and personally I think I'm more likely to be hit by a car or be in a car in an accident than be murdered, er, so I felt I could increase that risk without personally feeling that I was going to increase it because I think I'm probably below average. Murder in this region has gone up a bit over what it was but it's not, I wouldn't have said where we live is a high risk area.

Q. So you would allow some increase in it

A. I'd increase the murder over a car because personally I have a fear that I've more exposure to a car driver/passenger death than a death by murder. Respondent 12

The potential for reinterpretation of the risk figures is apparent in these responses.

Summary

The qualitative interviews allowed a small sample of respondent to explain their responses to contextless and contextual risk-risk questions. Analysis of these interviews revealed that respondents had engaged with the questions presented to them and were able to justify their responses to them. They were generally able to appreciate alternative strategies and explain their own response strategies.

The introduction of context had different effects for different people, some of whom maintained very similar responses and focussed mainly on the statistics, whilst others adopted the same strategy but arrived at different switchover points. Four respondents changed their strategies because of their dread of a specific accident which they went on to describe in strong terms. For the most part qualitative accounts were supportive of the validity of responses to risk-risk questions, but one area of potential misconstrual (confusion between personal and population risks) has been highlighted.

5. *The “Absolute Risk Equalization” Heuristic*

One’s first reaction to the quantitative findings of the Newcastle-based focus group study of dread effects in relation to the risk of immediate death in different contexts is, understandably, surprise – and indeed concern – at the prevalence of the “absolute risk equalization” heuristic. Under this heuristic, faced with an increase of $\frac{10}{n}$ in

either context A whose baseline risk is, say, $\frac{400}{n}$ or context B in which the baseline risk is $\frac{10}{n}$, the respondent would choose to increase the risk in context B and would reach indifference only when the increase in the risk in context B had become very large and, in the extreme version of this heuristic, had approached 400.

Initially it appeared to the research team that expected utility maximization – and indeed rationality in general - required that, in the absence of any dread differential between contexts A and B, an individual should be indifferent as to whether the $\frac{10}{n}$ increase in risk is added to A or B. However, as demonstrated in Appendix A, if the risks in contexts A and B are treated as being independent rather than mutually exclusive – and there are good grounds for believing that independence is the more plausible assumption – then a rational individual would strictly prefer the increase of $\frac{10}{n}$ to be applied to context B and would reach indifference between an increase of $\frac{10}{n}$ to context A and an increase of $\frac{x}{n}$ to context B when $x > 10$. Furthermore it transpires that as $n \rightarrow 410$ from *above* then $x \rightarrow 400$ from *below*. This having been said, with $n=50$ million, as in our study, x would only exceed 10 by a *minute* amount. However, suppose that a respondent effectively ignored the information about the size of n and effectively treated n as being in the region of 410. Under these circumstances employment of an “absolute risk equalization” heuristic – or at least a variant thereof – would not appear to be so bizarre.

This more positive slant on the quantitative findings of the study is substantially reinforced by the findings of the follow-up qualitative study which suggest that most respondents understood the questions that they were asked, thought carefully about them and gave answers that were indeed reflective of their feelings of fear and dread concerning the premature fatality risks in different contexts.

In the light of all this, we feel reasonably confident that the study has correctly identified murder, train accidents, fires in public places and drowning as being clear dread risks in the eyes of the public, with hazardous production plants, domestic fires, car driver/passenger accidents and accidents in the home of more doubtful status and pedestrian accidents having no dread effect as such, or at least only a very minor effect in relation to the other contexts considered in the study.

6 Policy Implications of the Newcastle Study Findings

It will be recalled that in the pre-Ladbroke Grove study (commissioned jointly by the HSE, DETR, Home Office and HM Treasury) it was found that the value of preventing a statistical fatality (VPF) for each of rail accidents, fires in public places and domestic fires stood at a discount in relation to the roads VPF – see Chilton et al (2002). In turn, in the post-Ladbroke Grove study (commissioned by the HSE) only the rail VPF had risen to effective equality with the roads figure. These findings are also reported in Chilton et al (2002). In particular, denoting the roads VPF by VPF_{RD} , the rail figure by VPF_{RL} , the fires in public places figure by VPF_{PF} and the domestic fires figure by VPF_{DF} , the relative valuations were as follows:

Table 2: Relative Valuations

	Pre-Ladbroke Grove	Post-Ladbroke Grove
VPF_{RL}/VPF_{RD}	0.834	1.003
VPF_{PF}/VPF_{RD}	0.923	0.960
VPF_{DF}/VPF_{RD}	0.926	0.890

Given that the present study has clearly identified rail accidents and fires in public places as dread risks, at first glance it may seem puzzling that in the pre-Ladbroke Grove study both VPFs stand at a discount in relation to roads, while in the post-Ladbroke Grove study only rail has risen to effective equality with roads. However, in the focus group discussions in both the pre and post-Ladbroke Grove studies it became clear that in addition to considerations of dread *per se* many respondents were also influenced by the baseline level of risk in each of the contexts concerned and, to the extent that in the case of rail and fires in public places the baseline level of risk is substantially lower than for road accidents and in the case of domestic fires less than one third of the roads figure,, it seems clear that the baseline risk effect is to all intents and purposes cancelling out the dread effect.

With this in mind it was decided to regress the absolute VPFs implied by the relative valuations given in Table 2-together with the current absolute roads figure of $\text{£}1.25 \times 10^6$ -on mean dread effects derived under Approach 1 and reported in Table 1, as well as mean baseline levels of risk which were as follows (though of course hazardous production plant, pedestrian, murder, drowning and accident in the home were not included in the regression analysis as we do not have VPF estimates for these contexts).

Table 3: Baseline Average Annual Risks

Car driver/passenger	1400 in 50 million
Train	40 in 50 million
Domestic Fire	400 in 50 million
Fire in public place	30 in 50 million
Hazardous production plant	250 in 50 million
Pedestrian	800 in 50 million
Murder	250 in 50 million
Drowning	100 in 50 million
Accident in the home	2000 in 50 million

Given that car driver/passenger accidents featured in both set S and in set B, the regression analysis was based on a total of five observations, namely rail, fires in public places, domestic fires and two observations on roads. While a number of specifications were tried, by far the best fit was a linear function constrained to pass through the origin given that with zero dread and zero baseline risk one might reasonably expect a zero VPF. More specifically the regression equation took the form:

$$VPF_i = \alpha B_i + \beta D_i + u_i$$

where B_i is mean baseline risk in context i , D_i is the mean dread effect and u_i is a random error term. The data for the VPF values and values for B and D were drawn from different studies, we are therefore implicitly assuming that the underlying characteristics of the two sample groups are the same. The regression results were as follows:

Table 4: Regression Results

	Pre-Ladbroke Grove		Post-Ladbroke Grove	
	<u>Coefficient</u>	<u>Pvalue</u>	<u>Coefficient</u>	<u>Pvalue</u>
B_i	3.00×10^{10}	0.040	2.81×10^{10}	0.030
D_i	358,782.6	0.014	391,786.1	0.006
	Adjusted $R^2 = 0.9294$		Adjusted $R^2 = 0.9537$	

The first thing to note about these regression results is the quality of the fit for both the pre and post-Ladbroke Grove subsamples, though it has to be admitted that the latter are almost certainly in large part a reflection of the very small sample size. Clearly, therefore, the regression analysis tends to confirm the hypothesis that at least for the contexts considered in the Newcastle study, baseline risk effects are indeed effectively offsetting pure dread effects, thereby yielding VPFs that do not differ greatly between contexts, with the possible exception of domestic fires where it appears that baseline risk effects *more* than offset dread effects. Indeed if one computes the VPFs predicted by the estimated regression model then the results are as

shown in Table 5, where VPF_{RDS} denotes the VPF_{RD} for subsample S and VPF_{RDB} that for subsample B.

Table 5: Predicted VPFs

	Pre-Ladbroke Grove	Post-Ladbroke Grove
VPF_{RDS}	$£1.4069 \times 10^6$	$£1.4058 \times 10^6$
VPF_{RDB}	$£1.2203 \times 10^6$	$£1.2021 \times 10^6$
VPF_{RL}	$£1.2941 \times 10^6$	$£1.4094 \times 10^6$
VPF_{PF}	$£1.0190 \times 10^6$	$£1.1099 \times 10^6$
VPF_{DF}	$£0.7028 \times 10^6$	$£0.7302 \times 10^6$

In turn, the contribution of the baseline risk and dread effects to each of the predicted VPFs are as shown in Table 6.

Table 6: Contribution of Baseline Risk and Dread Effects to Predicted VPFs

	Pre-Ladbroke Grove		Post-Ladbroke Grove	
	Baseline Risk	Dread	Baseline Risk	Dread
VPF_{RDS}	£840,000 (60%)	£566,877 (40%)	£786,800 (56%)	£619,022 (44%)
VPF_{RDB}	£840,000 (69%)	£380,310 (31%)	£786,800 (65%)	£415,293 (35%)
VPF_{RL}	£24,000 (2%)	£1,270,090 (98%)	£22,480 (2%)	£1,386,923 (98%)
VPF_{PF}	£18,000 (2%)	£1,001,003 (98%)	£16,860 (2%)	£1,093,083 (98%)
VPF_{DF}	£240,000 (34%)	£462,830 (66%)	£224,800 (31%)	£505,404 (68%)

Clearly, therefore, while dread effects have a very marked impact on the VPFs in the case of rail and fires in public places, these effects are offset by the impact of very low baseline risks in these two cases.⁹ This, together with the pre and post-Ladbroke Grove VPF estimates reported above in Table 2 indicates that there would appear to be no grounds for marked differences between monetary values of safety in the various contexts considered in the Newcastle study. Indeed, considerations of administrative convenience and of treatment equity between contexts, taken together with the findings of this study strongly suggest that a *uniform* VPF equal to the roads figure should be applied to the contexts concerned.

⁹ By way of comparison, we have also carried out the regression analysis on the dread effects predicted by Approach 3 with the top and bottom 6 outliers trimmed (see Table 1). The results indicate that the relative baseline risk and dread effects are broadly similar to those reported in Table 6. For a more detailed discussion of the Approach 3 regression results see Appendix B.

Finally, it is clear from both the original and predicted VPFs that the media attention and political reaction that followed the Ladbroke Grove accident did have a marked effect on the public's degree of dread concerning rail accidents. This suggests that it should be possible to drive the degree of dread associated with a given context in a *downward*, rather than upward, direction by appropriate emphasis on steps that have been taken to improve safety in the context concerned, as well as a more circumspect and balanced media treatment. One possible way of testing this hypothesis would be to conduct a focus-group study in which the sample was split into three subsamples, the first of which would be provided with more negative information concerning risk in a given context, the second with "neutral" information and the third with more positive information. If our hypothesis is correct then willingness –to-pay based values of safety should decline significantly as one moves from the first through to the second to the third subsample. This would appear to be a potentially fruitful subject for future research.

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Appendix A: Assessing Variations in the Risk of Death by Different Causes: A Note

Consider an individual facing the possibility of premature death during the forthcoming period by either of two causes, A and B. Suppose also that the two causes are viewed by the individual with an equal degree of dread, with the risk of death by cause A being $\frac{400}{n}$ and the risk of death by cause B $\frac{10}{n}$, where $n > 410$.

Next suppose that the individual is faced with a choice between increasing the risk of cause A by $\frac{10}{n}$ or increasing the risk of cause B by $\frac{10}{n}$. On the assumption that the individual is rational it is then tempting to suppose he/she would be indifferent between the two risk increases since either increase would raise the overall risk of death from $\frac{410}{n}$ to $\frac{420}{n}$, so that with each cause having the same degree of dread for the individual, he/she would not care which of the two was in fact increased.

However, this conclusion implicitly presupposes that the two potential causes are *mutually exclusive* and there are, in fact, very good reasons for believing that this is a dubious assumption.

Thus, for example, let $n = 420$, so that following the risk increase the overall risk of death under the mutual exclusivity assumption becomes $\frac{420}{420} = 1$ entailing that death is a *certainty*. But of course even after the increase in risk (whether to cause A or cause B) it is possible (if somewhat improbable) that the individual could avoid death by *either* cause.

All of this suggests that, rather than treating the two causes as being mutually exclusive, they should instead be regarded as being *independent*. More specifically a “good” outcome in both of “lotteries” A and B would result in the individuals’ survival; a “good” outcome in lottery A and a “bad” outcome in lottery B would result in death by cause B; a “bad outcome in lottery A and a “good” outcome in lottery B would result in death by cause A and, finally, “bad” outcomes in both lotteries would result in death by one of the two causes chosen at random.

Under these circumstances, the overall risk of death, p_A , faced by the individual if the increment of $\frac{10}{n}$ were made to the risk from cause A would be given by:

$$p_A = \frac{410}{n} + \frac{10}{n} - \frac{4100}{n^2} \tag{1}$$

$$= \frac{420}{n} - \frac{4100}{n^2}. \tag{2}$$

(which, note, even with $n=420$ is still strictly less than 1, in contrast to the mutually exclusive case).

In turn, if the increment of $\frac{10}{n}$ were made to the risk from cause B then the overall risk of death, P_B , would be given by:

$$P_B = \frac{400}{n} + \frac{20}{n} - \frac{8000}{n^2} \quad (3)$$

$$= \frac{420}{n} - \frac{8000}{n^2} \quad (4)$$

Clearly, therefore, from equations (2) and (4) we have $p_B < p_A$ so that the individual would *not* be indifferent between the two increments but would have a strict preference for making the increment to the risk of cause B.

Notice that exactly the same conclusions would follow if we assumed that the cause “lotteries” took place in sequence so that with, for example, the increment in risk being made to cause A and the lottery for cause A preceding that for cause B, the overall risk of death, \hat{p}_A , would be given by

$$\hat{p}_A = \frac{410}{n} + \frac{10}{n} \left(1 - \frac{410}{n}\right) \quad (5)$$

$$= \frac{410}{n} + \frac{10}{n} - \frac{4100}{n^2} \quad (6)$$

$$= \frac{420}{n} - \frac{4100}{n^2}$$

which is of course identically equal to p_A . Similar results follow for alternative assignments of the increase in risk and lottery sequences.

The question that then naturally arises is given that the increment of $\frac{10}{n}$ to the risk of cause B is strictly preferred to the increment of $\frac{10}{n}$ to cause A, how large could the increment to the risk of cause B be made before the individual would switch to a preference for the increment of $\frac{10}{n}$ to the risk of cause A? Clearly the answer depends on the size of n , with the “indifference” increment to the risk of cause B being larger, the smaller is n . To illustrate, consider the (admittedly somewhat extreme) case in which $n = 411$. It then follows that with the increment of $\frac{10}{n}$ added to the risk of cause A

$$P_A = \frac{420}{411} - \frac{4100}{411^2} \quad (7)$$

$$= \frac{420}{411} - \frac{9.98}{411} \quad (8)$$

$$= \frac{410.02}{411} \quad (9)$$

In turn, with an increment of $\frac{x}{n}$ added to the risk of cause B we have the overall risk of death, \tilde{p}_B , given by:

$$\tilde{p}_B = \frac{410 + x}{411} - \frac{400(10 + x)}{411^2} \quad (10)$$

$$= \frac{410 + x}{411} - \frac{0.97(10 + x)}{411} \quad (11)$$

$$= \frac{400.30 + 0.03x}{411} \quad (12)$$

$$\text{so that } p_B < p_A \text{ iff} \\ 400.30 + 0.03x < 410.02 \quad (13)$$

that is:

$$0.03x < 9.72 \quad (14)$$

$$\text{or} \\ x < 324.0 \quad (15)$$

Clearly, therefore, the indifference level of x (when $\tilde{p}_B = p_A$) is 324.

In turn, by an identical process of reasoning, if we set $n = 410.1$ then it can be shown that $\tilde{p}_B < p_A$ iff $x < 396.6$ so that the indifference level of x is 396.6 ie *very* close to the numerator of the risk of death from cause A so that the individual is effectively acting as an absolute risk equalizer.

It is then natural to ask how things would turn out for *decreases*, rather than increases, in risk. In fact, by a process of reasoning that is identical to that developed above it can be shown that a rational individual will strictly prefer a decrease of, say, $\frac{5}{n}$ to the

risk of cause A (ie the larger baseline risk) than a decrease of $\frac{5}{n}$ in the risk of cause B. Furthermore, the “indifference” decrease in the risk of cause A, which will be strictly less than $\frac{5}{n}$, gets smaller, the smaller is n . For example, with $n = 500$ the

indifference risk decrease for cause A, given a decrease of $\frac{5}{500}$ for cause B, is

$$\approx \frac{1}{500}.$$

Appendix B: Regression Results with Dread Effects Estimated Using Approach 3 with Top and Bottom Six Outliers Trimmed Out.

Again, using the specification $VPF_i = \alpha \beta_i + \beta D_i + u_i$ the regression results were as follows:

Regression Results

	Pre-Ladbroke Grove		Post-Ladbroke Grove	
	coefficient	P value	coefficient	P value
B_i	4.66×10^{10}	0.044	4.63×10^{10}	0.052
D_i	3,365	0.085	3,612	0.083
	Adjusted $R^2 = 0.8264$		Adjusted $R^2 = 0.8124$	

In turn, the predicted VPF were as follows:

Predicted VPFs

	Pre-Ladbroke Grove	Post-Ladbroke Grove
VPF_{RDS}	$£1,3788 \times 10^6$	$£1.3759 \times 10^6$
VPF_{RDB}	$£1.3452 \times 10^6$	$£1.3398 \times 10^6$
VPF_{RL}	$£0.5319 \times 10^6$	$£0.5687 \times 10^6$
VPF_{PF}	$£1.3638 \times 10^6$	$£1.4620 \times 10^6$
VPF_{DF}	$£0.4064 \times 10^6$	$£0.4066 \times 10^6$

And finally, the contribution of baseline risk and dread effects to predicted VPFs were as follows:

Contribution of Baseline Risk and Dread Effects to Predicted VPFs

	Pre-Ladbroke Grove		Post-Ladbroke Grove	
	Baseline Risk	Dread	Baseline Risk	Dread
VPF_{RDS}	£1,304,800 (95%)	£74,026 (5%)	£1,296,400 (94%)	£79,522 (6%)
VPF_{RDB}	£1,304,800 (97%)	£40,378 (3%)	£1,296,400 (97%)	£43,447 (3%)
VPF_{RL}	£37,280 (7%)	£494,69 (93%)	£37,040 (7%)	£531,644 (93%)
VPF_{PF}	£27,960 (2%)	£1,335,836 (98%)	£27,780 (2%)	£1,434,212 (98%)
VPF_{DF}	£372,800 (92%)	£33,648 (8%)	£370,400 (91%)	£36,186 (9%)

**Appendix C HSE DREAD RISK: FOCUS GROUP PROTOCOL (B)
AUGUST 2003**

NOTE TO MODERATOR:

PRIOR TO GROUP STARTING WRITE THE DATE ON ALL THE RESPONDENT ANSWER SHEETS THAT ARE TO BE USED IN THAT GROUP.

KEEP ANSWER SHEETS FROM EACH RESPONDENT TOGETHER AND KEEP ALL ANSWER SHEETS FROM EACH GROUP IN SEPARATE, CLEARLY MARKED FILES.

1. INTRODUCTION/WELCOME

- WELCOME RESPONDENTS. THANK THEM FOR COMING. INTRODUCE YOURSELVES.
- I will just give you a brief background to the study but will be happy to answer any further questions you might have after the group has finished.
- The study is funded by the HSE who wish to take account of what the public think when making their decisions. Essentially, safety costs money and they have to choose which areas to prioritise. They want to know do their choices reflect our choices and, if not, how do they differ?
- Before we start I just want to mention two more points.
- The first thing is that when answering you should concentrate solely on the choices you would make for yourself and your own opinions. Please do not think of other people or what they would choose. This study is taking place in various places across the country and by asking a broad range of people we will get a very good idea of what other people would choose. So just think about yourself. I would also like to stress there are no right or wrong answers – what is the right choice for you is the wrong choice for someone else and so on. All answers that we report to the HSE will remain anonymous.
- The second thing is that this is part of a wider study being carried out by a number of institutions (Universities of Newcastle, East Anglia and London). The study is concerned with what people think about reducing the risks of certain types of death. Clearly, there are many different types of death so each partner has taken responsibility for different areas. For example, UEA and London are working on deaths that involve some sort of long term suffering such as cancers but today's/tonight's groups is part of the Newcastle study which is concerned only with "quick", premature deaths in different accidents.

2. CAUSES OF PREMATURE DEATH

- The first thing I want to do then is to introduce the six accidents we will be concentrating on in this group.
- **GO THROUGH OVERHEAD 1. STRESS:** By “die immediately or fairly soon after” we mean the brief time leading up to the incident and the minutes or hours after. It’s deliberately vague. It’s really how you perceive what dying in that type of accident would be like – each of you will have your own idea. The main thing is, you definitely die and the incident is not preceded or followed by weeks or months of long drawn out suffering.

3. BASELINE RISKS

- We will come back to feelings later in the group. For the next part of the group I want to focus on the level of risk you face of dying in each accident. In other words, the statistical risk. So what I want you to do now is to think about how much at risk you are compared to the average person in the population.

- **DISPLAY OVERHEAD 2. READ OUT THE 1ST SENTENCE AND EXPLAIN:**

50 MILLION is the approximate population of England and Wales so “800 in 50m” means that each year 800 pedestrians will be killed in a road accident.

- But you should think about yourself. Do you walk about all over the place every day, much more than other people you know? If so, you might think that you had a much higher than average chance of dying as a pedestrian. If so, you would tick the first box on the sheet [INDICATE] you will be given in a moment. However, if you think you walk about a little bit more than other people you would tick the second box [INDICATE]. If you feel you walk about much the same amount as everyone else than you would tick the 3rd box, “about average” [INDICATE]. However, if you feel you don’t walk about that much or not at all you would tick the fourth or fifth box, “slightly less than average” or “much less than average” [INDICATE].

- **ASSISTANT: HANDOUT SHEET 1.**

- Once you have filled in your answer for the pedestrian accident, please do the same for the other five accidents.

- Please put your initials in the top right hand corner of the sheet and then ... will collect it in. Please also put your initials on all other sheets you are given.

- Please put your initials in the top right hand corner of the sheet and then will collect it in. Please also put your initials on all other sheets you are given.

• **ASSISTANT: COLLECT IN SHEET 1. BEGIN CUSTOMISING RISK-RISK TRADE OFF SHEETS. SEE ACCIDENTS C/E, C/F, C/G, C/H, C/B FOR DETAILS.**

4. RISK-RISK TRADEOFFS (1)

- There are many different types of accident that can happen and often a government department or the HSE are interested in what factors people consider are important in prioritising between implementing safety programmes in different areas.

• For these next exercises, I want you to suppose that for whatever reason expenditure on our safety had to be cut back a little, perhaps because the economy was not doing so well. This could take the form of less money spent on maintenance, inspection or prevention depending on the area. Any reduction in expenditure would have the effect of increasing your risk of dying prematurely.

- Before we do this, I just want to do something with you. Its purpose is to help to make sure that you are comfortable with what you will be doing in the next set of questions so that the choices you make are more like the ones you would make in real life as opposed to just a result of confusion.

WRITE UP THE FOLLOWING TEMPLATE ON THE BOARD/FLIPCHART, USE THEIR CHOICE OF X AS A BASIS FOR AN OPEN DISCUSSION ABOUT SWITCHOVER POINTS (LEGITIMISING BOTH SWITCHING OVER AT THE EQUAL RISK POINT OR A DIFFERENT POINT), THE FACT THAT INCREASING A RISK IN ONE AREA OF COURSE INCREASES OVERALL RISK OF DYING EVEN IF CHOOSE THE SMALLER BASELINE RISK, PROBING REASONS FOR THEIR CHOSEN SWITCHOVER POINT. INDIVIDUALS MAY HAVE DIFFERENT SWITCHOVER POINTS SO ENSURE YOU ASK AT LEAST TWO WHAT THEIR "X" WOULD BE.

ACCIDENT 1
20 in 50m

ACCIDENT 2
550 in 50m

Risk of death increased by 10 in 50 million.

(ASK: Which accident would you choose this risk increase in?)

(TICK CHOICE. IF THERE IS A DIFFERENCE OF OPINION DO ONE ACCIDENT FIRST AND THEN COME BACK TO THE OTHER)

(ASSUMING HERE ACCIDENT 1 CHOSEN)

X in 50 Million 10 in 50 million

(ASK: When the risk increase was 10 in 50 million you chose Accident 1. Say for some reason the increase was different for the two accidents. How big a number would X have to be so that you would swap and choose the risk increase of 10 in 50 million in Accident 2, which stays at 10 in 50 million. YOU MAY NEED TO SUGGEST A NUMBER E.G. 1000 IF THEY APPEAR STUCK BUT IT WOULD BE BEST TO AVOID IF POSSIBLE)
(WRITE UP EACH PERSON'S X)

- You will now answer a number of questions in which you will be comparing two risks at a time. Please bear in mind that the purpose of the last exercise was to help you understand the procedure as much as anything – as I said at the outset there is no right or wrong answer as such, all we want is your choice. So in the following exercises, we would not be surprised if each of you chose different answers or some of you chose the same answer. It is your choices we are interested in. The first question will be a practice question so please ask about anything you are unsure of.

ACCIDENT Y/ACCIDENT Z

- Imagine first that expenditure would be cut back in one of two areas of safety, Y or Z. UNCOVER TITLE OF OVERHEAD 3.

UNCOVER 1ST 2 BOXES ON OVERHEAD 3 AND GO THROUGH THE INFORMATION ON AVERAGE AND PERSONAL RISK.

- Please imagine for the purposes of this exercise that you are told that you personally have a slightly lower than average risk of dying by Accident Y and a slightly higher than average risk of dying in Accident Z.

- So the risk to the average person from Accident Y is 400 in 50 million so that means your risk is slightly lower than 400 in 50 million. You should try to think of a number a little smaller than 400 in 50 million that would fit that description for you. Different people will have different numbers – it depends what YOU think by “slightly smaller”. It will help you to write this down by the side of the box.

- Likewise, the risk to the average person from Accident Z is 300 in 50 million so that means your risk is slightly bigger than 300 in 50 million. You should try to think of a number a little bigger than 300 in 50 million that would fit that description for you. Different people will have different numbers – it depends what YOU think by “slightly bigger”. It will help you to write this down by the side of the box.

- Imagine the reduction in expenditure would have the effect of increasing your personal risk of dying in one of these accidents by 10 in 50 million, but that you could tell the HSE as to which area you would prefer that increase to be in, perhaps by a vote, or tell them that you or do you not mind which of these two risks is increased?. If you tell them that you do not mind that means the risk increase still happens – just that they, not you, get to choose which one

- **ASSISTANT: HAND OUT SHEET 2yz**

- Please put your initials in the top right hand corner and then simply circle the risk increase you would choose if you had to, Accident Y or Accident Z or put an equals sign if you do not mind..

- **ASSISTANT: HAND OUT A RISK-RISK TRADE-OFF TABLE SHEET**

FOR THOSE THAT SAY THEY DO NOT MIND, TELL THEM THEY DO NOT HAVE TO FILL THE TABLE IN BUT SHOULD LISTEN CAREFULLY TO

YOUR INSTRUCTIONS TO THE OTHERS AND CHECK THAT THEY HAVE UNDERSTOOD WHAT OTHERS HAVE DONE.

- The first page tells you what to do. I will go through what to do now, but you may wish to read it again before you answer the question. When I have finished you should fill in the table on page 2.
- DISPLAY OVERHEAD 3 (cont.). First will everyone please write down Y or Z, depending on what you chose, in the first sentence [INDICATE WHERE}
- First, this is just for those of you that chose Y [IF NO ONE CHOSE Y JUST GO TO Z]. I will deal with Z in a moment. So will everyone that chose Y please write down Y in the first column. Also in the first column write your perceived personal risk from that accident (the number you wrote down on the other sheet). Then write Z in the second column and your perceived personal risk for Z [INDICATE].
- So you said that when the risk increase was the same i.e. 10 in 50 million i.e. when you add 10 in 50 million to both accidents, you would choose Increase Y, so you write Y in the first row, third column. This is just the same question as on the previous sheet.
- Now let's imagine that instead of Increase Y being 10 in a million, it was slightly higher i.e. 40 in 50 million. This would mean that 40 in 50 million would be added to your personal risk of dying in Accident Y and your overall personal risk of dying would increase by 40 in 50 million. Would you still choose this increase or would you instead now choose the increase in the risk of Accident Z (which stays at 10 in 50 million)?
- If Yes, write Y in the next box alongside this pair. Carry on down the table one row at a time comparing the two risk increases on each row and write down which risk increase you would choose. If you still prefer Y write Y but if not and you would now prefer to increase your risk of dying in Accident Z by 10 in 50 million, write Z. When you write down Z you can stop.
- Now for those of you that chose Z [IF NO ONE CHOSE Z DO NOT GO THROUGH]...SAME PROCEDURE AS ABOVE EXCEPT REVERSED [WRITE DOWN Z IN FIRST COLUMN ETC].

ACCIDENT C/ACCIDENT E

- **ASSISTANT:** TO CUSTOMISE - CHECK EACH INDIVIDUALS (BY INITIAL) RISK ASSESSMENT (SHEET 1) FOR MURDER INCIDENT AND FIRE IN A PUBLIC PLACE. PREPARE A CUSTOMISED SHEET 3 RISK-RISK TRADE SHEET E.G. IF MURDER INCIDENT IS MUCH HIGHER THAN AVERAGE AND FIRE IN A PUBLIC PLACE IS MUCH LOWER THAN AVERAGE TAKE OUT A SHEET FROM THE ENVELOPE (MUCH HIGHER)/ (MUCH LOWER). WRITE RESPONDENT'S INITIALS AND C/E ON TOP RHS FOR REFERENCE.

HAND OUT RISK RISK TRADE OFF SHEET WHEN MODERATOR IS READY TO PROCEED.

- DISPLAY OVERHEAD 4 AND GO THROUGH. Now I want you to do the same for two more accidents, Accident C and Accident E.

- Please put your initials in the top right hand corner and then simply circle the risk increase you would choose if you had to, Accident C or Accident E or put an equals sign if you do not mind. In these next few questions you will all have different personal risks so please write down a number that best sums up for you your personal risk in the box [INDICATE].

- **ASSISTANT:** HAND OUT CUSTOMISED (C/E) RISK-RISK TRADE-OFF TABLE SHEET [EXCEPT TO RESPONDENTS WHO HAVE INDICATED EQUALITY].

- You will be asked to fill in a table similar to before. Write in your chosen risk increase in the first sentence and then the first two columns as before. You should indicate whether you would choose C or E. [USE OVERHEAD 5 TO RECAP HOW TO FILL IN THE TABLES USE OVERHEAD 5]

- It may be the case that you come to the bottom of the table and haven't changed your mind, either in this question or other ones. If so, please write down the risk increase in your chosen accident that would make you switch to the other one. [INDICATE; FOR ANY SUCH RESPONDENTS ENSURE THEY WRITE A NUMBER DOWN UNLESS THEY REALLY CANNOT. OTHERWISE WE CANNOT GET ANY DATA FROM THEM FOR THIS QUESTION].

ACCIDENT C/ACCIDENT F

- **ASSISTANT:** TO CUSTOMISE - CHECK EACH INDIVIDUALS (BY INITIAL) RISK ASSESSMENT (SHEET 1) FOR MURDER INCIDENT AND ACCIDENT IN THE HOME. PREPARE A CUSTOMISED SHEET 3 RISK-RISK TRADE SHEET E.G. IF MURDER INCIDENT IS MUCH HIGHER THAN AVERAGE AND ACCIDENT IN THE HOME IS MUCH LOWER THAN AVERAGE TAKE OUT A SHEET FROM THE ENVELOPE (MUCH HIGHER)/ (MUCH LOWER). WRITE RESPONDENT'S INITIALS AND C/F ON TOP RHS FOR REFERENCE.

HAND OUT RISK RISK TRADE OFF SHEET WHEN MODERATOR IS READY TO PROCEED.

- Now I want you to do the same for two more accidents, Accident C and Accident F.
- Please put your initials in the top right hand corner and then simply circle the risk increase you would choose if you had to, Accident C or Accident F or put an equals sign if you do not mind. In these next few questions you will all have different personal risks so please write down a number that best sums up for you your personal risk in the box [INDICATE].

- **ASSISTANT:** HAND OUT CUSTOMISED (C/F) RISK-RISK TRADE-OFF TABLE SHEET [EXCEPT TO RESPONDENTS WHO HAVE INDICATED EQUALITY].

- You will be asked to fill in a table similar to before. Write in your chosen risk increase in the first sentence and then the first two columns as before. You should indicate whether you would choose C or F
- It may be the case that you come to the bottom of the table and haven't changed your mind, either in this question or other ones. If so, please write down the risk increase in your chosen accident that would make you switch to the other one. [INDICATE; FOR ANY SUCH RESPONDENTS ENSURE THEY WRITE A NUMBER DOWN UNLESS THEY REALLY CANNOT. OTHERWISE WE CANNOT GET ANY DATA FROM THEM FOR THIS QUESTION].

5. PRIORITISATION EXERCISE

- We will be doing some more of these later but at this stage I want to turn to a different issue-age.

- It is often the case that different health or safety programmes are more likely to benefit some age groups more than others. If that were the case, how might choose between spending money on such programmes.

- DISPLAY OVERHEAD 7, UNCOVER 1ST PAIR.

- For the purposes of this exercise please assume that all programmes are deliverable and cost the same.

- Please imagine that for whatever reason safety expenditure was to be increased. So there would be more money to spend on safety programmes. Out of these first two [INDICATE] which would YOU prefer to see carried out? Please assume, quite realistically, that the money could only be spent on one or the other in order for either to be successful. Please tick the box under the first one if you would prefer that one or the second one if you would prefer that. If you cannot decide and thus would be happy for someone else such as myself to choose then tick the middle box (note that this does not mean they both get implemented, just that you don't mind which one).

- **ASSISTANT: HAND OUT SHEET 4**

- OPEN DISCUSSION - HOW/WHAT THEY CHOSE.

Please do the same for questions 2 & 3. OPEN DISCUSSION AS BEFORE

6. *RISK RISK TRADE OFFS (2)*

- We will now return to the questions we were doing before. There are just three more of them before we move onto something else.

ACCIDENT C/ACCIDENT G

- **ASSISTANT: TO CUSTOMISE - CHECK EACH INDIVIDUALS (BY INITIAL) RISK ASSESSMENT (SHEET 1) FOR MURDER INCIDENT AND CAR DRIVER/PASSENGER ROAD ACCIDENT PREPARE A CUSTOMISED SHEET 3 RISK-RISK TRADE SHEET E.G. IF MURDER INCIDENT IS MUCH HIGHER THAN AVERAGE AND CAR DRIVER/PASSENGER ROAD ACCIDENT IS MUCH LOWER THAN AVERAGE TAKE OUT A SHEET FROM THE ENVELOPE (MUCH HIGHER)/ (MUCH LOWER). WRITE RESPONDENT'S INITIALS AND C/G ON TOP RHS FOR REFERENCE.**

HAND OUT RISK RISK TRADE OFF SHEET WHEN MODERATOR IS READY TO PROCEED.

- Now I want you to do the same for two more accidents, Accident C and Accident G.

- Please put your initials in the top right hand corner and then simply circle the risk increase you would choose if you had to, Accident C or Accident G or put an equals sign if you do not mind. In these next few questions you will all have different personal risks so please write down a number that best sums up for you your personal risk in the box [INDICATE].

- **ASSISTANT: HAND OUT CUSTOMISED (C/G) RISK-RISK TRADE-OFF TABLE SHEET [EXCEPT TO RESPONDENTS WHO HAVE INDICATED EQUALITY].**

- You will be asked to fill in a table similar to before. Write in your chosen risk increase in the first sentence and then the first two columns as before. You should indicate whether you would choose C or G

- It may be the case that you come to the bottom of the table and haven't changed your mind, either in this question or other ones. If so, please write down the risk increase in your chosen accident that would make you switch to the other one. [INDICATE; FOR ANY SUCH RESPONDENTS ENSURE THEY WRITE A NUMBER DOWN UNLESS THEY REALLY CANNOT. OTHERWISE WE CANNOT GET ANY DATA FROM THEM FOR THIS QUESTION].

ACCIDENT C/ACCIDENT H

- **ASSISTANT:** TO CUSTOMISE - CHECK EACH INDIVIDUALS (BY INITIAL) RISK ASSESSMENT (SHEET 1) FOR MURDER INCIDENT AND PEDESTRIAN-ROAD ACCIDENT PREPARE A CUSTOMISED SHEET 3 RISK-RISK TRADE SHEET E.G. IF MURDER INCIDENT IS MUCH HIGHER THAN AVERAGE AND PEDESTRIAN-ROAD ACCIDENT IS MUCH LOWER THAN AVERAGE TAKE OUT A SHEET FROM THE ENVELOPE (MUCH HIGHER)/ (MUCH LOWER). WRITE RESPONDENT'S INITIALS AND C/H ON TOP RHS FOR REFERENCE.

HAND OUT RISK RISK TRADE OFF SHEET WHEN MODERATOR IS READY TO PROCEED.

- Now I want you to do the same for two more accidents, Accident C and Accident H.
- Please put your initials in the top right hand corner and then simply circle the risk increase you would choose if you had to, Accident C or Accident H or put an equals sign if you do not mind. In these next few questions you will all have different personal risks so please write down a number that best sums up for you your personal risk in the box [INDICATE].

• **ASSISTANT:** HAND OUT CUSTOMISED (C/H) RISK-RISK TRADE-OFF TABLE SHEET [EXCEPT TO RESPONDENTS WHO HAVE INDICATED EQUALITY].

- You will be asked to fill in a table similar to before. Write in your chosen risk increase in the first sentence and then the first two columns as before. You should indicate whether you would choose C or H
- It may be the case that you come to the bottom of the table and haven't changed your mind, either in this question or other ones. If so, please write down the risk increase in your chosen accident that would make you switch to the other one. [INDICATE; FOR ANY SUCH RESPONDENTS ENSURE THEY WRITE A NUMBER DOWN UNLESS THEY REALLY CANNOT. OTHERWISE WE CANNOT GET ANY DATA FROM THEM FOR THIS QUESTION].

ACCIDENT C/ACCIDENT B

- **ASSISTANT:** TO CUSTOMISE - CHECK EACH INDIVIDUALS (BY INITIAL) RISK ASSESSMENT (SHEET 1) FOR MURDER INCIDENT AND TRAIN ACCIDENT PREPARE A CUSTOMISED SHEET 3 RISK-RISK TRADE SHEET E.G. IF MURDER INCIDENT IS MUCH HIGHER THAN AVERAGE AND TRAIN ACCIDENT IS MUCH LOWER THAN AVERAGE TAKE OUT A SHEET FROM THE ENVELOPE (MUCH HIGHER)/ (MUCH LOWER). WRITE RESPONDENT'S INITIALS AND C/B ON TOP RHS FOR REFERENCE.

HAND OUT RISK RISK TRADE OFF SHEET WHEN MODERATOR IS READY TO PROCEED.

- Now I want you to do the same for two more accidents, Accident C and Accident B.
- Please put your initials in the top right hand corner and then simply circle the risk increase you would choose if you had to, Accident C or Accident B or put an equals sign if you do not mind. In these next few questions you will all have different personal risks so please write down a number that best sums up for you your personal risk in the box [INDICATE].

- **ASSISTANT:** HAND OUT CUSTOMISED (C/H) RISK-RISK TRADE-OFF TABLE SHEET [EXCEPT TO RESPONDENTS WHO HAVE INDICATED EQUALITY].

- You will be asked to fill in a table similar to before. Write in your chosen risk increase in the first sentence and then the first two columns as before. You should indicate whether you would choose C or B
- It may be the case that you come to the bottom of the table and haven't changed your mind, either in this question or other ones. If so, please write down the risk increase in your chosen accident that would make you switch to the other one. [INDICATE; FOR ANY SUCH RESPONDENTS ENSURE THEY WRITE A NUMBER DOWN UNLESS THEY REALLY CANNOT. OTHERWISE WE CANNOT GET ANY DATA FROM THEM FOR THIS QUESTION].

7. FEELINGS TOWARDS CAUSES OF DEATH (DREAD)

- In this next part of the group I want to go back to the accidents we considered right at the beginning and to begin to think about our feelings towards them. For example, what, if anything, particularly frightens you about any of the six causes of death. Is there anything about them that you

personally/dread? Or perhaps compared to other things they are not that bad?

- Imagine that you could avoid just one of them for certain which one would it be?

ASK EACH RESPONDENT AND WRITE UP THE CAUSE/REASON ON THE BOARD.

- Imagine instead that you “had to die” but could choose by which of these causes. Which would you least fear?

ASK EACH RESPONDENT AND WRITE UP THE CAUSE/REASON ON THE BOARD.

8. RANKING

• ASSISTANT: HAND OUT 2 CARDS

- ...has just given you two cards. Please place the one you fear the most furthest away from you on the table and the one that you fear the least nearest to you. If you think they are both equally bad or good place them side by side.

• ASSISTANT: HAND OUT ENVELOPE (REMAINING 4 CARDS).

- Please rank all six from worst to best in front of you. Include the other two cards in the ranking.

• ASSISTANT: WHEN THEY HAVE COMPLETED THIS HANDOUT SHEET 5.

- Please fill in the sheet. Give a score of 1 to the accident you fear the most, 2 to the next one and so on through to 6 for the one you fear the least. If you have placed two equal give them the same score.

• DISPLAY OVERHEAD 10.

- AS EACH PERSON FOR THEIR SCORES. WRITE UP ALL RANKINGS. PICK OUT ANY “INTERESTING” FEATURES.

9. ADD FEELINGS TO EXPOSURE

• ASSISTANT: GIVE BACK TO EACH RESPONDENT THEIR SHEET 1

- Before we continue with the next set of questions, here is Sheet 1 again. Please write a word or sentence that sums up for you how you feel about that risk - for example, what you thought about when you were ranking it compared to others. I will be asking you to think about these sort of things

in the next set of questions so this is simply to help you remember while it is “fresh” in your mind.

9. RISK-RISK TRADEOFFS

- For these next exercises, again I want you to suppose that for whatever reason expenditure on our safety had to be cut back a little, perhaps because the economy was not doing so well. This could take the form of less money spent on maintenance, inspection or prevention depending on the area.
- But this time, you will know the actual areas in which the expenditures could be reduced and thus in which areas your risk of dying prematurely could be increased by some amount.
- Before we continue let’s just revisit the thought experiment we did at the beginning.

USE THIS AS A BASIS ON WHICH TO DISCUSS THE IMPACT OF CONTEXT ON CHOICE AND TO DISCUSS HOW ONE MIGHT TRADE OFF ACCIDENTS WITH A HIGH BASELINE RISK AND A LOW FEAR VERSUS ONE WITH A LOW BASELINE RISK BUT A HIGH FEAR.
INTERACTIVE DISCUSSION.

- [INDICATING FLIPCHART]. Let’s say that now you know the types of accidents. Accident 1 is a Bus Passenger and Accident 2 is a Car Passenger. Would your switch over point i.e. X still be ? [THIS CAN BE DONE ON A GROUP BASIS OR, MORE LIKELY, ON AN INDIVIDUAL BASIS IF THEY HAVE A RANGE OF X’S)
- IN EACH OF THE RISKS BELOW IF ANYONE SAYS THAT THEY ARE NOT EXPOSED TO THE RISK TELL THEM TO WAIT FOR THE NEXT QUESTION.

MURDER/FIRE IN A PUBLIC PLACE

- Imagine first that expenditure would be cut back in one of these two areas, murder or fire in a public place.

- DISPLAY OH 11

- **ASSISTANT: HANDOUT SHEET 6(i)**

- As before, imagine the reduction in expenditure would have the effect of increasing your risk of dying in one of these accidents, but that you could choose which one.

- Before you do this please refer to Sheet 1. Fill in your risk for each of the accidents on the two lines in the boxes i.e. if you have ticked “much lower than average” write “much lower” [INDICATE] and underneath [BY THE QUESTION MARK – INDICATE] write some number that sums up for you what that means, just like in the earlier questions of this type. The sentence you have written on Sheet 1 is meant to remind you of your feelings about the risk.

- Would you choose to increase your risk by 10 in 50 million of dying in a murder incident or in a fire in a public place?

- Please circle the one you would choose. If you do not mind and are happy for the government to choose, put an equal sign between them

- **ASSISTANT: HAND OUT RISK-RISK TRADE OFF SHEET 6(ii) (DO NOT HAND OUT A SHEET TO ANYONE INDICATING EQUALITY)**

- Please complete the table in the same way as you did in the previous exercises when you compared two accidents. So if you preferred to increase the risk of dying in a murder incident by 10 in 50 million write I in the first sentence and column as well as your personal risk and the information for fire in a public place in the second column. Then write I in the first row. Then compare the two risk increases and indicate when, if at all, you would switch to fire in a public place (J). Likewise, if you chose to increase the risk of dying in a fire in a public place by 10 in 50 million write J in the first sentence and column as well as your personal risk and the information for murder in the second column. Then write J in the first row. Then compare the two risk increases and indicate when, if at all, you would switch to murder (I).

- DISPLAY OVERHEAD 12. QUICK RECAP ON HOW TO FILL IN IF NECESSARY.

MURDER/ACCIDENT - HOME

- This time please compare murder with an accident in the home.
- DISPLAY OH 12
- **ASSISTANT: HANDOUT SHEET 7(i)**
- As before, imagine the reduction in expenditure would have the effect of increasing your risk of dying in one of these accidents, but that you could choose which one.
- Before you do this please refer to Sheet 1. Fill in your risk for each of the accidents on the two lines in the boxes i.e. if you have ticked “much lower than average” write “much lower” [INDICATE] and underneath [BY THE QUESTION MARK – INDICATE] write some number that sums up for you what that means, just like in the earlier questions of this type. The sentence you have written on Sheet 1 is meant to remind you of your feelings about the risk.
- Would you choose to increase your risk by 10 in 50 million of dying in a murder incident or in an accident in the home?
- Please circle the one you would choose. If you do not mind and are happy for the government to choose, put an equal sign between them
- **ASSISTANT: HAND OUT RISK-RISK TRADE OFF SHEET 7(ii) (DO NOT HAND OUT A SHEET TO ANYONE INDICATING EQUALITY)**
- Please complete the table in the same way as you did in the previous exercises when you compared two accidents.

MURDER/CAR DRIVER/PASSENGER

- This time please compare murder with a car driver/passenger road accident.

- DISPLAY OH 13

- **ASSISTANT: HANDOUT SHEET 8(i)**

- As before, imagine the reduction in expenditure would have the effect of increasing your risk of dying in one of these accidents, but that you could choose which one.

- Before you do this please refer to Sheet 1. Fill in your risk for each of the accidents on the two lines in the boxes i.e. if you have ticked “much lower than average” write “much lower” [INDICATE] and underneath [BY THE QUESTION MARK – INDICATE] write some number that sums up for you what that means, just like in the earlier questions of this type. The sentence you have written on Sheet 1 is meant to remind you of your feelings about the accident.

- Would you choose to increase your risk by 10 in 50 million of dying in a murder incident or as a car driver/passenger in a road accident?

- Please circle the one you would choose. If you do not mind and are happy for the government to choose, put an equal sign between them

- **ASSISTANT: HAND OUT RISK-RISK TRADE OFF SHEET 8(ii) (DO NOT HAND OUT A SHEET TO ANYONE INDICATING EQUALITY)**

- Please complete the table in the same way as you did in the previous exercises when you compared two accidents.

MURDER/PEDESTRIAN

- This time please compare murder with a pedestrian in a road accident.
- DISPLAY OH 14
- **ASSISTANT: HANDOUT SHEET 9(i)**
- As before, imagine the reduction in expenditure would have the effect of increasing your risk of dying in one of these accidents, but that you could choose which one.
- Before you do this please refer to Sheet 1. Fill in your risk for each of the accidents on the two lines in the boxes i.e. if you have ticked “much lower than average” write “much lower” [INDICATE] and underneath [BY THE QUESTION MARK – INDICATE] write some number that sums up for you what that means, just like in the earlier questions of this type. The sentence you have written on Sheet 1 is meant to remind you of your feelings about the accident.
- Would you choose to increase your risk by 10 in 50 million of dying in a murder incident or as a pedestrian in a road accident?
- Please circle the one you would choose. If you do not mind and are happy for the government to choose, put an equal sign between them
- **ASSISTANT: HAND OUT RISK-RISK TRADE OFF SHEET 9(ii) (DO NOT HAND OUT A SHEET TO ANYONE INDICATING EQUALITY)**
- Please complete the table in the same way as you did in the previous exercises when you compared two accidents.

MURDER/TRAIN

- This time please compare murder with a train accident.
- DISPLAY OH 15
- **ASSISTANT: HANDOUT SHEET 10(i)**
- As before, imagine the reduction in expenditure would have the effect of increasing your risk of dying in one of these accidents, but that you could choose which one.
- Before you do this please refer to Sheet 1. Fill in your risk for each of the accidents on the two lines in the boxes i.e. if you have ticked “much lower than average” write “much lower” [INDICATE] and underneath [BY THE QUESTION MARK – INDICATE] write some number that sums up for you what that means, just like in the earlier questions of this type. The sentence you have written on Sheet 1 is meant to remind you of your feelings about the accident.
- Would you choose to increase your risk by 10 in 50 million of dying in a murder incident or in a train accident?
- Please circle the one you would choose. If you do not mind and are happy for the government to choose, put an equal sign between them
- **ASSISTANT: HAND OUT RISK-RISK TRADE OFF SHEET 10(ii) (DO NOT HAND OUT A SHEET TO ANYONE INDICATING EQUALITY)**
- Please complete the table in the same way as you did in the previous exercises when you compared two accidents.

10. DEMOGRAPHICS

- **ASSISTANT: HAND OUT SHEET 11.**
- Please complete this yourselves All answers will be treated in the strictest confidence. We will use them for research purposes only simply to check that we interview a broad enough range of people.

11. CONCLUSION

- Thank you very much. PAY.

HSE ‘Dread Risk’: UEA /Durham/Queen Mary team’s report
January 2007

1. Background

The Newcastle study was focused on risk trade-offs between different forms of sudden premature death, viewed from the perspective of the individual respondent’s preferences about personal safety. While this allowed some examination of the extent to which particular deaths were dreaded *per se*, and considered issues related to the potential biases arising from different levels of baseline risk, that study could not easily address hazards to which many respondents were not themselves exposed (e.g. chemical substances in the workplace), and did not look at deaths which were preceded by periods of ill-health. Moreover, given that the Newcastle study asked respondents to answer from their own perspective, it could not explore questions about people’s attitudes to the ages of victims (other than by looking for any effects of respondents’ own ages) and did not explicitly address the question of how the allocation of responsibility or blame affected attitudes (although respondents may have made implicit judgments about this in some cases).

The UEA/Durham/Queen Mary study sought to gather information about the weights that might be given to such considerations by asking respondents to answer in their capacity as citizens and express their preferences over general principles of social decision making regarding different life-saving interventions.

Our Progress Report dated July 2004 indicated the strategy we intended to adopt in this part of the study. We proposed using a discrete choice experiment (DCE) consisting of two main elements. First, a section asking questions designed to examine the weights people attach to ‘generic’ attributes such as the typical age of victims and the length and severity of the period of ill-health prior to death, etc. And second, a section designed to obtain an indication of how far such generic weights correspond with attitudes when specific hazard contexts are identified.

The essential features of the design were set out in that earlier Progress Report. In the next section, we summarise those key features, pointing to modifications made in the light of further piloting and describing in more detail the eventual structure of the study.

2. The Study Design

2.1 The ‘generic’ model

In the earlier Report, the attributes of interest and the levels associated with those attributes were set out as follows:

- Number of deaths prevented: 10, 15, 25 or 50.
- Age group of typical victim: under 17 years, 17-40 years, 40-60 years, or over 60.
- Length of illness or suffering prior to death: a few minutes, a couple of weeks, a year or two, or 3-5 years.
- Who is most responsible or to blame for the death: nobody in particular, the individuals themselves, other individuals, or business/government.

After further discussion with members of the Steering Group, an additional component was included to indicate the quality of health/life during the period of ill-health prior to death: either ‘a bit worse than normal’ or else ‘a lot worse than normal’.

It turned out that this addition did not require any modification to the reduced-form design that involved a total of 64 scenarios paired to give 32 choices between two hazard scenarios. Those 32 ‘generic’ pairs were then divided between three Versions of the questionnaire, with two being common across all three.

The original intention had been to present each pair in the form of a choice between two life-saving interventions, as in the example below:

Which life-saving intervention do you think is better?

	Intervention A	Intervention B
Number of lives saved	Save 15 people from type of death A	Save 10 people from type of death B
Age-group affected	Under 17 year olds	17-40 year olds
Quality of life in period leading up to death	A lot worse than normal for the last 3-5 years of their lives	A <u>bit worse than normal</u> for last 1-2 years of their lives

Who is most to blame	Nobody in particular	The individuals themselves
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The interventions cost the same amount of money

Which is better?

A

B

However, further piloting showed that an uncomfortably large minority of respondents were liable to be confused by this framing. The expectation had been that people would identify the scenario they regarded as worse and nominate the intervention which would prevent that scenario as the better intervention.

Unfortunately, too many respondents simply considered which scenario was less unpleasant and selected that. So respondents who thought the 10 deaths described in B above did not constitute as bad a prospect as the 15 described in A were too often liable to put a tick in box B to indicate that the *scenario* was better, rather than putting a tick in A to signify that the *intervention to prevent that scenario* should receive greater priority.

It was therefore decided to ask the questions in the form that people found easier to answer: that is, to describe two scenarios and ask them to say which of the two they considered to be worse, and *how much worse* they considered it to be.

Thus the two scenarios shown above would have appeared in the final format as follows:

Which is worse?

	A	B
Number of people who die	15 deaths	10 deaths
Age-group	Under 17 year olds	17-40 year olds
Quality of life in period leading up to death	A lot worse than normal for last 3-5 years of their lives	A bit worse than normal for last 1-2 years of their lives
Who is most to blame	Nobody in particular	The individuals themselves

What do YOU think?

(tick one)

A is much worse than B

A is slightly worse than B

B is slightly worse than A

B is much worse than A

In total, the generic part of the questionnaire – a booklet labeled Section 1 – consisted of 23 questions in that format. The first five of these were ‘practice’ questions, which involved setting everything except one item the same for both scenarios and then using the five questions to vary the different attributes one at a time. This was accompanied by asking respondents to write a sentence on each occasion to explain their answer, followed by a brief discussion to check for understanding.

Having gone through these five practice questions, respondents were asked to answer Questions 6 to 23 on their own, with no further intervening discussion (although they could if they wished ask the moderator to come to them to clarify anything they were concerned about). Those eighteen questions were made up as follows. Twelve of them were part of the main effects design, with two (Questions 10 and 18) being common to all three Versions, while the other ten were unique to a particular Version. Having the common questions allowed a check that the different subsamples allocated to the different Versions were answering common questions in a similar manner, while dividing the other 30 questions between the three Versions gave coverage of all 32 pairs.

The other six questions involved five pairs that would appear again in Section 2 with contextual information; but in Section 1 this context was omitted and only the generic information was given. One of these five pairs was presented twice – first as Q6, then again as Q21 – to check whether there was any discernible systematic change occurring as a result of respondents becoming more familiar with the task as they worked through the questionnaire. These questions that were not part of the main effects design – numbered Q6/Q21, Q9, Q13, Q17 and Q23 – were different in each of the three Versions and were included for two reasons: first, to see how well the parameters estimated on the basis of the main design could predict patterns of response to other questions in generic form that were not part of the estimation procedure; and second, to examine whether when the same pairs were re-presented in Section 2 with the addition of information about context, any significant differences could be observed.

2.2. The contextual scenarios

In Section 2, respondents were presented with another 5 pairs of scenarios, but this time with information about specific contexts. For example, in all three Versions Q24 had scenario A involving deaths of drivers in road traffic accidents while scenario B referred to deaths of passengers in rail accidents. What varied across the three Versions was the number of deaths: in Version 1 it was 10 deaths of both kinds, while in Version 2 it was 15 road and 10 rail, and 25 road versus 10 rail in Version 3. The full listing of scenarios for Section 2 of the three Versions is given below.

Question Number	Version 1	Version 2	Version 3
Q24	10 car drivers	15 car drivers	25 car drivers

	vs 10 rail passengers	vs 10 rail passengers	vs 10 rail passengers
Q25	50 smoking cancer vs 25 asbestos cancer	25 CO poisoning vs 15 accidents at work	15 smoking cancer vs 10 asbestos cancer
Q26	25 car drivers vs 15 pedestrians	10 accidents at work vs 15 car drivers	25 accidents at work vs 50 car drivers
Q27	15 pedestrians vs 25 breast cancer	25 pedestrians vs 15 breast cancer	15 CO poisoning vs 25 accidents at work
Q28	10 work-related cancer vs 15 car drivers	25 work-related cancer vs 50 car drivers	15 car drivers vs 25 pedestrians

The rationale behind the various elements of this part of the design was as follows.

A comparison of responses to Q24 across the three Versions was intended to see to what extent there was a weighting in favour of preventing a rail passenger fatality over a car driver fatality: while we might not be surprised to find a majority favouring rail in Version 1, where the number of deaths was the same, would this persist in Version 2 where there were 50% more car driver deaths? And if so, was the premium such that rail passenger deaths would receive priority even against two-and-a-half times as many car driver deaths, as in Version 3?

In fact, it became apparent that the ‘blame’ attribute was doing a great deal of work in these questions, so part way through the study we added an extra question – referred to in the analysis below as Q29 – which was the same as Q24 except that car drivers were replaced by car passengers, and those mostly to blame became ‘other individuals’ rather than ‘the individuals themselves’.

Questions 25-28 inclusive can be thought of as falling into one of two categories. In some cases, evidence from piloting suggested which way a weighting would go, and the objective was to get some indication of the strength of that weighting. For example, we knew from piloting that deaths from asbestos-related cancer would be given more weight than deaths from lung cancer attributed to the individuals themselves being smokers. So the numbers in the Questions 25 in both Versions 1 and 3 were both pointed in the same direction, in one case in the ratio 1.5:1 and in the other case in the ratio 2:1; likewise for work-related cancers vs car drivers (Questions 28 in Versions 1 and 2) and for accidents at work vs car drivers (Q26 in Versions 2 and 3). However, for pedestrians vs breast cancer (Q27 in Versions 1 and 2), CO poisoning vs accidents at work (Q25 in V2 and Q27 in V3) and pedestrians vs car drivers (Q26 in V1 and Q28 in V3) the numbers were counterbalanced in each direction because we had no strong priors¹⁰.

¹⁰ It might be thought that pedestrians would receive more weight than drivers. That was our intuition; but the Newcastle data suggested that dying as a pedestrian was weighted lower than dying as a driver, so we thought we should not prejudice the direction in this case.

Respondents had not been asked to explain their decisions for Q6-Q23, but for each of the contextual questions in Section 2 a box was provided at the bottom of the page and respondents were invited to write a sentence or two giving their reasons why they had ticked a particular box.

Section 2 concluded with a page asking for basic personal information about the respondent: gender, age of respondent, ages of any other members of the household, indication of existence of health problems in the household, and respondent's current/past occupation or occupation of other significant household member.

3. Implementation

At the time of writing the July Progress report, the intention had been to collect the data by posting questionnaires out, talking respondents through the introductory sections, and then asking them to answer the rest of the questions by themselves at their own pace and post the questionnaires back once completed. However, a trial of this procedure indicated problems: a number of the respondents who did return the questionnaires had clearly struggled when left to their own devices; but response rates were very poor and a disproportionate number of respondents were from social classification A/B. It was therefore decided to convene a number of groups to be moderated by JC, GL and AR to administer the questionnaires. While this necessarily involved some reduction in sample size compared with our postal/telephone-based projection, it gave greater control over the socio-demographic composition of the sample, while at the same time allowing us to check that respondents were understanding the tasks and enabling us more easily to supplement quantitative data with some qualitative information.

Groups were therefore convened in Cambridge, Darlington, Durham, Norwich and Stockton. The procedure in each group was as follows (all of the relevant materials are in the Annex). Respondents were each given the double-sided sheet headed HEALTH AND SAFETY SURVEY and the moderator went through it with them, clarifying any points arising. It was emphasized that although four specific examples were being used to illustrate the way scenarios might correspond with real-world (albeit simplified and stylized) cases, the questionnaire they were about to see would be asking them to think in more general terms: i.e. in terms of general principles rather than particular cases.

With that introductory sheet still to hand, respondents were each given their copy of Section 1, and were taken through the five practice questions, with brief discussions after each one. This gave them an opportunity to think about and discuss each attribute in turn. They were then told that the remaining questions would vary between two and all four attributes at a time, and that some of these differences might reinforce one another while others might pull in opposite directions. They were asked to work through the rest of the booklet. If they wished to return to any questions and modify their answers, they were free to do so. When all group members had completed Section 1, there was an opportunity for a brief discussion of the ways in which they had balanced the different considerations.

Section 1 was then collected and Section 2 was handed out. Respondents’ attention was drawn to the fact that these questions gave contextual information and that there was an invitation not only to tick a box but also to write a sentence or two in support of their decision. When all had completed Section 2, there was a discussion – depending on the time available – of the ways in which people had responded, and why. Finally, respondents were paid for their attendance and thanked for their contributions.

4. Results

We start by discussing responses to each of the five practice questions. Recall that the purpose here was to introduce the different dimensions one at a time and investigate how respondents reacted to differences along each dimension when considered in isolation. It would have been too time-consuming to examine all permutations in the practice questions, so we focused on one difference per dimension and asked respondents to write a sentence or two to support their decisions in the hope that these written comments might provide broader insights into the kinds of considerations that were influential. In what follows, we summarise both the quantitative and the qualitative data.

4.1 Practice Questions

The quantitative responses to each of these questions are reported in Table 1. The written comments were subjected to thematic coding.

4.1.1 Question 1 (*length of suffering*)

In Q1 the numbers of people dying (25), the age-group affected (17-40 year olds), and who is most to blame (business or government) were the same for both A and B. The difference between them was the length of suffering prior to death – the last few minutes for A and the last 3-5 years for B.

Q (attribute varied)	A worse/ much worse	Left Blank	B worse/ much worse
Q1 (length of suffering)	46 (14.7%)	6 (1.9%)	261 (83.4%)
Q2 (quality of life)	18 (5.8%)	4 (1.3%)	291 (92.9%)
Q3 (blame)	233 (74.4%)	9 (2.9%)	71 (22.7%)
Q4 (age-group)	267 (85.3%)	21 (6.7%)	25 (8.0%)
Q5 (numbers dying)	289 (92.3%)	8 (2.6%)	16 (5.1%)

The data in Table 1 show a clear majority of respondents indicating that B was worse or much worse than A (83.4%). One in six respondents (44 cases) who made this choice were selected at random for written comments (6 did not write any comments). The following themes emerged from the respondents who did write comments (38 cases)

- 37 raised concerns either about the **impact of the longer suffering on the victims' quality of life** (35), and/or the **victims' families or carers** (8 cases):
 - *Group A although very tragic enjoyed the majority of their lives with reasonably good health whereas B suffered for a long period of time [1009_v1]*
 - *Any death is bad. However death preceded by prolonged suffering impacts not just on the victims but also on family, friends, support systems [1125_v3]*
- 1 gave a reason which had **nothing to do with the length of suffering**:
 - *In either case when business or government is to blame it is unacceptable [1059_v2]*

The written comments of the minority of respondents (46 cases) indicating that A was worse or much worse than B were also analysed and showed the following themes:

- 14 did not write down any comments, 4 gave reasons which were **hard to code** or had nothing to do with the length of suffering, and 5 wrote comments which seemed to **contradict their choice**:
 - *This is an active group and most contributing to economy as such this is a drain on the country [2170_v1]*
 - *B has longer period of time to suffer [1076_v1]*
- The remaining respondents thought the victims of A would have **less time to adjust** (15 cases):
 - *The person and family have no time to prepare for their death [2059_v1]*
- the accident was **unforeseen/ came out of the blue** (2 cases):
 - *This sounds like a complete accident out of the blue, nothing can be done [2057_v1]*
- implied **negligence** (2 cases):
 - *Suggests that accident is caused by mal practice, or negligence. [2069_v3]*
- or that the **people in B would live longer** (5 cases):
 - *Prolonged life in B [2064_v3]*

Finally, of the 6 respondents who left this question blank:

- 3 did not write any comments and 1 wrote a comment which suggested they thought **A was worse than B**:
 - *A because with B you have a chance to get used to the idea of losing your life [1022_v2]*
- The remaining 2 respondents gave reasons which suggested they **balanced the suddenness of A against the length of suffering in B**:
 - *A – this is applicable due to the suddenness of the incident. B – because they length of time to dwell illness [1055_v3].*

4.1.2 Question 2 (quality of life)

In Q2 the numbers of people dying (10), ages (40-60 year olds), blameworthiness (nobody in particular) and length of suffering (1-2 years) were the same. In this question the difference between A and B concerned with victims' quality of life in the period leading up to their deaths. In A they were told it would be a bit worse than normal and with B a lot worse than normal.

As in Q1 the data in Table 1 show a large majority of respondents (92.9%) indicating that B was worse or much worse than A. Again one in six of these respondents' (48 cases) comments were analysed to reveal the following themes (9 did not write down any comments):

- 36 wrote comments which flagged up the fact that B's **quality of life was a lot worse** (11 of these comments said something about the **impact on the victims' family and carers**)
 - *Logic, a matter of degree? I go for a bit worse than normal because its preferable to a lot worse than normal [2007_v3]*
 - *It affects family and carers as well as victim who would feel affected by this [1093_v2]*
- The remaining respondents wrote comments which were related to **other attributes** which were the same between A and B – such as the length of suffering or who is to blame (3 cases)
 - *Death should be as quick as poss [1133_v2]*
 - *Harder for the individual and those close to them. Harder to adjust to also when nobody is to blame. [2051_v2]*

Notably 12 of the 18 respondents who indicated that A was a worse or much worse than B did not write down any comments. The remaining 6 who did gave the following reasons:

- 1 thought A was worse because it was probably **more unexpected**:
 - *Death is probably not expected in the 2 years period of slightly worse quality of life [2171_v3].*
- The others gave reasons that were vague or **hard to code** (2 cases):
 - *How illness affects other family members [1033_v3]*
 - 7
 - *Accident at work and hospital. [2042_v3]*
- **related to other attributes** (1 case):
 - *If you are going to die, the sooner the better if you are suffering. [2109_v3]*
- or seemed to **contradict their choice** (2 cases):
 - *One is actually expecting an early end to their lives and there is not much suffering. [2170_v1]*

Finally, 3 of the 4 respondents who left this question blank did not write any comments. The one who did gave a reason which suggests they **couldn't choose**:

- *I am not sure I could choose between them [1097_v3]*

4.1.3 Question 3 (blame)

In Q3 the numbers of people dying (15), ages (over 60 year olds), quality of life (bit worse than normal), and length of suffering (1-2 years) were kept constant. The

difference was that for A business or government was most to blame and for B it was the individuals themselves.

Table 1 shows that the majority of respondents (74.4%) thought A was worse or much worse than B. The themes to arise from one in six respondents' written comments (39 cases) were as follows (7 did not write down any comments and 2 were hard to code):

- 12 respondents commented that people **trust business or government** to look after their safety:
 - *Because we trust business and government to ensure we are safe. [2025_v1]*
- Others commented that the **victims of A were not to blame** (10 cases) or had **no choice** (8 cases), whereas the deaths of the victims in **B were self-inflicted** (12 cases):
 - *A is slightly worse because they were not to blame [1140_v2]*
 - *In A the choice is taken away from the individual. [2077_v2]*
 - *Shouldn't spend money on protecting people from their own stupidity [1018_v2]*

The themes to come out of comments of the 71 respondents who thought B was worse or much worse than A were as follows:

- 16 did not write any comments, 5 were hard to code, and 1 thought they were equal and just chose at random:
 - *I think they are exactly equal. On the spin of a 'mental coin'. [2033_v3]*
- Many of the remaining respondents wrote general comments about the fact that the **B deaths were self-inflicted** (36 cases):
 - *It is self-inflicted e.g., drink, drugs et. it is the individual to blame, Also some accidents such as suicide are self-inflicted so they are to blame. [1023_v2]*
 - *Individuals should take responsibility for their own actions, government has some responsibility for other's lives but for individuals to cause their own deaths is terrible [1057_v3]*
- Other comments included the belief that **people may be more difficult to change** than business or government (2 cases):
 - *Very difficult! But, people are more difficult to change than government so therefore B is MUCH WORSE. [1069_v3]*
- deaths where individuals are responsible may have **other impacts** (5 cases):
 - *Relatives would be more likely to be upset if individual cause their own death [1108_v1]*
 - *TV and newspaper reports on deaths [1118_v1]*
- the **victims may not have intentionally put themselves at risk** (3 cases):
 - *I feel B is slightly worse because it is down to the individuals themselves but also if this is linked to drinking, smoking or any other addiction then I feel the individual would not have meant to kill themselves [1029_v3]*
- that the **deaths were preventable** if the people hadn't put themselves at risk to start with (5 cases):
 - *Because they could have been prevented by themselves, for example a healthy person could have lived. [2160_v1]*
- or the **poor state of safety in business environments** (2 cases):
 - *Safety education non-existent in business environment. [2159_v1]*

One of the 9 who left this question blank did not write any comments and one gave a reason that was difficult to code.

- The others who wrote comments **wanted to know more** before giving an answer (3):
 - *I cannot really score or comment on this one due to lack of information [1056_v3]*
- or thought that **blame wasn't important** (4)
 - *A death is the same whether you bring it on yourself or are blameless [1136_v2]*

4.1.4 Question 4 (age-group)

In Q4 the numbers of people dying (25), quality of life (a bit worse than normal), length of suffering (last few minutes) and blameworthiness (other individuals) were the same. The difference between A and B was that A concerned the deaths of 17-40 year olds and B concerned the deaths of over 60 year olds.

The data in Table 1 show a clear majority (85.3%) indicating that they felt the deaths of 17-40 year olds was worse or much worse than deaths of over 60 year olds. Again a one in six random sample of respondents who made this choice (44 cases) revealed the following themes in their written comments (5 respondents did not write any comments and 1 gave a reason which was hard to code):

- 34 respondents wrote comments about the differences in life-span between the two groups, for example, that the 17-40 year olds **haven't had much life**:
 - *The only reason I can give for this is the people are younger than in B so haven't had much of their life but really there isn't much difference [1006_v1]*
- have much **longer left to live** than the over 60s:
 - *Younger age group has many more years to come and a longer period to enjoy life and to contribute to society. Oldest people may have already made their contribution and enjoyed life more to the full [2007_v3]*
- and still have a **lot to accomplish**:
 - *All life has value, but younger persons still have much to accomplish, whereas older people have lived their lives more [2025_v1]*
- A number of respondents also noted that the deaths of younger people may have a greater impact on their families because younger people may **leave dependents behind** (5 cases):
 - *A may have left dependants behind – less life [1036_v3]*
- and society will miss out on their **future contribution to the economy** (5 cases):
 - *They on average have longer time to live, and as society needs working people to function then A is worse. But only slightly [1074_v1]*

The written comments of the minority of 25 respondents who regarded the deaths of the over 60s as worse than the 17-40s revealed the following themes (8 did not write any comments and 3 gave hard to code reasons)

- 2 gave answers which implied they found the question unanswerable:
 - *You have too long to suffer [1133_v2]*
 - *To me this question is unanswerable [1055_v3]*

- 8 of the remaining respondents noted that the **17-40s can cope better** whereas the **over 60s are more vulnerable**, have **contributed more to society**, and have **more family connections**:
 - *Possibly 17-40 year olds have greater strength to cope with situation [1001_v1]*
 - *Older people, because of their vulnerability [2116_v2]*
 - *Generally those over 60 ... have contributed more to society [1032_v3]*
 - *B has more to reflect on. More family connections and so on to think about (more people will possibly be upset). I'm assuming that A and B retain consciousness. [2029_v1]*
- However a number of respondents wrote comments that were seemingly **opposite to their choice** (4 cases):
 - *A is a larger amount of the population in work etc. Over 60s had a lot of life experience already [1002_v1]*
 - *Both cases are bad but I feel B is slightly worse because the over 60 year olds have lived their lives and the 17-40 are just starting [1029_v3]*

Finally, of the 21 respondents who left this question blank (2 did not write any comments):

- 2 wrote comments which suggested they thought **A was worse than B**:
 - *The 17-40 year olds still have a life to lead [1097_v3]*
- The majority of the remaining respondents thought that **age was irrelevant** (14 cases):
 - *I think it is equally the same i.e., each death is as bad and worse as each other. Despite the age difference.[1044_v1]*
 - *The 60 years suffer the same as younger people [1082_v2]*
 - *Age is not relevant. Individuals are most important. They are all someone's sons, daughters, mothers, fathers, brothers, sisters etc. [1126_v3]*
- 3 respondents did however write comments which suggested they may have taken age into account under different circumstances:
 - *If other individuals are to blame then it is immaterial the age group or quality of life. [1130_v3]*

4.1.5 Question 5 (numbers dying)

In Q5 the ages (17-40 year olds), quality of life (lot worse than normal), length of suffering (last few weeks), and blameworthiness (the individuals themselves) were the same. However, A concerned 50 deaths and B 25.

As shown in Table 1 92.3% of respondents thought A was worse or much worse than B. The thematic coding of one in six respondents' comments (24 cases) showed the following:

- 7 respondents did not write any comments and 1 was hard to code:
 - *Were they not able to be helped [2059_v1]*
- A large number noted the differences in the number of people dying (15 cases) and a couple commented on the impact this would have on families and friends:
 - *More people are dying [1003_v1]*
 - *More people are dying so there is more families, friends etc, hurt. [2122_v2]*

The comments of the 16 people who thought B was worse or much worse than A revealed the following themes (7 respondents did not write any comments and 5 were hard to code):

- 3 of the remaining respondents gave reasons which seemed to be **opposite to their choice** (3 cases):
 - *The less deaths the better. [2041_v3]*
 - *Because it's double the number. [2160_v1]*
- whereas the comments of one other implied that **more deaths are better**:
 - *World very overpopulated. Also perhaps they were enjoying themselves more when other people being careful [1105_v3]*

Finally, of the 8 people who left this answer blank (4 did not write any comments):

- 1 thought the number of deaths was irrelevant, and the remaining 3 thought they were they same because the individuals themselves were to blame for the deaths:
 - *Again it doesn't matter how many people die the families will still suffer for those lost [1104_v3]*
 - *Can't discriminate as all deaths are their fault [1043_v1]*

In general, then, the impacts of differences along each dimension, when considered in isolation, were much as might have been expected. However, what is important is how much weight is accorded to each dimension relative to the others. When different dimensions work in opposite directions, which ones exert the stronger pull? When certain dimensions operate in the same direction, are there important interactions between them which add or subtract something from their separate contributions? And how far are the generic dimensions deployed in this study able to adequately capture the factors that influence respondents' judgments in particular specified cases?

In subsection 4.3 below, we consider how far patterns of response to certain of the generic questions appeared sensitive (in the appropriate direction) to changes in the characteristics of the scenarios, and we examine evidence of the extent to which those patterns carried over from the generic questions to the later questions where all the information was the same, except that the specific causes of death were identified. As mentioned earlier, for each of the questions where the contexts were identified, respondents were asked to write a sentence or two explaining their answers. These written comments supplement the quantitative data.

In subsection 4.4, we report the results of estimating the generic model. Of course, to the extent that responses to generic questions do not necessarily carry through to cases where particular causes are identified, these generic estimates can only have limited predictive power. Nevertheless, they may help to provide some indication of the relative weights accorded to the different dimensions and give some idea of the rates of trade-off between those various dimensions.

First, however, we consider how far responses appeared stable within the generic section of the study.

4.2. The Repeated Question: Q6/Q21

	A	B
Number of people who die	10 deaths	10 deaths
Age-group	17-40 year olds	17-40 year olds
Quality of life in period leading up to death	A bit worse than normal for last few minutes of their lives	A lot worse than normal for last few minutes of their lives
Who is most to blame	The individuals themselves	Business or government

Because it seemed possible that respondents' judgments might evolve somewhat as they worked through the questions, the first question they were presented with after the five practice questions was later repeated as Q21. The question as it appeared in Version 1 was as follows (Versions 2 and 3 were the same, except that the numbers of deaths in A was 15 in Version 2 and 25 in Version 3):

The three Tables below show the patterns of choice in each Version of the questionnaire. In all cases A>>B indicates the response 'A is much worse than B', while A>B denotes 'A is slightly worse than B'; A<B and A<<B are the corresponding statements in the opposite direction.

The three Tables tell somewhat different stories. In Version 1 (Table 2), the split between A and B is fairly stable – 15:86 in Q6, 14:87 in Q21 – but those identifying B as worse become less extreme in their view: 61 regarded B as much worse in Q6, but this number falls to 49 in Q21.

	Q6				
Q21	A>>B	A>B	A<B	A<<B	Total
A>>B	1	2	1	1	5
A>B	2	4	2	1	9
A<B	2	2	13	21	38
A<<B	1	1	9	38	49
Total	6	9	25	61	101

In Version 2 (Table 3), the A:B split changed from 30:78 to 18:90, a difference which is just significant at the 5% level.

	Q6				
Q21	A>>B	A>B	A<B	A<<B	Total
A>>B	2	2			4
A>B	4	3	5	2	14

A<B	4	11	29	14	58
A<<B	2	2	10	18	32
Total	12	18	44	34	108

By contrast, in Version 3 (Table 4) the overall pattern of responses does not change much: there are respondents who change, but the movements largely cancel one another out.

Table 4					
Repeated Question in Version 3 (25:10)					
	Q6				
Q21	A>>B	A>B	A<B	A<<B	Total
A>>B	4	3		4	11
A>B	7	4	6	1	18
A<B	3	5	24	8	40
A<<B	1	2	8	18	29
Total	15	14	38	31	98

What is reassuring, however, is that if we focus on Q21 and compare Versions 1-3, responses tend to migrate in the expected direction. A becomes progressively worse, as the number of deaths increases from 10 to 15 and then to 25, while the number of deaths in B stays at 10 in all three Versions. Table 5 shows the percentages (1 d.p.) making each response in the three Versions. However, it is noteworthy that although the tendency *is* in the right-to-left direction we should expect, it is not especially responsive to the changes in the numbers of deaths in the A scenario. Notably the B scenario differed from the A scenario on two attributes aside from the numbers of deaths. In B the victims' quality of life was a lot worse than normal as opposed to a bit worse than normal, and business and government were to blame rather than the individuals themselves.

Table 5					
Q21 in Versions 1-3					
(Deaths in A Increase 10→15→25)					
	A>>B	A>B	A<B	A<<B	N
Version 1	5.0	8.9	37.6	48.5	101
Version 2	3.7	13.0	53.7	29.6	108
Version 3	11.2	18.4	40.8	29.6	98

4.3. Comparing Generic With Contextual Questions

As explained earlier, 12 of the 18 generic questions were intended to provide estimates of how different attributes affected respondents' attitudes to scenarios, while the other six – five different plus one repeated – showed in generic format various pairs that would be presented again together with their named contexts in Questions 24 to 28. A further contextual question, Q29, was added part way through.

4.3.1 Car Drivers/Passengers vs Rail Passengers

Consider first Q24, which presented the same attributes as Q21, but this time labeling the deaths in scenario A as car drivers, while the deaths in scenario B were identified as rail passengers. Comparing Table 6 with Table 5, there is a more pronounced tendency for those who consider B worse than A to judge it to be much worse and a slight tendency for the A:B split to shift towards B. Even in Version 3 when there are 2.5 times as many car driver deaths, B was still considered worse or much worse than A by nearly 3 in 4 respondents (73.4%).

	A>>B	A>B	A<B	A<<B	N
Version 1	7.9	5.0	21.8	65.3	101
Version 2	4.7	9.3	37.4	48.6	107
Version 3	10.2	16.3	26.5	46.9	98

The reasons why respondents considered rail accident deaths to be worse than car accident deaths were explored by analyzing the written comments they provided. Particular attention was paid to the comments of those respondents who had switched their choice from Q21.

34 respondents who switched from rating A as worse or much worse than B in Q21 to B (rail passenger deaths) as worse or much worse than A (car driver deaths) in Q24.

- 6 did not write down any comments
- 14 respondents felt rail deaths were worse because the individuals were **not to blame**, had **no choice**, or were **helpless**
 - *Not the individual's fault [1005_v1]*
 - *The individual is powerless to influence events [1048_v3]*
- A number of respondents **expected the railways to be safe** (10 cases) or thought that **rail accidents should be avoidable** (2 cases)
 - *Whilst all travel involves risk, when travelling by train danger is not expected. [1057_v3]*
 - *Avoidable by better maintenance of track and carriage. [2044_v3]*
- 6 were concerned with the **greater suffering of the rail accident victims**

- *Due to the suffering that they had more than to who was to blame. [2063_v3]*
- And a couple of respondents made comments relating to the **violent nature of the death** in a rail accident
 - *In rail accidents parts of bodies are found everywhere along the railway lines [1023_v2]*
 - *If passengers are trapped in wreckage, they will suffer more because they are afraid and know that no-one can reach them in time [2154_v1]*

Hence it does seem that the ‘blame’ attribute was a powerful factor in influencing many respondents’ choices. If road fatalities consisted primarily of drivers who were largely to blame for their own accidents, the evidence is that there would be a very considerable premium for preventing rail passenger fatalities vis-à-vis such road accident fatalities.

	A>>B	A>B	A<B	A<<B	N
Version 1	5.9	15.7	54.9	23.5	51
Version 2	15.8	26.3	47.4	10.5	38
Version 3	25.7	33.3	35.9	5.1	39

However, since it is clearly the case that not all road accident fatalities are mainly the responsibility of the individuals themselves, we added a Q29 to all three Versions which was the same as Q24 except that the victims in A were now identified as car *passengers*, and blame was attributed to ‘other individuals’. The effect was marked (see Table 7), especially in Versions 2 and 3, where the percentages judging A to be worse more than doubled, with nearly 60% considering A worse than B when there were 25 car passenger deaths. It may be somewhat surprising that the impact was not stronger: but this may testify to some of the other reasons why respondents thought the rail passenger deaths were worse than the car driver deaths, including expectations that the railways should be a safe form of transport for passengers, and concerns about the worse quality of life or violent nature of the death.

4.3.2 Smoking Cancer vs Asbestos Cancer

In Table 8 we report the results from the smoking cancer vs asbestos cancer contextual scenarios presented in Versions 1 and 3 of the questionnaire (C row entries) along with their generic equivalents (G row entries). In these scenarios we described both types of deaths as affecting people over 60 whose quality of life would have been a lot worse than normal for the last 1-2 years of their lives. However the scenarios differed in terms of who is most to blame for the deaths – the individuals

themselves for A (lung cancer caused by smoking), business or government for B (asbestos-related cancer). We expected the ‘blame’ factor would shift respondents towards identifying B as worse than A; and since there were no other factors to shift respondents in the other direction, in both versions we also varied the numbers of deaths such that A would be considered worse than B (Version 1 – 50 deaths in A, 25 deaths in B; Version 3 – 15 deaths in A, 10 deaths in B).

In the scenarios where A was set at 15 deaths and B at 10 deaths the A:B split is much the same for the generic (Q9) and contextual questions (Q25), with almost three quarters regarding 10 deaths from asbestos-related cancer as worse than 15 deaths from lung cancer caused by smoking.

		A>>B	A>B	A<B	A<<B	N
Version 3						
15 Smoking cancer vs 10 Asbestos cancer	G	14	15	33	37	99
	C	14	14	19	52	99
Version 1						
50 Smoking cancer vs 25 Asbestos cancer	G	27	26	29	20	102
	C	15	11	24	52	102

When the numbers of deaths change to 50:25 so that scenario A now has twice as many rather than 1.5 times as many deaths as B, the distribution of responses in the generic format shifts to reflect this – indeed, to the extent that more than half of the sample now rate A as worse than B. Noticeably, however, identifying smoking as the cause in A and asbestos as the cause in B in the contextual version of the question not only shifts the A:B split sharply in the direction of B but also causes B to be markedly more often rated as much worse. The end result is that there is little difference between the distributions of responses in the two contextual questions: once respondents know that smoking and asbestos are the causes, sensitivity to different numbers of deaths is greatly reduced, to the point of being negligible.

We explored the reasons why respondents (19 in Version 3 and 32 in Version 1) switched from choosing A as worse or much worse than B in the generic version to B as worse or much worse than A in the contextual version by analyzing their written comments. The main themes to emerge were (5 respondents did not write any comments)

- That **smoking is a choice** and as such **smokers only have themselves to blame** whereas the **victims of asbestos related cancer were not at fault** (29 cases)
 - *Smoking is a choice so if they are dying from smoking related cancer then its only themselves to blame [1003_v1]*
 - *It was not their fault.[2095_v3]*
- That whereas people know the risks of smoking people are **unaware of the damage that asbestos might cause** (17 cases)
 - *A – smokers well aware of risks. B – people a lot less aware [1041_v1]*

- *People were not warned of asbestos damage it could cause. [2065_v3]*
- That **business and government should take responsibility** for people’s safety regarding asbestos (9 cases)
 - *It is the duty of business/ government to lay down guidelines concerning asbestos [1048_v3]*
 - *Government should know better than to put a dangerous substance in households / businesses. [2162_v1]*

These themes all suggest that the blame dimension influenced the respondents’ choices. While this is encouraging in the respect that the reasons for choosing the asbestos-related cancers as worse than the smoking-related cancers falls within the scope of the dimensions we used to describe the generic scenarios, it does seem that the addition of the labels increased the influence of this dimension. It is possible that these two examples fall at the extremes of the blame dimension for many people and if we had chosen other less extreme contexts to represent the individual and business-government types of deaths the generic choices would have more closely predicted the contextual choices.

4.3.3 Accidents at Work vs Car Drivers

In Table 9 we report the results from the accidents at work vs car drivers contextual and generic scenarios presented in Versions 2 and 3 of the questionnaire. In these scenarios we described both types of deaths as affecting 17-40 year olds. However the scenarios differed in terms of the quality of life of the victims in the period leading up to death – a lot worse than normal for the last few weeks of their lives for A (accidents at work), a bit worse than normal for the last few minutes of their lives for B (car drivers), and who is most to blame for the deaths – business or government for A and the individuals themselves for B. We expected that both the quality of life and the blame factor would shift respondents towards identifying A as worse than B, so we made the numbers of deaths in B higher than those in A in both versions.

Table 9						
Generic (G) and Contextual (C) Responses for Accidents at Work (A) vs Car Drivers (B)						
		A>>B	A>B	A<B	A<<B	N
Version 2						
10 Accidents at work vs 15 Car drivers	G	36	45	22	3	106
	C	47	41	12	6	106
Version 3						
25 Accidents at work vs 50 Car drivers	G	41	37	12	10	100
	C	40	38	10	12	100

In both versions we found no significant differences between the generic and contextual patterns of response, with more than three out of four respondents considering the work accident deaths to be worse than the car accident deaths, even though fewer deaths are involved.

It is worth noting that the two scenarios differed in terms of three dimensions (quality of life, length of suffering, and blame) so from the distributions of responses to this question alone it is not possible to identify which of the differences had the most influence. Thematic analysis of the written comments was therefore conducted to try to gain some insight. The themes to emerge from the 25 respondents who switched their choice to regarding the work accident deaths as worse than the car accident deaths are summarized below (7 of these respondents did not write any comments):

- Whereas 3 respondents mentioned the fact that the **quality of life** of the work accident victims was worse:
 - *Quality of life worse in last few weeks. [2129_v2]*
- 12 gave reasons related to **fault, choice and control**:
 - *B are causing deaths themselves [1023_v1]*
 - *Individuals could do nothing to prevent the deaths [1086_v2]*
- Or raised concerns about the fact that the **workplace should be a safe place** for people to work in (5 cases)
 - *Policies etc. should be in place to prevent any deaths etc. at work from occurring, [2121_v2]*

From this analysis it would appear that the difference on the blame dimension was the most influential in causing respondents to regard accidental deaths at work as worse than car driver deaths.

4.3.4 Work-related Cancer vs Car Drivers

In Table 10 we report the results from the work-related cancer vs car drivers contextual and generic scenarios presented in Versions 1 and 2 of the questionnaire. These scenarios differed on all attributes: age-groups affected (A: 40-60 year olds; B: 17-40 year olds), quality of life in period leading up to death (A: a lot worse than normal for last 1-2 years of their lives; B: a bit worse than normal for last few minutes of their lives), and blame (A: business or government; B: the individuals themselves). We expected that 3 of the 4 differences (quality of life, length of suffering and blame) would shift respondents towards considering A to be worse than B, while we thought that age might shift respondents in the other direction. We therefore set the numbers of deaths higher in B in both versions.

Table 10						
Generic (G) and Contextual (C) Responses						
for Work-Related Cancer (A) vs Car Drivers (B)						
		A>>B	A>B	A<B	A<<B	N
Version 1						
10 Work-related Cancer vs 15 Car drivers	G	38	34	17	10	99
	C	69	23	6	1	99
Version 2						
25 Work-related Cancer vs 50 Car drivers	G	27	41	25	13	106
	C	57	36	12	1	106

In both versions, the responses to the generic formats were poor predictors of responses in the contextual: identifying the contexts not only had the effect of causing an even bigger majority to judge the smaller number of deaths in A to be worse, but also significantly shifted the ratings from slightly to much worse.

Compare this to the accidents at work vs car drivers scenarios reported back in Section 4.3.3 where there was no significant difference between the generic and contextual patterns of response. In that case, the specific knowledge that the deaths in A were work-related had no additional impact over and the above a general knowledge that business or government were to blame. In contrast, being told that the work-related deaths are due to *cancer* appears to have a much greater impact on responses. This may be due to the impression that work-related cancers are the result of prolonged exposure and long term negligence on the part of the employer resulting in more weight being attached to the blame dimension. It may also be that the label 'cancer' leads to a different interpretation of the quality of life dimension for a given level. For example, 'a lot worse than normal' may seem significantly worse once respondents know that the death was caused by cancer.

The written comments of the respondents who switched to regarding the work-related cancer deaths as worse than the car driver deaths clearly support the view that the blame and quality of life dimensions influenced their choices (see below for main themes emerging from the 28 respondents who provided written comments out of the 48 who switched). However no specific or emotive comments were made about the fact that the deaths were labeled as 'cancer' death:

- That the work-related cancer victims had **no choice** over the situation and their deaths were **caused by others** (14 cases)
 - *The individuals had no control. [2027_v1]*
 - *Awful, why so many deaths, again due to business or government. In scenario B, the car drivers are to blame for the deaths. [2113_v2]*
- Or that the work-related cancer victims had **greater or longer suffering** (10 cases)
 - *I think A is much worse than B because suffering one-two years before death is more painful than die instantaneously. [2045_v2]*
- More generally a number of respondents expressed that **workers should be protected by business or government** (10 cases) or that these **deaths could have been prevented** (3 cases):
 - *You should not be put at risk in a work place and should be protected by law. [2058_v1]*
 - *Cancer could have been prevented if they hadn't been exposed to the chemicals at work due to the business. [1087_v2]*

4.3.5 CO Poisoning vs Accidents at Work

In Table 11 we report the results from the CO (carbon monoxide) poisoning vs accidents at work scenarios presented in Versions 2 and 3. These scenarios were identical on the age-group (17-40 year olds) and blame (business or government) dimensions. They differed in terms of the quality of life in period leading up to death (A: a bit worse than normal for last few minutes of their lives; B: a lot worse than normal for last few weeks of their lives). We expected these differences to shift

respondents towards choosing B as worse than A. We set the numbers of deaths in Version 3 to reinforce this choice (15 deaths in A: 25 deaths in B) and in Version 2 to offset it (25 deaths in A: 15 deaths in B).

Table 11 Generic (G) and Contextual (C) Responses for CO Poisoning (A) vs Accidents at Work (B)						
		A>>B	A>B	A<B	A<<B	N
Version 2						
25 CO poisoning vs 15 Accidents at work	G	13	31	41	21	106
	C	26	32	41	7	106
Version 3						
15 CO poisoning vs 25 Accidents at work	G	0	1	25	72	98
	C	10	10	37	41	98

Varying the numbers of deaths clearly had the expected effect in the generic versions with 97 of the 98 presented with Version 3 and 62 of the 106 presented with Version 2 identifying B as worse or much worse than A. The contextual scenarios produced rather different distributions, with responses shifting away from the victims of work-related accidents towards the victims of CO poisoning. So being told that a death is work-related *per se* will not necessarily lead respondents to attach more weight to those types of deaths.

The written comments revealed some reasons why the labeling of the scenarios shifted this many respondents towards the victims of CO poisoning (49 cases in total of whom 33 provided written comments).

- Aside from making comments about the differences in the numbers of deaths (15 cases given Version 2), a number of respondents (12 cases) commented that failing to check, maintain or install gas appliances correctly constituted **neglect** or that there was **no excuse** for faulty gas appliances:
 - *Gas appliances should be checked, this is neglect. [2038_v3]*
 - *There is no excuse for faulty gas appliances. There are laws regarding these. Obviously it's too late to check after a death has occurred. [2022_v2]*
- On a related theme it was also mentioned that the **CO deaths could be prevented** and were **easily avoidable/ unnecessary** (9 cases):
 - *A: there deaths can be prevented by checking of appliances – but slower death of B ALMOST counterbalance [1062_v2]*
 - *Easily avoidable if government funded installing carbon monoxide detectors in homes. These deaths are totally unnecessary [1128_v3]*
- Aside from those main themes a couple of respondents made comments about the **specific nature of the death from CO poisoning**:
 - *Poisoning in any way or form is in my opinion one of the worst deaths imaginable [1067_v2]*
 - *Example A as it is death by something you could never have prepared yourself for [1032_v3]*

4.3.6 Car Drivers vs Pedestrians

In Table 12 we report the results from the car drivers vs pedestrians scenarios in Versions 1 and 3. These scenarios were identical on the quality of life and length of suffering dimensions (a bit worse than normal for last few minutes of their lives). They differed in terms of the age-groups affected (A: 17-40 year olds; B: over 60 year olds) and blame (A: the individuals themselves; B: other individuals). We expected that the age-group difference might shift respondents towards choosing A as worse than B, while the blame dimension was likely to push in the opposite direction. We therefore set the numbers of deaths in the two versions to shift respondents either towards B (Version 3: 15 deaths in A; 25 deaths in B) or towards A (Version 1: 25 deaths in A; 15 deaths in B).

Table 12 Generic (G) and Contextual (C) Responses for Car Drivers (A) vs Pedestrians (B)						
		A>>B	A>B	A<B	A<<B	N
Version 1						
25 Car drivers vs 15 Pedestrians	G	19	30	36	15	100
	C	11	15	45	29	100
Version 3						
15 Car drivers vs 25 Pedestrians	G	8	17	36	38	99
	C	1	4	35	59	99

The data from the generic scenarios show that the changes in the numbers of deaths resulted in B being more often identified as worse in Version 3 (74/99 respondents) than in Version 1 (51/100). However, the contextual scenarios produce very different distributions, with a clear majority of respondents in both versions regarding B (pedestrian deaths) as worse or much worse than A (car driver deaths).

The following themes emerged from the written comments of those who switched to this choice in the contextual scenario (51 cases of whom 38 gave written comments):

- The fact that the pedestrians were **not to blame** for their deaths or had **less control** over the situation than the car drivers (23 cases)
 - *Due to the fact that pedestrians are not to blame [1073_v1]*
 - *The individuals are less likely to have had individual control. [2027_v1]*
- **Pedestrians should feel safe walking the streets** and the death would be unexpected (4 cases)
 - *It should be safe to walk the streets. [2024_v1]*
- The over 60s are a **vulnerable age group** (2 cases)
 - *I think this is a vulnerable age group in this type of accident and should be given more consideration. [2104_v3]*
- The **impact on other people** or **fallout** (2 cases)
 - *Although all car accident related deaths are tragic to those concerned, it must be especially difficult for those grieving when there is someone else who can be held accountable. [2060_v1]*
 - *Although it is a very thin divide, if it's caused by someone else the fall out is worse. [2137_v1]*
- Or the fact that in Version 3 the **number of deaths** was higher (6 cases)
 - *I feel B is slightly worse because of the number of deaths [1029_v3]*

As with the cancer caused by smoking vs asbestos scenarios reported back in Section 4.3.2 the labeling of the scenarios in this question as car drivers vs pedestrians clearly emphasized the difference on the blame dimension.

4.3.7 Pedestrians vs Breast Cancer

		A>>B	A>B	A<B	A<<B	N
Version 2						
25 Pedestrians vs 15 Breast cancer	G	17	21	42	26	106
	C	18	32	35	21	106
Version 1						
15 Pedestrians vs 25 Breast cancer	G	11	19	37	33	100
	C	8	17	42	33	100

In Table 13 we report the results from the pedestrians vs breast cancer scenarios presented in Versions 1 and 2. These scenarios were identical on the age-groups affected (over 60 year olds). They differed in terms of the quality of life/ length of suffering (A: a bit worse than normal for last few minutes of their lives; B: a lot worse than normal for last 3-5 years of their lives) and blame dimensions (A: other individuals; B: nobody in particular). Whereas we expected that the quality of life and length of suffering dimensions might shift respondents towards choosing B as worse than A, we did not have any strong a priori expectations about the impact that the difference on the blame dimension might have. We therefore set the numbers of B deaths higher in Version 1 but lower in Version 2.

In this question the impact of changing the numbers of deaths in the generic scenarios was not statistically significant, although it was in the expected direction (68/106 choosing B as worse or much worse than A in Version 2 and 70/100 in Version 1). However, unlike some of the other pairings reported in previous sections, the distributions of responses in the contextual scenarios were quite similar to the generic format.

Of the 29 respondents who switched to considering breast cancer deaths as worse or much worse than pedestrian deaths in the contextual scenarios the following themes emerged from the written comments that were coded (22 cases):

- The **greater suffering for a longer period** (16 cases)
 - *Although fewer people die the quality of life is bad for a long time [1094_v2]*
- The **larger number of deaths** (version 1, 6 cases)
 - *More deaths and lot more suffering [1005_v1]*
- That breast cancer **cannot be avoided**, is **incurable**, or the **psychological impact** of having a breast removed (4 cases)
 - *More deaths, more suffering, cannot be avoided [1078_v1]*
 - *Breast cancer is not a curable disease. [2080_v2]*
 - *Lots of people do not examine themselves, often leave finding a lump until its too late, sometimes have to have mascetme psychological loss of breast before death. [1022_v2]*

4.4 The generic discrete choice model

This section describes the results of the generic model estimated from responses to the 32 questions that made up the ‘main effects’ design (see section 2.1). We used a logit model which estimates the probability that one scenario in a pair is considered to be worse than the other based on the levels of attributes in each. The aim was to get some measure of the relative importance of each attribute in determining whether one scenario is worse than another and how changes in the levels of an attribute affect choices.

As logit is a binary choice model, we combined response modes ‘worse than’ and ‘much worse than’ in the estimation process. On this basis, there was no significant difference in response to those questions – Q10 and Q18 – that were common to all three questionnaires. Hence, we considered it appropriate to pool the data across the three versions of the questionnaire.

Recall that the attributes and levels associated with those attributes were set out as follows:

- **Number** of deaths prevented: 10, 15, 25 or 50.
- **Age** group of typical victim: under 17 years, 17-40 years, 40-60 years, or over 60.
- **Duration** of illness or suffering prior to death: a few minutes, a couple of weeks, a year or two, or 3-5 years.
- **Severity** if illness or suffering prior to death: quality of life a bit worse than normal, quality of life a lot worse than normal
- Who is most responsible or to **blame** for the death: nobody in particular, the individuals themselves, other individuals, or business/government.

In principle, the disutility¹¹ of a *particular type of death* might be expected to be some function of the age of the typical victim, the duration and severity of any period of ill-health prior to death, and the primary responsibility/blame for the death. On this basis, the disutility of a *particular scenario* would be the disutility of the type of death in question *multiplied* by the numbers of deaths specified in the scenario. Thus if the disutility of a type X death is given as $U(X) = f(\text{age}_X, \text{severity}_X, \text{duration}_X, \text{blame}_X)$, a scenario involving 50 such deaths will entail a total disutility of $50U(X)$: that is, twice as much disutility as a scenario involving 25 deaths of that type. Of course, the true model may not be *linear* in the number of deaths as in this simple example, but we would expect it to be generally *multiplicative* in nature.

¹¹ It is probably more appropriate to use the term ‘disutility’ here as we asked respondents to identify which scenario they consider to be *worse* than the other.

As above, standard utility theory entails that respondents ought to be multiplying the disutility of a particular type of death by the number of those deaths. Standard DCE estimation procedures, however, rely on taking *absolute differences* of attribute levels. We therefore estimated a model that was multiplicative in the number of deaths as follows:

$$P(B) = f\{(N_B^\alpha - N_A^\alpha) + \gamma_a(N_B^\alpha * age_B - N_A^\alpha * age_A) + \gamma_s(N_B^\alpha * severity_B - N_A^\alpha * severity_A) + \gamma_d(N_B^\alpha * duration_B - N_A^\alpha * duration_A) + \gamma_b(N_B^\alpha * blame_B - N_A^\alpha * blame_A) + e\}$$

where $P(B)$ is the probability that a respondent will consider scenario B to be worse than A, N_A^α and N_B^α are the number of deaths in scenarios A & B respectively raised to power α , and γ_i is the coefficient on the i^{th} attribute. When α is set equal to one, all deaths are given equal weight. Values of α less than 1 indicate a declining marginal disutility of deaths, so that 50 deaths would be given less than five times the weight of 10 deaths; while values of α greater than 1 indicate an increasing marginal disutility of deaths. The remaining attributes enter the model as dummy variables with the omitted dummies representing the following base case: Age = over 60's, Severity = *bit* worse than normal, Duration = for last *few minutes* of their lives, Blame = nobody in particular

The disutility of this 'base type' of death was accorded a value of 1. We first estimated the model with $\alpha = 1$, but a number of the coefficients appeared to have the 'wrong' sign and did not fit the data at all well. It seemed that setting $\alpha = 1$ imposed a restriction on the weight placed on the number of deaths which diverged from what respondents actually did to such an extent that it distorted many of the other parameter estimates.

We then explored other values of α . A grid-search showed that the log-likelihood function was minimized (i.e. the model fitted best) when $\alpha = 0.2$. The results of estimating the model on this basis are shown in Table 14. Observations were not independent (as each respondent contributed 12 observations), so standard errors were adjusted to allow for clustering by respondent. The parameter estimates and their respective levels of significance are given in Table 14.

Variable	Coefficient	Robust Std Error	Significance
Deaths	(offset)		
Dage(<17)	.817	.065	0.000
Dage(17-40)	.605	.055	0.000
Dage(40-60)	.355	.049	0.000
Dsev(lot)	.331	.035	0.000
Ddur(weeks)	.152	.045	0.001
Ddur(1-2 yrs)	.276	.047	0.000

Ddur(3-5yrs)	.354	.053	0.000
Dblame(indiv)	-.259	.057	0.000
Dblame(other)	.526	.054	0.000
Dblame(bus/gov)	.537	.051	0.000
Log pseudo-likelihood = -1839.4199			
Number of observations = 3401			

The deaths variable is ‘offset’ to make the disutility of the base type death equal to 1. The remaining variables are prefixed by a ‘D’ to indicate that they are multiplicative in the number of deaths. With $\alpha = 0.2$ the coefficients are all signed in accordance with prior expectations. The dummies on age show that disutility increases as the age of the typical victim falls – i.e. deaths of younger people are worse, all other things being equal. Also in line with expectations, the dummy for severity ‘a lot worse than normal’ (compared with ‘a bit worse’) increases the disutility of a scenario and disutility increases with duration of suffering. The dummies relating to blame show an interesting pattern. Blame(individual) is the dummy for ‘the individual themselves to blame’ which, according to the model, *reduces* the disutility of a scenario relative to the base case - ‘nobody in particular to blame’. On the other hand, blame(other) and blame(bus/gov) - dummies representing ‘other individuals to blame’ and ‘business or government to blame’ respectively - increase the disutility of a scenario.

4.5 Testing the predictive power of the generic model.

Although setting $\alpha = 0.2$ gave the best fit to the data used for estimation (i.e. the responses to the 32 questions in the main design), it did not always appear to be such a good predictor of responses to the other questions which involved generic descriptions of the contextual scenarios (see section 4.3 above). In particular, it tended to somewhat underestimate actual sensitivity in those questions to the numbers of deaths.

For this reason, we increased the value of α to 0.3 and re-estimated the model¹², with the results shown in Table 15.

Table 15: Model 2: $\alpha = 0.3$			
Variable	Coefficient	Robust Std Error	Significance
Deaths	Offset		
Dage(<17)	.526	.051	0.000
Dage(17-40)	.293	.041	0.000
Dage(40-60)	.121	.032	0.000
Dsev(lot)	.196	.027	0.000

¹² Increasing the value of α to 0.4 resulted in some coefficients having the wrong signs and/or key variables no longer being significant.

Ddur(weeks)	.096	.034	0.004
Ddur(1-2 yrs)	.175	.040	0.000
Ddur(3-5yrs)	.316	.051	0.000
Dblame(indiv)	-.231	.047	0.000
Dblame(other)	.295	.043	0.000
Dblame(bus/gov)	.345	.036	0.000
Log pseudo-likelihood = -1886.1191			
Number of observations = 3401			

We turn now to how well each model predicts responses to those questions that were not used in the estimation process i.e. the contextual scenarios and their generic equivalents.

4.5.1 Model predictions: car driver vs rail passengers

We begin with the car driver/rail passenger comparisons and first focus on Q21 (the generic equivalent). The first two columns of Table 16 show the predictions about the percentages of respondents who will consider B to be worse than A made by Models 1 and 2 respectively. The last two columns show the actual percentage of respondents who answered in that manner (i.e. the combined $A < B$ and $A \ll B$ data given in section 4.2).

It is clear that both sets of predictions move in the right direction. Model 1, however, predicts *less sensitivity* to the numbers of deaths than found in the actual data. For example, in moving from Version 1 (10 deaths in A) to Version 3 (25 deaths in A), Model 1 predicts that the percentage of respondents rating B worse than A falls from 85.6 to 79.5, while the actual percentage of respondents who answered in that way fell from 86.1 in Version 1 to 70.4 in Version 3. Model 2 does a better job of predicting these percentages, although it still falls several percentage points short of the actual outcome in Version 1.

Table 16: Comparison of Model Predictions with Actual Responses for Q21 in Versions 1-3 (Deaths in A Increase 10→15→25)			
	Model 1	Model 2	Actual % Rating B Worse ($A < B$ or $A \ll B$)
Version 1	85.6	82.4	86.1
Version 2	83.3	78.0	83.3
Version 3	79.5	70.5	70.4

Now consider Q24, which presented the same attributes as Q21, but labeled the deaths in scenario A as car drivers, while the deaths in scenario B were identified as rail passengers. Table 17 again shows the predicted percentages and the actual responses to that question¹³.

In this case, the proportions of respondents saying B was worse than A did not alter greatly after the context was revealed (although there *was* a tendency for those who considered B worse than A to judge it to be much worse). Thus, the pattern found in Table 16 is more or less replicated here, with Model 1 tending to underestimate the sensitivity of responses to the numbers of deaths. Model 2 gave better predictions of the sensitivity, but slightly underestimated the percentages rating B worse in Versions 1 and 2.

¹³ Since Q21 and Q24 are identical in terms of those attributes that appear in the models, the predicted percentages are identical to those in Table 16 for both Models. The same is true for all other pairings of contextual questions with their generic equivalents.

Table 17: Comparison of Model Predictions with Actual Responses for Q24 in Versions 1-3 (Deaths in A Increase 10→15→25)			
	Model 1	Model 2	Actual % Rating B Worse
Version 1	85.6	82.4	87.1
Version 2	83.3	78.0	86.0
Version 3	79.5	70.5	73.4

It will be recalled that an additional question was added about halfway through the study to see how responses would change if the road accident victims were car passengers rather than drivers, and if other individuals were primarily responsible for their deaths. Table 18 reports the results in the same format as Table 17.

Table 18: Comparison of Model Predictions with Actual Responses for Q29 in Versions 1-3 (Deaths in A Increase 10→15→25)			
	Model 1	Model 2	Actual % Rating B Worse
Version 1	63.2	62.0	78.4
Version 2	56.4	52.0	57.9
Version 3	46.6	37.5	41.0

In this case, both models underestimated the sensitivity of responses to changes in the numbers of deaths of car passengers and were quite a distance away from the actual responses in Version 1.

4.5.2 Model predictions: smoking cancer vs asbestos cancer

Table 8 reported the results from the smoking cancer vs asbestos cancer contextual scenarios presented in Versions 1 and 3 of the questionnaire along with their generic equivalents. Table 19 examines how well the two models predict these responses.

Table 19: Predicted and Actual Responses – Generic (G) and Contextual (C) Scenarios for Smoking Cancer (A) vs Asbestos Cancer (B)				
	Model 1	Model 2	Actual % Rating B Worse	
Version 3			G	C
15 smoking cancer vs 10 asbestos cancer	74.7	69.6	70.7	71.7
Version 1				
50 smoking cancer vs 25 asbestos cancer	75.7	68.2	48.0	74.5

In the case of Version 3, there is no marked difference in the proportion of respondents saying B is worse than A between the generic and contextual questions and Model 2 predicts both percentages well. In Version 1, identifying smoking as the cause in A and asbestos as the cause in B in the contextual version of the question shifted the A:B split sharply in the direction of B. Thus we could not expect any model to predict well in both the contextual and generic situations. What is somewhat surprising, perhaps, is that both models do better at predicting responses to the contextual, rather than the generic, version of the question. Table 19 shows that both models clearly overestimate the proportion of respondents saying B is worse than A in the generic situation in Version 1, although Model 1 comes close to the actual percentage in the contextual question.

4.5.3 Model predictions: accidents at work vs car drivers

Table 9 reported the results from the accidents at work vs car drivers contextual scenarios presented in Versions 2 and 3 of the questionnaire, along with their generic equivalents. In both versions we found no significant differences between the generic and contextual patterns of response, with more than three out of four respondents consider the work accident scenarios to be worse than the car accident scenarios, even though fewer deaths were involved in the latter. Table 20 shows that Model 2 accurately predicts the proportions saying that B is worse than A (i.e. that the car drivers deaths are worse) in the case of the generic scenarios.

Table 20: Predicted and Actual Responses – Generic (G) and Contextual (C) Scenarios for Accidents at Work (A) vs Car Drivers (B)				
	Model 1	Model 2	Actual	
Version 2			G	C
10 accidents at work vs 15 car drivers	13.6	22.0	23.6	17.0
Version 3				
25 accidents at work vs 50 car drivers	11.4	20.1	22.0	22.0

4.5.4 Model predictions: work-related cancer vs car drivers

Table 10 reported the results from the work-related cancer vs car drivers scenarios presented in Versions 1 and 2. In this case, responses to the generic formats were poor predictors of responses in the contextual in both versions: identifying the contexts caused a smaller minority to judge the larger number of deaths in B to be worse. Table 21 shows that both models underestimate the percentages of respondents who considered B to be worse than A in the generic question and at the same time tend to overestimate the percentages in the contextual question.

Table 21: Predicted and Actual Responses – Generic (G) and Contextual (C) Scenarios for Work-Related Cancer (A) vs Car Drivers (B)				
	Model 1	Model 2	Actual	
Version 1			G	C
10 work-related cancer vs 15 car drivers	16.1	18.8	27.3	7.1
Version 2				
25 work-related cancer vs 50 car drivers	14.0	16.2	35.9	12.3

4.5.5 Model predictions: CO poisoning vs accidents at work

Table 11 reported the results from the CO poisoning vs accidents at work scenarios presented in Versions 2 and 3. In this case, responses to the generic formats considerably overstated the percentages who rated B as worse once the contexts were identified. So no model could possibly provide good predictions of both. In fact, as Table 22 shows, Model 1 came closer to predicting the generic responses to Version 2 (and closer to, although still 20 percentage points away from, the generic responses in Version 3). Model 2 gave a much better estimate of sensitivity to the changes in numbers and overall came much closer than model one to the contextual responses across both versions.

Table 22: Predicted and Actual Responses – Generic (G) and Contextual (C) Scenarios for CO Poisoning (A) vs Accidents at Work (B)				
	Model 1	Model 2	Actual	
Version 2			G	C
25 CO poisoning vs 15 accidents at work	60.7	45.8	58.5	45.3
Version 3				
15 CO poisoning vs 25 accidents at work	78.8	75.5	99.0	79.6

4.5.6 Model predictions: car drivers vs pedestrians

Table 12 reported the results from the car drivers vs pedestrians scenarios presented in Versions 1 and 3. Here the contextual scenarios produced very different distributions, with many more respondents in both versions regarding pedestrian deaths as worse or much worse than car driver deaths: once again, therefore, it cannot be the case that any model will give good estimates of both contextual *and* generic. Table 23 shows that while both models give accurate predictions for the generic question in Version 1, Model 2 is clearly better in Version 3. In contrast to the smoking/asbestos and CO poisoning/accidents at work cases, both models do much better at predicting responses to the generic, rather than contextual, questions, which is more in line with our prior expectations.

Table 23: Predicted and Actual Responses – Generic (G) and Contextual (C) Scenarios for Car Drivers (A) vs Pedestrians (B)				
	Model 1	Model 2	Actual	
Version 1			G	C
25 car drivers vs 15 pedestrians	51.5	53.1	51.0	74.0
Version 3				
15 car drivers vs 25 pedestrians	64.4	73.2	74.8	95.0

4.5.7 Model predictions: pedestrians vs breast cancer

Table 13 reported the results from the pedestrians vs breast cancer scenarios presented in Versions 1 and 2. Once again there was some divergence between the contextual and the generic scenarios, with the contextual scenarios producing a bigger spread. Unusually, as Table 24 shows, both models predicted greater sensitivity than was actually observed in the generic cases and neither did a very good job of predicting the generic percentages. However, by virtue of predicting greater sensitivity, Model 2 came much closer to the contextual percentages than Model 1.

Table 24: Predicted and Actual Responses – Generic (G) and Contextual (C) Scenarios for Car Drivers (A) vs Pedestrians (B)				
	Model 1	Model 2	Actual	
Version 1			G	C
15 pedestrians vs 25 breast cancer	64.2	74.1	70.0	75.0
Version 2				
25 pedestrians vs 15 breast cancer	49.8	50.1	64.2	52.8

4.6 Relative performance of the different models

Models 1 and 2 were variants of the multiplicative specification given above, the only difference between them being the value of α used. Since we tried $\alpha = 0.3$ in response to the fact that we could see that the model underpredicted sensitivity when α was set

at 0.2, it is not surprising that Model 2 often fares better than Model 1. Even greater sensitivity of the fitted values would have been desirable in a number of cases; but, as noted earlier, raising α much further tended to destabilize other parameter estimates. We therefore focus on Model 2 for the purposes of the discussion in the next section.

5 Computing Relative Weights.

We may use the coefficients in Table 15 to calculate the disutility of one death of a particular type by simply adding up the coefficients, allowing the disutility of the 'base type' of death to take on a value of 1¹⁴. For example, the disutility score for a car driver death as described in the study would be:

$$U(\text{car driver}) = 1 + 0.293 + 0 - 0.231 = 1.062$$

where 1 is the disutility of the 'single death' base case, 0.293 is the coefficient on age (17-40 year olds), and -0.231 is the coefficient on blame (individuals themselves): the zero included in the expression reflects the fact that the 'degree of severity' was the same as for the base case.

Similarly, the single death disutility of a rail passenger as described in this study may be calculated as:

$$U(\text{rail passenger}) = 1 + 0.293 + 0.196 + 0.345 = 1.834$$

where 1 is the disutility of the base case, 0.293 is the coefficient on age (17-40 year olds), 0.196 is the coefficient on severity (lot worse than normal) and 0.345 is the coefficient on blame (business or government).

Thus, the weight given to a rail passenger death relative to a car driver death may be computed as $1.834/1.062 = 1.727$ ¹⁵. Taking the value of preventing a car driver fatality as #1.25m, this ratio of 1.727:1 would translate into a VPF for a rail passenger of £2.16m.

Similarly, we may calculate the disutility associated with the death of a pedestrian as defined in this study (i.e. age: over 60 years, severity: bit worse than normal for last few minutes of their lives, blame: other individuals) as:

$$U(\text{pedestrian}) = 1 + 0 + 0 + 0.295 = 1.295$$

Thus, the weight given to the death of a pedestrian relative to that of a car driver may be computed as $1.295/1.062 = 1.219$ which would translate into a VPF for a pedestrian of £1.52 m.

Recall that we defined a death resulting from an accident at work as affecting 17-40 year olds, with quality of life a lot worse than normal for the last few weeks of their lives with business or government mostly to blame. Thus, the disutility of an accident at work may be calculated as:

¹⁴ Recall that the base death is: Age = over 60's, Severity = *bit* worse than normal, Duration = for last *few minutes* of their lives, Blame = nobody in particular.

¹⁵ The corresponding estimate from the model in which $\alpha = 0.2$ is 1.834.

$$U(\text{accident at work}) = 1 + 0.293 + 0.196 + 0.096 + 0.345 = 1.93$$

The weight given to a death resulting from an accident at work relative to that of a car driver is then 1.817:1, which would translate into a VPF for an accident at work of £2.27m.

Before considering other comparisons, it may be worth illustrating how sensitive the road: rail relativity (for example) may be to the way in which each type of death is characterized. In the study, the car driver deaths were described in terms of ‘the individual themselves’ being to blame. But this is clearly not appropriate in the case of *all* car drivers (and even less so if car passengers are included). Thus, the estimated weight of 1.73:1 is likely to be an overestimate of the weight attached to rail passengers vis-à-vis the *average* car user fatality. For example, if the ‘blame’ attribute were changed to ‘nobody in particular’ in the case of car users, the computed ratio falls to 1.42:1. The ratio falls further to 1.16:1 if ‘other individuals’ are seen as the cause of the car user deaths. So the appropriate ratio depends on the assumptions about the proportions of car user deaths attributed to own behaviour, other people’s behaviour, or ‘pure’ accident. If, in addition, other road accident victims such as cyclists and pedestrians were to be taken into account, the ratio between the typical road accident victim and the typical rail passenger victim would be modified further, depending on the distribution of particular types upon which each ‘average’ case is based.

In theory, the model provides a ‘generic’ tool that may be used to estimate the relative weight between any pairs of deaths that may be described in terms of levels on the four attributes. For example, we may wish to estimate the relative weight given to a lung cancer death caused by asbestos relative to one caused by smoking as outlined in 4.5.2 above. Recall that both types of deaths affect people over 60 whose quality of life would have been a lot worse than normal for the last 1-2 years of their lives, differing only in terms of who is most to blame for the deaths (individuals themselves vs business/government). Using the same method as before, we may estimate the disutility of each type of death and compute a relative weight between the two.

$$U(\text{smoking-related lung cancer}) = 1.14$$

$$U(\text{asbestos-related lung cancer}) = 1.716$$

Thus, the weight given to one death from asbestos-related lung cancer relative to a similar death caused by smoking may be computed as 1.505: 1¹⁶.

We may also use the model to explore the effect that age has on the relative weights, holding other attributes constant. For example, in a comparison of breast cancer and childhood cancer we may wish to hold the severity and duration of suffering constant (a lot worse than normal for last 3-5 years of their lives) and assume that nobody in particular is to blame in both cases. The deaths would then differ only in terms of the age-groups affected (under 17 years vs over 60 year olds). From Table 15, the disutility of the childhood cancer death may then be calculated as 2.038 and the

¹⁶ The corresponding estimate from the model in which $\alpha = 0.2$ is 1.591.

disutility of the breast cancer death as 1.512, yielding a ratio of 1.348:1, a relative weight that may be attributed wholly to the age differential.

Of course, all of this is subject to recognizing the limitations of the parameter estimates. First, it must be borne in mind that there were a number of cases where respondents reacted differently to the contextual than to the generic scenarios. This could well reflect the fact that some influential variable(s) were omitted from the generic model, or that being given information about context caused certain categories of included variables to be interpreted somewhat differently. Moreover, the fact that the best estimate of α on the basis of the ‘main effects’ design seemed to underestimate sensitivity in the cases that were not used for estimation may be an additional indication that variables were omitted and/or that there was some misspecification of those variables. So it would be unwise to place *too* much weight on the particular parameter estimates above.

On the other hand, it does seem clear that the variables included in the model *do* matter to people and *do* differentiate between different types of death on grounds of the age of victims, the degree of prior ill-health associated with the death, and the locus of responsibility. The direction in which each variable operates is also clear. The question of *just how much* to differentiate may not have been completely and precisely determined, but there would seem to be a basis for a ‘tariff’ that may be broadly plausible and can be further refined.

**VALUATION OF HEALTH AND SAFETY BENEFITS : DREAD RISKS
FINAL REPORT OF THE MICHAEL SPACKMAN STUDY**

BACKGROUND

1. We here address societal concerns in the HSE's policy domains from an applied, public policy perspective – that is the relevance of societal concerns to the setting and implementation of workplace health and safety standards by government.
2. The term societal concerns is used by the HSE, and more widely, to describe hazard-specific factors, other than aversion to individual risk, which bear upon society's (or the government's) tolerability of and aversion to that risk.¹⁷ A formal statement of policy on societal concerns is set out in the final version of *Reducing risks, protecting people* (R2P2) (HSE, 2001). However, although R2P2 remains current, the HSE have since commissioned further work, which is considered below.
3. There has also since the publication of R2P2 been much other central government activity, driven from the centre on risk handling; but as noted in subsection 0 below this has only very recently begun to touch significantly upon the issues covered here. Nor apparently has there been any other substantial work within central government. Research on societal concerns has however been commissioned by Railway Safety, and subsequently the Railway Safety and Standards Board, which is considered below. Academic publications on risk have continued to flow but, to the best of our knowledge, few contribute significantly to the practical identification and handling of societal concerns in areas of interest to the HSE. We do however note and comment on two recent books.
4. We first summarise the R2P2 approach. This is followed by a brief comment on the wider handling of risk in government, and an examination of other thinking beyond R2P2 about societal concerns. We conclude with a discussion of the issues, of ways in which the handling of societal concerns could be further clarified and developed, and of some implications for empirical work.

¹⁷ The use of the term by the HSE was adopted in the course of an interdepartmental study, with external advisers, (HM Treasury, 1996), prompted by Treasury concerns about differences between the handling of road and rail safety. Previously the term "societal risk" had been used. This term societal risk is now confined to the implications of multi-fatality accidents, in which usage it has some international currency.

THE R2P2 APPROACH TO SOCIETAL CONCERNS

The TOR framework

5. R2P2 maintains the TOR framework, first published in 1988.¹⁸ This framework achieves a major advance on previous practice by combining, within the workplace context, ethically determined near-prohibitions on (relatively) high levels of risk with, at least in principle, a considered trade-off between costs and safety benefits for risks at lower levels.¹⁹ The quantification of the boundary between the “tolerable” and “unacceptable” regions for risk of death²⁰ is seen by HSE, and widely accepted, as an ethical judgement reflecting societal concern (R2P2, paragraph 132).
6. Within the tolerable region of risk, acceptability to HSE is presented as being determined by individual risk and societal concerns.

Individual risk

7. Concerns about individual risk are described as reflecting “*how individuals see the risk from a particular hazard affecting them and things they value personally*” (paragraph 25). In expanding on this R2P2 notes that although individuals “*may be prepared to engage voluntarily in activities that often involve high risks, as a rule they are far less tolerant of risks imposed on them and over which they have little control, unless they consider the risks as negligible. Moreover, though they may be willing to live with a risk that they do not regard as negligible, if it secures them or society certain benefits, they would want such risks to be kept low and clearly controlled.*” (underlining added)
8. Subsequently R2P2 applies this discrimination between different levels of concern about individual risk, with the one exception of cancer risks,²¹ only to the determination of whether a hazard needs, or does not need to be regulated (such as

¹⁸ And later reissued in a second edition (Health and Safety Executive, 1992).

¹⁹ This trade off being generally described as ALARP (As low as reasonably practicable), or in some contexts SFAIRP (So far as is reasonably practicable), or ALARA (As low as reasonably achievable).

²⁰ This quantification is now less conspicuous than in previous guidance, but still maintained as follows: “... in our document on the tolerability of risks in nuclear power stations, we suggested that an individual risk of death of one in a thousand per annum should on its own represent the dividing line between what could be just tolerable for any substantial category of workers for any large part of a working life, and what is unacceptable for any but fairly exceptional groups. For members of the public who have a risk imposed on them ‘in the wider interest of society’ this limit is judged to be an order of magnitude lower – at 1 in 10 000 per annum.” (R2P2, paragraph 132).

²¹ In valuing small changes in the risk of death, risks of death by cancer are weighted by the HSE twice as heavily as changes in risks of death due to other causes, on the grounds that this reflects a preliminary assessment of people’s willingness to pay for such changes on risk (R2P2 Appendix 3, paragraph 13).

climbing equipment as opposed to unsupervised mountaineering; or electric drills or kettles as opposed to domestic DIY or cooking). If the hazard does need to be regulated, “individual risk” is defined simply by the magnitude of the hazard (such as the risk of death or injury), with the adjustment where relevant for cancer.

9. Degrees of voluntariness, controllability and benefit from the activity clearly do vary across hazards although, as we note later, it is far from clear that these have much bearing on upon *individual* risk aversion. They appear, rather, to be societal issues, relevant to the divide between regulated and non-regulated activities, and perhaps also to societal judgements on how strong regulation should be.
10. There are however other determinants of individual risk aversion not recorded in R2P2. Dependence upon age is covered only in the context of societal concern (where it also belongs). Differing aversion to different types of hazard, for example involving more or less suffering before death, is reflected only in the extra weighting for cancer – although these latter dimensions are of course a subject of this current research project.

Societal concerns

11. Societal concerns are described in R2P2 as reflecting “*the risks or threats from hazards which impact on society and which, if realised, could have adverse repercussions for the institutions responsible for putting in place the provisions and arrangements for protecting people, e.g. Parliament or the Government of the day*” (paragraph 25). R2P2 expands at several points on factors which it suggests generate such societal concerns, as follows (underlining added).

- “... *this type of concern is often associated with hazards that give rise to risks which, were they to materialise, could provoke a socio-political response, e.g. risk of events causing widespread or large scale detriment or the occurrence of multiple fatalities in a single event.*²² *Typical examples relate to nuclear power generation, railway travel, or the genetic modification of organisms.*” (paragraph 25).
- “*Hazards giving rise to societal concerns share a number of common features. They often give rise to risks which could cause multiple fatalities; where it is difficult for people to estimate intuitively the actual threat; where exposure involves vulnerable groups, e.g. children; where the risks and benefits tend to be unevenly distributed – for example between groups of people with the result that some people bear more of the risks and others less, or through time so that less risk may be borne now and more by some future generation.*” (paragraph 26)

²² “The occurrence of multiple fatalities in a single event” is presented as a sub-set of societal concerns, defined, as noted above, as **societal risk**.

- “... it would be quite unusual for high levels of individual risk not to engender societal concerns, on equity grounds,” (paragraph 132)
- “Hazards giving rise to such [societal] concerns often involve a wide range of events with a range of possible outcomes. [Examples are] the death of a child as opposed to an elderly person, dying from a dreaded cause, e.g. cancer, or the fear of affecting future generations in an irreversible way.” (paragraph 134)
- “... societal concerns are often absent for a wide range of hazards, for example, this is often the case for those hazards that are familiar or where the risks they give rise to are generally accepted as being well controlled.” (paragraph 141)
- “[Sometimes] it is not possible to allay the societal concerns about the risk. For example, though experts may regard available control measures as adequate for controlling a particular risk, that view may not be shared by society as a whole, as established through existing democratic processes and regulatory mechanisms, either because the majority of people believe that the measures will not always be observed or that they have doubts that the risks should be entertained at all.” (paragraph 146)

12. A further distinction is drawn in R2P2 (although not used in practice by the HSE) between “direct societal concerns” about “the impact of the hazard on those affected” and “a concern that, in the wake of an event giving rise to such concerns, confidence in the provisions and arrangements in place for protecting people against risks to health and safety, and the institutions responsible for setting out and enforcing these provisions and arrangements, would be undermined”(paragraph 27).

13. Much of the section of R2P2 headed societal concerns, in paragraphs 134 to 137, is about FN curves, with HSE’s convention that “the risk of an accident causing the death of 50 people or more in a single event should be regarded as intolerable if the frequency is estimated to be more than one in five thousand per annum.”²³

DEVELOPMENTS ON SOCIETAL CONCERNS OUTSIDE R2P2

The Whitehall Risk Programme

14. The Prime Minister announced in July 2001 that the Cabinet Office Strategy Unit would undertake a study of the handling of risk in government. In November 2002 the Strategy Unit produced a substantial report (Cabinet Office, 2002) and

²³ For such a risk spread over a population of many thousands, as is typically the case, this implies a maximum level of individual risk of fatality from such an event well below the “normal” tolerability limit for individual exposure of around 1 in 10,000.

the Government immediately established a two year Risk Programme, hosted by HM Treasury, to implement the Strategy Unit recommendations. The Programme is steered by a committee at Permanent Secretary level, supported by a small (four member) multidisciplinary Risk Support Team, and ongoing assistance from, in particular, the Treasury Public Service Delivery Analysis team and the Environment Agency. The Programme's most recent report (*Improving Government's Risk Handling: Second report to the Prime Minister*), published in November 2003 (HM Treasury, 2003.2, 2003.3), is a substantial document which is however concerned much more with corporate (administrative/ political) risk than with risk regulation.^{24,25}

15. More relevant to risk regulation is the Programme's short (one page) note on *Principles of managing risks to the public* published in September 2003 (HM Treasury and Cabinet Office, 2003), which is sound, but restates, in an elegant form, existing published principles. Subsequently an interdepartmental working level committee has been set up which is seeking to progress, among other issues, the handling of societal concerns.²⁶
16. The current status of this work was presented by the head of the Risk Support Team at a seminar in March 2004 (Pullinger, 2004). This noted the need to "capture structured, informed and considered views" of the public and the importance of seeking views based on evidence rather than media judgments or self-selected contributions (e.g. from pressure groups). Societal concerns were presented in terms of a summary version of the criteria often taken to steer risk communication - namely unfamiliarity, uncertainty, and inequity or dread characteristics of the risk, and the degree on individual control and trust in others

²⁴ The administrative focus of the Programme is illustrated by its definition of "risk": *Risk is most commonly held to mean "hazard" and something to be avoided. But it has another face - that of opportunity. Improving public services requires innovation - seizing new opportunities and managing the risks involved. In this context risk is defined as uncertainty of outcome, whether positive opportunity or negative threat, of actions and events. It is the combination of likelihood and impact, including perceived importance.* This contrasts with the more technical HSE usage: ... *it has proved useful to HSE to make a conceptual distinction between a hazard and a risk by describing a hazard as the potential for harm arising from an intrinsic property or disposition of something to cause detriment, and risk as the chance that someone or something that is valued will be adversely affected in a stipulated way by the hazard. HSE - as far as the health, safety and welfare of people is concerned - frequently makes use of the above conceptual distinction in its guidance ...* (R2P2, paragraph 39)

²⁵ The high political profile of such concerns is well illustrated by the Prime Minister's minute of 29 March 2004, copied to Cabinet Ministers, quoted (Sunday Times, 18 April) as saying that: "Too often in the past, change has been initiated in ignorance of the risks, and of what might be done to deal with them. In future we need to ensure that risks have been adequately considered before we make policy announcements. We also need to be more open with the public, engaging them in our decision-making about risks and winning their trust." This last sentence is of course also relevant to the handling of societal concerns about risk regulation.

²⁶ This is work which previously would have fallen within the remit of the Interdepartmental Liaison Group on Risk Assessment (ILGRA), a technical group set up under HSE chairmanship in the early 1990s to "undertake a review of the principles and practices used in Government for risk assessment with a view to identifying best practice; encouraging common approaches; and to producing a report describing and comparing current practices". However, although this group produced three "Reports to Ministers", in 1996, 1998 and 2002, it had no effective levers of influence. It was disbanded in 2002 as its functions were subsumed by the Risk Programme.

in managing the risk. We suggest later that evidence-based risk regulation calls for an approach that embraces these issues, but also digs deeper.

17. This preliminary Risk Programme presentation also suggested that societal concerns should be brought within a “willingness to pay” framework; although we understand that this is shorthand for a broad concept of bringing societal concerns within some more formal analytical structure than now, both as indicators of risk communication problems and as factors to consider in the setting of standards and defining enforcement regimes. We suggest later that some societal concerns might be fully incorporated into formal, quantitative analysis, although this is unlikely ever to be realistic for others, in particular those based on alternative value systems.

Research reports

18. Since publishing R2P2 the HSE have commissioned two studies from a mainly sociological perspective – by Adams and Thompson (2002) and by Ball and Boehm-Christiansen (2002). The HSE have also commissioned work on the underlying causal chains and a “gauging tool” for societal concerns (Bandle et al, 2003); and internally they have developed a simplified, practical application of its FN framework for societal (multi-fatality) risk (Hirst and Carter, 2002).
19. Railway Safety, subsumed in April 2003 into the new Railway Safety and Standards Board, has a programme of research on “Policy and risk”. This has included two companion papers, by Wolff (2002) and by Elliott and Taig (2003), on the ethical aspects of safety decision-making in the context of railways, although both papers address issues of wider application.
20. Prior to R2P2, and written in the context of health policy, but still an outstandingly clear summary of media triggers and fright factors, is the Department of Health (1998) paper widely described as “Pointers”.
21. No other government or regulated body appears in recent years to have published materially relevant work, although we understand that the Environment Agency has commissioned some work in progress on participatory risk assessment, which should be closely relevant to the handling of societal concerns. The Department for Transport, which retains the leading role in establishing a baseline “value of a prevented fatality” (VPF), and values for road injuries, has recently established a Government policy that the same VPF should be applied to road and rail safety. The announcement, as recorded in section 0 below, is in terms which might be taken as rejecting societal concerns as a decision criterion.

Academic publications

22. Academic work on risk in recent years has been, to say the least, prolific, but little of it appears to contribute materially to the problem of societal concerns in the setting of health and safety standards. Two books are however considered here (Jaeger et al, 2001; Hood et al, 2001, 2004).²⁷

FOUR DISCIPLINARY PERSPECTIVES

23. We here review seven publications under the headings of sociology, philosophy, engineering/ risk assessment and public administration/ public law perspectives. We adopt this format because this is the way the literature is structured, reflecting the backgrounds and experiences of the contributors, even those who, like many of the authors of the papers and books considered below, can fairly claim a good interdisciplinary grounding.

Sociology perspectives

24. The HSE published in 2002 two papers on societal concerns, written from a mainly sociological perspective. The work was originally commissioned as a single project. However, as is clear from the papers, the two sets of authors had incompatible views. We follow this with a commentary on a wide ranging academic study.

Adams and Thompson (2002) “Taking account of societal concerns about risk: Framing the problem”

25. Professor John Adams, to quote his website, “was a member of the original Board of Directors of Friends of the Earth in the early 1970s and has been involved in public debates about environmental issues ever since [He is] intrigued by the persistence of attitudes to environmental risks ... and seeks to understand these attitudes and the reasons for their persistence, in the hope of transforming shouting matches into more constructive dialogues.” Professor Michael Thompson, as a contributing author to De Vries and Goudsblom (2003) is described as “a social anthropologist. ... His current interest is in the area of democratisation of processes in areas (such as risk management, environment and development in the Himalaya, technology and climate change) that have tended to be treated as merely technical.”
26. Adams and Thompson make several points which are fair, if largely uncontroversial, with well chosen examples. They stress the important point that regulation which “pursues only the costs of getting it wrong” can lose important

²⁷ It happens that these two books are currently being offered by Amazon as a “perfect partnership” joint package.

social benefits.²⁸ They also note that changes in safety standards may change behaviour, which may reduce the safety benefit in exchange for other benefits (such as shorter journey times), and have external impacts which may reduce safety elsewhere. They also argue for public consultation on safety regulation, which is a point now generally well taken by the HSE. However their main thesis is a very specific, crusading view of risk policy analysis, based on their own framework for types of risk, and cultural theory with a strong “constructivist” emphasis.

27. Thus, accepting the need to balance the potential rewards of getting it right against the potential costs of getting it wrong, the two other key framing devices they propose are as follows.

- i) There are three types of risk that can helpfully be distinguished: **directly perceptible** [for example ‘climbing a tree’], **perceived with the help of science** [for example ‘cholera’] and **virtual** - where scientists disagree or confess ignorance [for example ‘BSE/ vCJD, global warming, low-level radiation, pesticide residues, HRT, mobile phones, passive smoking, stock market,’]. These three types of risk can be further subdivided into risks that are **voluntary** and those which are **imposed**.
- ii) The rewards and costs of risk taking are viewed through **perceptual filters**. A typology of filters is presented: **individualist, egalitarian, fatalist** and **hierarchist**.

28. They explain that “robust risk management” within this framework requires:

the adoption of **constructivism** and the abandonment of **objectivism**. This will rule out the use of single metric methods such as cost-benefit analysis and require the adoption of **typology-based discourse analysis**. ... HSE must transform itself into a ‘clumsy institution’ – i.e. one that abandons the goal of optimality (which can serve only one perspective at the cost of excluding and alienating the others) and listens intently to all the stakeholders.

29. They reject²⁹ “objectivism - the idea that we can clearly distinguish between what the risks really are and what people variously and erroneously believe them to be”. This they say “will have to give way to constructivism – the idea that risk is inherently subjective: something that we project onto whatever it is that is ‘out there’”.

30. The authors explain that this rejection of objectivism (which roughly equates with what Jaeger et al describe as the Rational Action Paradigm), “is not to reject science”, nor presumably does it reject costs, although these are nowhere mentioned. However it rejects “single-metric decision models”, which they interpret widely, to include *any* attempt to value any aspect of risk in monetary terms.

31. The perceptions of these authors appear to stem largely from their strong grounding in environmental and anthropological issues, which in some ways

²⁸ Examples quoted are successful legal action following school trips which would be regarded by many as well supervised, which has led to NUT advice to teachers to avoid them, and requirements for hand washing facilities which have led to children no longer being allowed to handle reptiles at some centres.

²⁹ At one point they talk of “reconciliation ... between ... the objectivists and the constructivists”, but within a few lines this becomes “the abandonment of objectivism”.

differ greatly from the health and safety regulation issues of concern to the HSE. This is illustrated by their presentation of “global climate change” as “a typical issue”. Global climate change, far from being typical even of environmental, let alone health and safety issues, is an extreme case, where there is wide (although not universal) agreement that conventional CBA valuations have a very limited role. Indeed one of the authors of this current report has written the following (in the context of discounting estimated future costs and benefits over time), which is broadly consistent with Adams and Thompson:

In the case of global warming, the distribution problem is even more severe [than that of just handling the very long term]. Most of the costs of reducing emissions appear to fall on the present developed economies, and most of the long-term benefits, of reduced impacts on sea level and climate change, appear to fall on developing countries. Schelling (1999), with some logic, presents this as an issue of overseas aid. On the other hand, the developed economies are also the main producers and beneficiaries of the emissions. This all contributes to an ethical quagmire, which can only be resolved, given our present level of understanding of human preferences, by political rather than analytical processes. (Spackman, 2002)

32. Some of the health and safety issues within the purview of the HSE do raise difficult ethical and perceptual problems and even in simpler cases valuing *every* important cost and benefit in monetary terms is rarely if ever realistic. However no HSE application even approaches the ethical, political and empirical complexity of global climate change.
33. The authors’ threefold categorisation of types of risk might be more simply be expressed as: a) risks which are clear to everyone; b) risks which are clear to experts; and c) risks which are clear to no one. There is some value in this division, but it is not clearly well matched to the needs of the HSE. In launching the publication of R2P2, the HSE chose three case studies: the regulation of outdoor centres for young people; the explosion of gas mains in residential areas; and automatic train protection. It is not clear where these case studies fit into the Adams and Thompson categories, nor that discussion of where they might fit would provide useful insights.
34. The authors also put great weight on one popular model of cultural theory, which, as noted above, divides stakeholders into individualists (who incline to leave free markets to sort things out), egalitarians (defined by Adams and Thompson as mainly environmental groups), fatalists (who stand back from the fray), and hierarchists (who advocate trusting authority, and include by assertion, in the Adams and Thompson model, government structures such as the HSE).
35. This cultural theory model shrewdly captures four comprehensive and familiar sets of attitudes (or “perceptual filters”) and can be useful in helping to describe the world. Indeed Hood et al use this model to describe the policy handling of the components of some risk regulation regimes: for example in the government approach to domestic radon, information gathering is hierarchist, while the approach to behaviour modification lies between individualist and fatalist. However Adams and Thompson use the model only to classify the attitudes of

stakeholders in general, illustrating these four perceptual filters in attitudes towards many issues – albeit none of them examples of HSE regulation.

36. Thus the model categorises four types of protagonist, which is interesting up to a point, but it does little to further constructive debate. It does however help the construction of stories. Adams and Thompson promote the story approach to policy debate. As they say, this is how audiences are persuaded. They explain this in the context of “the argumentative turn”, this being the title of a book (Fischer & Forester 1993), “which describes the re-orientation of policy analysis and design required to make it ‘open to a variety of solutions and scenarios that would give more weight to social priorities and local potentials’ (Hajer & Fischer 1999)”. Adams and Thompson explain that:

- Rather than understanding policy-makers as problem-solvers who apply objective, scientific, and value-free methods to cure society’s ills, advocates of the argumentative turn suggest we think of policy-makers as performers who seek to persuade an audience. In order to convince other policy-makers and the public, participants in the policy process use political symbols to construct credible and persuasive policy arguments.
- A policy argument, in consequence, tells a story: it provides a setting, points to the heroes and villains, follows a plot, suggests a solution, and, most importantly, is guided by a moral. Since policy arguments are designed to persuade, they are necessarily value-oriented. Yet this does not mean that policy arguments are mere opinion. Policy arguments explicate problems by recourse to rational methods: logic, consistency, and objectivity in terms of argumentative performance. Policy arguments are successful, not because they are based on an objective standard, but because they persuade. ...

37. Much of this is fair up to a point. But in the strong form promoted in Adams and Thompson’s paper it is the antithesis of evidence-based policy. It stands in contrast for example with the perceptions of Newman (2003), an American doctor concerned with the wellbeing of children (see box).

Stories versus evidence

Under the title of “The power of stories over statistics”, Newman explains his difficulties in giving what he believes is the best balance of medical treatment to children, in the face of the lobby group Parents of Infants and Children with Kernicterus (PICK).³⁰ Newman explains that:

I have now met many of the women in PICK and know that they want the AAP³¹ to recommend that all newborns have bilirubin measured before they leave the hospital. I like and admire these women and want to be on their side, heroically fighting to prevent an awful disease. On the other hand, I am a proponent of evidence based medicine and am reluctant to endorse a new screening recommendation that is not based on good evidence. In this case, the “evidence” is primarily the poignant stories of the kernicterus cases.³²

Newman also questions a US Federal Aviation Administration (FAA) decision to endorse a proposed regulation that children under 2 years of age ride in infant safety seats in aeroplanes, rather than being allowed to travel free on a parent’s lap. The issue arose from the death of a “lap child” in a potentially survivable crash in 1989, and another in 1994. It is a classic case of “societal concern” as defined by the HSE. The FAA had resisted such a regulation on the grounds that the increase in cost would divert a minority of families from air to car travel, with a consequent increase in deaths. Newman himself,

³⁰ Kernicterus is a rare but sometimes lethal consequence of severe jaundice.

³¹ American Academy of Pediatrics.

³² This is not to imply criticism of the work of PICK, or other lobby groups, in general. The PICK website mainly addresses concerns about plainly incompetent medical services and cover ups in this field, rather than the controversial issue of screening.

with others, estimated that deaths would increase if more than 5-10% of families chose to drive rather than fly. They also estimated that, even ignoring these possible highway deaths, if the seat taken by the infant was costed at \$200, the cost per death prevented would be \$1.3 billion.

Newman's concern is not with the regulation as such, which may or may not be in the public interest, but with the absence of evidence to support it. Deciding factors appear to have been views such as that of a Congressman for the district of the 1989 crash: "The question, I think, Mr Chairman, comes down to how many more children must die, how many more have to be hurt before we reach threshold of FAA's ghoulish cost-benefit ratio?" Against this, but less audible: "The infants who die in these car crashes do not crash and die statistically. They really crash. They really die ... [But] the name and photo of the dead infant in the car crash will not haunt anybody in the world of aviation safety." (Bishai, 2003, as quoted by Newman)

38. Newman would presumably be rejected by Adams and Thompson as an objectivist. He believes in collecting evidence, and valuing costs and benefits, and would probably welcome evidence on the extent to which families using airlines would be willing to pay for very small reductions in risk. On the other hand Newman makes it clear, as would most "objectivist" practitioners in this field, that he does not see such numbers as necessarily the whole story. In Newman's words, on reading testimony on the 1989 crash: "I understood how rational people could favour the regulation – no flight attendant and no family should have to go through what was described in the testimony". But, again to quote Newman:

The trouble with these compelling stories, however, is that their apparent simplicity and focus can lead to the neglect of complicated considerations of what else we might do with our resources, and how we should make these decisions. A problem for those promoting evidence based policies is that we are at a disadvantage when we cannot identify the specific people who would benefit or be harmed.

39. Adams and Thompson refer to developing Himalayan villages, Austria's arrangements for the management of hazardous wastes, the handling of radiation risks in a Boston hospital, and the current international regime that has cleaned up the Rhine.³³ It may well be that in such cases there has been a tendency, or worse, towards expert judgment being imposed on those affected, made on the basis of too narrow an understanding of consequences and local preferences; and that such issues cannot be satisfactorily managed without more local consultation. There is however no conflict - quite the contrary - between this and the use of quantitative analysis, with explicit valuation of preferences wherever it is feasible.

40. The qualification about feasibility is important. Adams and Thomson assert that "Cost-benefit analysts assume, not only that all risk-management concerns can be reduced to cash, but that such a reduction is a prerequisite for the making of 'rational' decisions." In support of this they quote the 1992 Royal Society Report, which is indeed simplistically worded:

³³ These examples are attributed to Thompson (2001). They are presented in the context of promoting the "clumsy institution", which Adams and Thompson explain was coined by Shapiro (1988) "as a way of getting away from the idea that, when we are faced with contradictory definitions of problems and solutions, we must choose one and reject the rest. It is now established in the literature as the precondition for decision-making arrangements that embody sufficient *essential contestation*. It is a tongue-in-cheek label that thumbs its nose at the hubris of the advocates of single-metric optimisation." The "hubris" presumably refers to their assumption that advocates of evidence based policy, including CBA, generally believe that everything can be valued *ex ante* in monetary terms.

The optimum level of safety will be when risks have been reduced to the point where the extra costs of an extra reduction just equals its benefits, but no further. ... To weigh costs and benefits explicitly requires measuring them in common units and, so far, the only common unit suggested has been monetary value. (Royal Society 1992)

To attack such an extreme position is easy. However in practice few (if any) practitioners believe that “all risk-management concerns can be reduced to cash”; still less do they believe that “such a reduction is a prerequisite for the making of ‘rational’ decisions”. In some cases (such as a small improvement of a road junction design) it may be that almost every material social impact can be valued, except perhaps the budgetary constraint; but in issues where societal concerns are important there are political and/or ethical aspects that are inherently issues for judgment. The challenge is to identify and structure these, support them with empirical evidence, and consult, in ways which best serve the public interest.

41. Adams and Thompson annex an attack on “single metric decision models” giving prominence to a paper (Beattie et al, 1998) by authors including several of those of this present report, in which we presented some serious problems in deriving willingness to pay for reductions in risk and how we responded to them. Adams and Thompson comment that this work “yet again implies a belief in the existence of an elusive ‘true’ number whose value they, and their numerous predecessors, have failed to elicit”. However the implicit belief of Adams and Thompson that people in general are so stupid, confused, or perverse that they are incapable of valuing risks in any circumstances is not consistent with our experience.
42. The nature of the approach proposed by Adams and Thompson is illustrated by a review, written by Adams in 2002 and reproduced in their paper, of the two academic books to which we refer below. The two books cover very different aspects of risk regulation. One (Jaeger et al), by sociologists and environmental policy experts, is a wide ranging review of the social science context of standard setting, independent of any national institutional structure. It ranges over the Renaissance, Hobbes, Hume, Kant, the rise, fall and rise of cardinal utility, the range of sociological theories, and much else. Its main concern is with the problems of the Rational Actor Paradigm (RAP), and to this extent it shares a theme of Adams and Thompson, but it takes a much broader view, and reaches a measured conclusion. The other book (Hood et al), by public administration experts and a lawyer, approaches the field from the other end – taking individual case studies in the UK institutional context, and using them to build a structure for describing and analysing risk regulation regimes.
43. Adams criticises Jaeger et al for not rejecting the RAP, and criticises Hood et al rather oddly for producing a descriptive structure that has “very little predictive power”.³⁴ He makes much of the fact that neither set of authors refers to any work of the other authors. This is unsurprising, given their different fields of interest; but Adams invites readers to conclude from this that “the two books are small isolated vessels floating on the vast inchoate ocean of risk”. He notes that both

³⁴ Hood et al offer a structure for describing and analysing regulatory regimes. They also use it to assess various hypotheses about the determinants of regimes, with significant predictive power.

books mention cultural theory, but criticises them for going “on to fry other fish leaving the impression that they see it as but one approach among many”.³⁵

44. Adams concludes with a summary of his own cultural theory paradigm as follows:

The cultural theory approach that both books compliment *en passant* offers answers to both problems [i.e. reconciling pluralism with collective rationality – Jaeger et al; and providing a more refined way of mapping regulatory regimes – Hood et al]. It does not reject rationality, it acknowledges *plural* rationalities; where the science is inconclusive the imagination is liberated to speculate *rationally* from different starting assumptions. Further, this approach limits the contending risk regulation regimes to a comprehensible and manageable number. It won't stop us arguing, but if adopted more widely as a navigational aid, more of the small boats on the ocean of risk might communicate with each other and point in the same direction

45. Thus the model proposed by Adams and Thompson is radical, but desperately narrow. It is promoting one paradigm from within a huge sociological canvas. In reality the “ocean of risk” is complex, but not inherently inchoate, and the argument that “where the science is inconclusive the imagination is liberated to speculate *rationally* from different starting assumptions” provides no navigational aid. The sole policy recommendation of Adams and Thomson is that “the HSE can only incorporate ‘societal concerns’ about risks in its policy-making and regulation-enforcing effectively by listening to and responding to *all* the solidarities – by being a ‘clumsy’ institution”. But this is surely uncontentious and insubstantial, at least in principle. However the regulator cannot effectively listen and respond to all the solidarities in practice without having a clear intellectual framework itself, both to structure the issues and establish principles to define what is and what is not in the public interest. This structure and set of principles are all but absent from Adams and Thompson’s paper.

46. Adams and Thompson assert that analysis should be confined to hard science, and in particular that work to discover how much people value small changes in risk should be excluded. They say that we should instead look to stories, with the most persuasive story teller expecting to win the day. This is a lobby group view of the world.

47. The paper is however of value in illustrating a viewpoint of which any policy analysis and handling of societal concerns needs to be aware.

³⁵ Hood et al respond to Adams in the preface to their 2004 edition. They suggest that *to accept the value of grid-group cultural theory in helping us to understand risk does not mean that that all we need to make sense of complex risk situations is the simplest of navigational aids. Such a rudimentary approach seems more likely to limit than to develop our ability to analyze risk and its regulation by not making use of the power of institutional analysis. ... looking at risk regulation regimes as combinations of multiple institutions, rules, practices and animating ideas ... should be helpful both to cultural theorists and scholars from other disciplines. ... as anyone who has tried to navigate a boat knows, better charts and other navigational equipment enhance the value of a compass. Having one does not reduce your need for the other.*”

Ball and Boehm-Christiansen (2002) “Understanding and responding to societal concerns”

48. Professor Ball and Dr Boehm-Christiansen both have a wide interdisciplinary background and experience in particular of environmental policy. They review relevant sociology and sociology-related literature.
49. They construct a twelve-fold categorisation of societal concerns, from which the practical conclusion is that such concerns are “very much a mixed bag” (and some more legitimate than others) and that “how to proceed clearly depends upon the type of societal concern with which one is confronted”.
50. This leads on to a discussion of theoretical models, starting with a clear summary of sociological models, drawing for its framework on Renn (1998). Renn proposed ordering the several sociological approaches in two dimensions. One dimension is the continuum between **constructivist** (“all knowledge about risk is socially-constructed, subjective, and unmeasurable”) and **objective** (“all knowledge is directly experienced from physical reality accessible through a combination of data collecting and theoretical reasoning”). The other dimension is the continuum between **individualistic**, which is self-explanatory and **structural** or collective (“social phenomena cannot be explained by individual behaviour alone, but ... rest upon interactive, often unintentional effects among individuals and between larger units, be they institutions, social groups, subcultures or a society”). Thus, for example, cultural theory sits in the constructivist/ structural (or subjective/collective) quadrant, while the “rational actor” concept sits in the opposite, objective/ individualistic quadrant.
51. There follows a discussion described as “a philosophical analysis”, but concerned essentially with political theory, public administration and, again, sociology, and concluding that it is all complicated. This is followed in turn by a presentation of the technique of rational field theory. The authors “consider this a powerful approach if used as a template for getting to the heart of risk management decision processes, which is where we believe many of the conflicts over societal concerns originate ... by exposing and exploring the rational fields of the various participants in a risk debate [so that] the door is opened for constructive dialogue and understanding”.
52. In their concluding discussion the authors suggest that the HSE “need not get too involved in the academic debates underlying rival theories, even perhaps being well advised to steer clear of them”, while noting the “substantial unanimity” that the culture and context of risk-taking behaviour are important and that discourse with all stakeholder groups is important. They go on to discuss, in the usage of sociology “the problem of bias” and “the typology of bias (prejudice)”. They quote three types of “prejudice”: “necessary prejudice” is a ‘prejudgement’ that, for example “heavy objects fall to the ground”; “blinkerred prejudice”, held

knowingly or unknowingly, is “a belief that is held by the believer to be an objective truth regardless of the strength of arguments against”; finally “reasoned prejudice” is “a position arrived at through reflection on either evidence or values or both, is open to revision, and is a prejudice which the holder is continually prepared to question and defend if he believes it to be defensible.”

53. Ball and Boehm-Christiansen suggest that only necessary prejudice and reasoned prejudice “should be countenanced by risk managers” and also that “not all values are equal”. This is fair to the extent that the government needs to assess the relative merits of competing views, but it skips over the fact that one person’s “reasoned prejudice” (for example that globalisation, or GM crop technology, should in general be encouraged or resisted) may be regarded by others as blinkered. Assessing what aspects of “public opinion” should and should not steer public policy, having regard both to distinguishing between the reasoned and the blinkered, and to pragmatism (e.g. trust in the system; government tolerability of a bad press), is more complex than Ball and Boehm-Christiansen acknowledge.

54. Turning to risk management the authors refer to Shrader-Frechette (1991), whose widely quoted book draws a helpful spectrum between the extremes of “those who decry the use of techniques such as QRA and CBA, and those who see decisions as being *made* by such tools”. Ball and Boehm-Christiansen explain that their middle of the road view coincides with that of Shrader-Frechette, as follows.

Although there are many cases where these techniques have been badly used, and although they have serious limitations, there are in principle reasons for continuing to use them, albeit with considerably more insight than has traditionally been the case. Critics will of course point to the flaws in these techniques, but it is a value-judgement whether flawed techniques (providing, we hope, that the flaws are made clear) are better or worse than no techniques at all. As Shrader-Frechette says, a society pleading for policy-making based solely on expertise, intuition and wisdom, or on ‘open discourse,’ to the exclusion of what can also be learnt from QRA-CBA, “is like a starving man pleading that only steak will satisfy him.”

55. The authors’ recommendations are generally balanced, albeit pitched more at the level of principle than practice. They can be summarised as follows.

- Societal concerns have disparate origins and motivations; where they matter, thorough political analysis should be undertaken to reveal the motivations, and HSE should guard against exploitation of societal concerns by commercial, political, or non-governmental groups. (It should in particular do more to investigate how stakeholders use evidence and values and the role of “prejudice” in this process.)
- The HSE should be informed of, but should not become over-committed to any particular model of risk perception and behaviour.
- The technical analysis of risk “provides only a narrow view of an issue which, while useful in some circumstances, ignores the culture and context of risk taking behaviour”. There should be more inclusive discourse over values and beliefs when addressing societal concerns.

- All pertinent voices should be represented, particularly those groups who will have to pay.
- The regulator may have to choose between “biases”, and in this case should make clear his own biases, and be prepared to modify them in the face of reasoned argument.
- The HSE should not abandon quantitative techniques, but should continue to ensure that users are aware of their limitations.
- The pressures created by societal concerns should not be “decoupled” from routine considerations of cost and practicability.

56. The language used by Ball and Boehm-Christiansen of “flawed techniques” is unfortunate. Neither QRA nor CBA is a flawed technique, although both, like any technique, are limited in what they can do. To apply any single technique as the total answer to health and safety policy analysis would be flawed. But these techniques are no more flawed than is say optical or radio astronomy, or mathematical analysis, as a technique for understanding the universe.

57. Ball and Boehm-Christiansen also make little distinction between the descriptive analysis of risks (for example by QRA) and prescriptive analysis of what the policy response should be (for example by CBA among other techniques).

Jaeger, Renn, Rosa and Webler (2001) “Risk, Uncertainty and Rational Action”

58. These authors, from sociology and environmental policy backgrounds, wrote this because “nowhere was there a book which combined the analytic and managements literature on risk with the rapidly growing literature on risk in the social sciences ... especially ... nowhere could we find a book that attempted to systematically integrate social scientific theory into risk.” They have produced, over a reported period of seven years, an impressive, jargon-free, but very wordy book, which provides a probably uniquely comprehensive review of the history of the Rational Actor Paradigm (RAP), which they explain “conceptualizes the social universe as an aggregate of atomistic actors”, and of the diverse relevant developments in recent years in sociology. This includes a good coverage of the relevant history of economic concepts.³⁶

59. Their main theme is that RAP, described as the monarch of the social sciences, rules a shaky kingdom. They make the fair point that “more than any other discipline, economics has elaborated the idea of rational action into a general theory for researchers”, but perhaps understate the extent to which economists strive to understand the real world. They suggest (in a style not untypical of the book as a whole) that evidence contrary to the rationality assumption “is

³⁶ Although not an intuitive grasp of economics. For example their explanation of the convexity of indifference curves includes the unqualified comment that “thus, getting an apple and an orange is always preferable to getting two apples or two oranges”.

embarrassing [to economics] at the level of special theories only. It is rarely more than an anomaly to the broader domains – a vexing noise to the harmonious duet of worldview and paradigm”.

60. Since earlier work by one of the authors (Renn) was heavily drawn upon by Ball and Boehm-Christiansen, it is unsurprising that they arrive, after 300 pages and over 500 references, at much the same general conclusion, again in the language of sociology:

RAP, the monarch, thus faces severe new challenges that risk the kingdom. At the same time, a new, functionally equivalent and equally potent paradigm has not yet emerged. The new paradigm must include the RAP perspective and it must be as rigorous and decisive as RAP with regard to computational structure and mathematical articulations of its assumptions. ... Criteria are needed for social rationality that encompasses collective values and goals.

Views may differ on whether this worthy goal is realistic. But we applaud the objective of bringing wider societal drivers into a coherent analytical structure.

61. This is an academic book, written in an academic style, and far from an operational manual for the setting or implementation of health and safety standards. However we include it as an intellectually balanced and comprehensive review and source book, from a sociological perspective, of the intellectual history and academic sociological debate on the RAP – departures from which are at the heart of at least some societal concerns.

Philosophy perspectives

62. Railway Safety, now the Railway Safety and Standards Board, commissioned in 2002 two papers written from a mainly philosophical perspective, one by a philosopher and the other by risk consultants.

Wolff (2002) “Railway safety and the ethics of the tolerability of risk”

63. Professor Jo Wolff is an academic and consultant philosopher. He addresses what he describes as the “problem” and “unusual divergence of attitude” that railways are perceived as very safe, “but on the other hand the public appear to want vast sums spent on further safety improvements”. He approaches this from the perspective of moral philosophy; and Railway Safety, in responding to the report, noted that particularly helpful aspects of it are the ways in which it:

- places in an ethical context the current regulatory approach to the tolerability of risk;
- identifies the differences between the ‘consumer’ view of risk (which generally accepts that safety performance on the railway is good) and a ‘citizen’ view, which expresses concern about the way safety is managed;
- emphasises the importance of system failures (and a perceived lack of ‘state of the art’ safety systems) in the evolution of public opinion.

We agree with this assessment, although the report ranges over many issues, with varying degrees of confidence. It is also, as was its remit, addressed to the needs

and context of the railway industry. Thus although much of Wolff's discussion and analysis is ostensibly about HSE practice, his interpretation of "societal concerns" is primarily that of public criticism of the railway industry, from the industry's rather than the regulator's perspective. Nonetheless the paper contains much that is of wider interest.

64. Wolff's extended Background section, on the HSE guidelines and the psychology of risk, is generally clear, helpful and uncontentious. His premise, that the belief that railways are safe, combined with public clamour for vast sums to be spent on a particular train protection technology, in the wake of accidents which it would have prevented, is not perhaps widely seen as a puzzle, nor especially unusual. However this does not diminish the value of work. He questions, rightly in our view, the distinction drawn in R2P2 between individual risk aversion and societal concerns.
65. Wolff's Analysis section is less straightforward, partly because of some misunderstanding about cost-benefit analysis as it is applied in safety regulation. He asserts for example that, assuming a diminishing marginal utility of money, "utilitarianism would generally favour more equal distributions than cost benefit analysis", without recognising that (although handling of distributional issues in general is conspicuously missing from most CBA) diminishing marginal utility of money is routinely included.³⁷
66. However he sets out clearly the distinction between absolute theories and consequentialism, suggesting that, for example, an accidental death and a murder have the same direct consequence, while from an absolutist perspective they have quite different moral character. He suggests that people "are prepared to take a consequentialist attitude when thinking about their personal exposure to risk ... however they will take a more of an absolutist stance when thinking about the types of risk that should exist in their society. This corresponds to the distinction between individual and societal concerns, and ... to a distinction between consumer and citizen." This distinction is useful, although the analogy with crime, as we discuss below, may be less close than Wolff implies. And the distinction is perhaps less relevant to what types of risk should exist in society than to intensity of regulation, and to what the response should be when certain types of risk materialise.
67. Wolff's central case study is taken from R2P2 (in a box in the R2P2 section on Tolerability limits), on the risk of carbon monoxide poisoning in rented accommodation. The HSE text reads as follows:

... during the period 1994/5-1998/9 the annual risk of death to the public from the use of gas (fire, explosion or carbon monoxide poisoning), averaged over the entire population of Great

³⁷ Most obviously in the routine discounting of the marginal income of future populations for the fact that they are expected to be richer; but also in other ways, for example by assuming a constant monetary value for public services and health, safety, or environmental benefits, regardless of the recipient's income; or by explicit formulae, as recommended in the current Treasury guidance (HM Treasury, 2003).

Britain, was 1 in 1 510 000 – in other words below the limit of what is often regarded as broadly acceptable. Gas incidents, however, continue to give rise to societal concern, particularly where the incidents occur because unscrupulous landlords seek to avoid the cost of simple safety checks on their gas heating systems and so put those who rent the accommodation (often young people) at greater risk. In effect such societal concerns override averaged numerical considerations.

Wolff concludes from this that “the key point” is that the risks are imposed by “unscrupulous landlords”. This, he says:

seems to introduce a new and vitally important element: **that of who or what is exposing people to the risk, and with what moral justification.** [emphasis in original] It seems that it is because we are appalled by certain landlords’ irresponsible behaviour in avoiding ‘simple safety checks’ that societal concerns are engaged. Here, then, we see ethical issues, of a particular, absolutist flavour, appearing as central to the analysis of attitudes of risk.

68. This is not very persuasive. It is true that society believes that there should be more regulation of appliances which are the responsibility of landlords than of those owned by the users (although the regulation of household gas appliances is itself far from absent). However this is not clearly any more than the general case of protecting people from hazards controlled by others, be they in the workplace, transport, consumer products, food, or medicine.³⁸
69. There is an ethical obligation on producers to take all reasonable measures to make their products safe. However it is also true that “unscrupulous landlords” make good newspaper copy. This is embarrassing to governments and to the regulator and must be expected to generate a blame avoidance response. This selective media amplification is the way of the world, but it is hard to see any *ethical* reason for applying higher standards of required risk mitigation to landlords than to employers or any other responsible parties. The HSE’s references to “young people” may more plausibly point to an ethical societal concern, but Wolff dismisses this aspect, which he says “does not seem to get to the heart of the issue”.
70. In fact the HSE text itself is less than clear. The figure of about 1 in 1,500,000 annual risk of death, averaged across the entire population, is below the region of significant regulatory concern (generally taken as around 1 in 1,000,000). However it seems reasonable to suppose that the risk across those households with gas appliances in rented accommodation is considerably greater than this, and into the ALARP region; while it is also clear that the HSE do not regard the risk, whatever it is, as too high to be tolerated. Thus, despite the comment about overriding “averaged numerical considerations”, the HSE seem to have done little if anything more than introduce regulation to promote action that is “reasonably practicable”. However it appears that, while the standards follow ALARP, monitoring and enforcement may be more rigorous than for some other regulated hazards imposing comparable individual risks.

³⁸ This can be seen as an ethical judgment about “duty of care”, although in many cases the regulatory function might be in sharper focus if viewed as dealing with the lack of information readily available to consumers about potentially dangerous products.

71. Wolff goes on to suggest more generally that that societal concern arises where risks are being imposed irresponsibly: “... if risks are perceived to be the result of reckless, negligent, incompetent or selfish behaviour this moral issue can become a matter of great concern, **independently of any concern for the actual harm likely to be done**” [emphasis in the original]. Indeed he sees societal concerns in terms almost wholly of culpability, referring to culpability or culpable negligence more than forty times, and suggesting that culpability “is the basis of societal concern”.
72. This reflects the context of the railway in 2002, when this was indeed the flavour of the day, but it is only loosely relevant to the setting of health and safety standards, which is the main societal concern problem faced by the HSE. The criticisms made of management after an accident, and indeed culpability proved or suspected, are not immaterial to risk regulation, but nor are they central to societal concerns, which are primarily an ex ante concept – as presented by the HSE in the examples chosen at the launch of R2P2. Culpability is something that emerges after the event and typically produces a surge of media debate and public outcry. This is a category of societal concern, and is a major issue for railways management. However from the HSE’s perspective it is perilously close to the “blinkered prejudice” that Ball and Boehm-Christiansen would have the regulator set aside.³⁹
73. Wolff discusses at length the ethical foundations of CBA, but faces the problem that “cost-benefit analysis” is an ill defined term, especially in respect of what it claims to include and to achieve. He constructs a concept of CBA that some practitioners might accept, but probably most would not. However his broad conclusion, that CBA does not in practice capture all of the costs and benefits relevant to policy decisions, is from our perspective uncontentious.
74. This leads to Wolff’s “key point” that an individual’s willingness to pay to reduce a risk to himself does not necessarily represent what the individual thinks should be paid by the government (or other responsible parties) to reduce it. He suggests that an individual might reveal a willingness to pay to reduce the risk of being murdered by, for example, taking a taxi instead of walking, but might support much higher expenditure to achieve that reduction in that particular risk. Or as another example that “it makes perfect sense to believe that we should, as a society, do more (or conceivably less) to prevent a death by arson than a death by accidental fire even if both are feared equally by individuals.” These examples raise interesting questions about public preferences, the appropriate policy response, and the distinction between responses before and after a serious injury or death.

³⁹ Indeed a general omission from Wolff’s analysis is recognition of societal pressures which in the public interest should in principle be resisted.

75. One question is how people's attitudes and preferences vary with respect to these various risks. It is not clear that, as Wolff implies, people take a simple consequentialist attitude to personal risk (i.e. being indifferent to equal small changes in risk of death by murder, train accident, or mountaineering), although our own previous work broadly supports Wolff's hypothesis.
76. A second question is what the policy response should be. Wolff implies that people's valuations of such changes in personal risk, if they could be derived, would be inappropriate as a basis for, or even irrelevant to policy choice in crime prevention, because of the moral character of crime. However debate about the allocation of crime prevention expenditure is increasingly conducted in exactly the terms which Wolff rejects. Thus to the extent that the personal suffering of the victim of burglary can be valued (as valued by the victim), as an addition to the material loss, this may be a sufficient measure of the social cost of that crime (when combined with wider social costs, such as those of policing, and possible feedbacks from the crime or its detection onto other crime). There is a debateable ethical case for spending still more to reduce these risks, but it is not an evidently strong case. Taking Wolff's example of murder: if, for example a programme to improve an urban area included an estimated reduction in the absolute risk of murders by say 2% per year, over a population of 10,000, one component of the benefit would be the value to those exposed of this reduction in risk. Another would be the saving of the often massive diversion of resources following a murder. It is far from clear that the social benefit, *ex ante*, includes a further ethical component because of the moral nature of the crime.⁴⁰
77. An ethical driver does however enter strongly *after* the event, in rather the same way that, if someone is in imminent danger the normal, human, proper response is to apply all the available resources to rescue, certainly without a cost-benefit analysis. So too, murder, because of its moral nature, demands a very high priority of investigative effort, constrained to be sure (as are rescues) by the resources previously allocated to the bodies concerned, but generally conducted on the basis of "doing everything that can be done", and not on the basis that the life now lost (or in immediate danger) is "worth" some sum of money. However this is some way from the central issues of societal concerns.⁴¹
78. It is far from clear that it is equitable for society (or consumers themselves through fares) to spend *ex ante* on railway safety, or crime prevention, more than that required to meet the value of the risk preferences of those at risk.

⁴⁰ Except in distributional terms. Lobbying and business pressures typically do not press most strongly for the improvements in the areas where they would bring the most benefit. An ethically concerned local authority will look for an equitable distribution. Another distributional aspect, noted above, is that monetary valuations of risks in such a context are generally designed to reflect changes in welfare regardless of income.

⁴¹ Except through "victims' groups", who understandably see the issue in terms of their appalling losses, to which putting monetary values generally makes little sense.

79. There is however an aspect which may in part reflect Wolff's concerns, which again relates to the distinction between aversion to small changes in risk ex ante (which it is realistic to value) and the valuation of death or catastrophic injury ex post (for which valuation is generally not realistic). This is that in cases such as the airline "lap children", discussed above, and of those killed in "ATP-preventable" train accidents, there is a strong social recognition that had a specific national or corporate decision been different (not to allow airline passengers to carry babies on laps, or to install automatic train protection) these "foreseeable" deaths would have been avoided. This is very different from for example road accidents where, even though many may be caused by poor road design or maintenance, no sharply defined national or corporate decision can be blamed.
80. Whether the societal concern which this generates should be seen as media amplified political pressure to be resisted as far as politically feasible, or as a considered expression of what people expect of a civilised society, is a moot point, which would merit public debate. If wholly the former, the case for installing TPWS⁴², when 100 times as many transport deaths, with their associated family tragedies, might be prevented by spending the same sum on well chosen road safety measures, is one of political and commercial expediency. If it is a considered expression of what people expect of a civilised society, it becomes an ethical case.
81. Wolff's consumer/citizen distinction is nonetheless important. R2P2 puts voluntariness, controllability and user benefit under the heading of "individual risk". In practice it seems that, as suggested by Wolff and broadly confirmed by some of our own work, these factors do not have much effect on peoples' willingness to pay for risk reduction. However they do have a big influence on people's (i.e. societal) views about whether the hazard should be regulated and may possibly, although this is less clear, be relevant to the degree to which mitigation should be required by regulation.
82. The distinction is also important when preferences about risks are being sought from people who are only very rarely, or never "consumers" of the hazard in question.
83. Wolff draws a puzzling distinction as follows between "ordinary" risks and systems failures, suggesting that whereas ALARP might apply to the former it does not to the latter:

... very few people have any idea at all that the [railway] industry takes any systematic approach to safety. There is, then, some possibility that the sense of neglect would disappear if it became public knowledge that the industry uses the type of RCBA [Risk CBA] that it does. However, we have no evidence that the public would accept the ALARP principle even if they knew about it. Rather, it seems likely that the public have a more complex response, and will tend to differentiate types of accidents and the appropriate response. In particular, it is a

⁴² Train Protection and Warning System.

reasonable conjecture that for 'ordinary' risks the ALARP principle may carry some conviction, but for risks relating to systems failures this would seem quite unacceptable.

It is not clear why Wolff's last conjecture is "reasonable".

84. In another concern about ALARP, Wolff notes that it may well not be applied by the private sector in some cases. In particular:

Consider the issue of road safety. This falls into at least two areas: safety of the infrastructure (junction design etc) and safety of vehicles. Although something like the ALARP principle may apply to the former, it seems unlikely to apply to the latter. For example it is a fair assumption that safety recalls are not always justified by the ALARP principle based on VPF, or that safety modifications in new models can be justified in this way.

However it is hard to see how this relates to societal concerns. Some government regulations apply to vehicles, to which ALARP in principle applies. If a commercial company perceives a different cost benefit balance which it would prefer, and which would further increase safety, it will presumably implement this. But (although in practice this might well lead to a tightening of regulatory standards), it has no fundamental implications for public policy.

85. Wolff also criticises the HSE's handling of societal risk (multi-fatality accidents) as follows.

Using a multiplier for multiple fatality accidents to express societal concern seems to me to be based on a faulty assumption; that societal concern is a form of magnified individual concern. To the degree that it is not, some other approach seems necessary.

This seems to us a fair point, to which we return later.

86. Wolff's central conclusion is that

If it is thought that a risk is being imposed in a way which can be morally criticised - through negligence, recklessness or selfishness - this will lead to a level of societal concern which may not be reflected in individual attitudes to risk. ... [this] public concern is not with the level of risk, but with the apparent irresponsibility with which these risks are imposed,

This distinction between concern about risk per se and concern about the responsibility or competence of the risk imposing management is also the central theme of Elliott and Taig, discussed below, although it relates to public criticism of the railway industry, *not* societal concern about the regulatory regime.

87. Wolff appends to his paper a critique of work produced by many of ourselves for the HSE in 2000 (Beattie et al, 2000, Burton et al, 2001). While he makes some fair observations, we question Wolff's initial judgments on several issues.⁴³ One of us is now in correspondence with him.

Elliott and Taig (2003) "Ethical basis of railway safety decisions"

88. Dr Elliott and Tony Taig are well known risk consultants, with a scientific/engineering/ management background, who were asked by the Railway Safety and

⁴³ It does not however appear that Wolff necessarily rejects the concept of valuing small changes in risk in the same way as more conventional costs and benefits. This contrasts with the view of the philosopher Parfit (1984) (p480), to whom the idea was abhorrent, especially when it came to giving more weight to the interests of the current than to future populations. In an Appendix on the interests of future people he says: "My example in the text [p357] is not imagined. It has been seriously suggested that, in assessing the risks of disposal of nuclear wastes, we should [discount] to future *deaths*" [emphasis in original]. Parfit's chosen example is the extreme case of nuclear waste and applying a discounting rate over hundreds of years, which in our view also is unjustified; but he would clearly object equally to such a practice in comparing the costs and benefits of a road safety scheme over a few decades.

Standards Board to report on the ethical basis of safety decisions. Their report is based mainly on a series of interviews with authorities in the field, which they report revealed “a remarkably consistent picture about the ethical duties of organisations in respect of safety”.

89. Their general analysis reflects the authors’ wide practical experience and is mostly a model of clarity and good sense. Their observations include the following (as direct quotations, except where otherwise indicated).

Preliminary observations

- Many continental railways admire ALARP/TOR and the explicit use of TOR.
- TOR/ ALARP/ HSWA does not sit easily with complex hazardous systems.

“Responsible safety decisions”

- To set out to make decisions more acceptable, without also pursuing “rightness”, seems like a dereliction of duty under HSWA and as citizens. [Unfortunately the authors do not elaborate on their interpretation of “rightness”.]
- The nature and degree of responsibility of an organisation towards people put at risk by its activities depends critically on the relationship between the individual at risk and the organisation creating or managing that risk.
- It cannot be acceptable for someone to be allowed to impose a risk on another simply because the risk is small. [In medical contexts] the guiding principle is “informed consent”. [In wider contexts] different people will have different views about the relative weight to attach to the risk ... and the benefits accruing to others, [but] the principle of informed consent is just as important.
- We [society] ... are not prepared to leave the business of risk taking and risk creating purely to those involved. We would never contemplate, for example, licensing a game show to offer Russian roulette with huge payouts to the survivors.

The general obligations of risk-imposing bodies

- It is morally acceptable to impose risks on other people without their consent only if there is a broad social consensus that: i) the activity giving rise to risk is legitimate and valued; and ii) risks are kept very small ... particularly for those who bear the risk in order for others to benefit.
- Individual organisations, whether public or private sector, cannot decide what is acceptable in society’s eyes. Organisations should work within a framework determined by a proper process ... This is a matter for public policy, and simple utilitarian arguments such as CBA and VPF as to the worth of incremental safety improvements are of limited relevance.

On the supplier/customer relationship:

- Society imposes a “lower threshold” of safety ... and protects the weak (such as children). People disagree as to the morality of allowing the customer to be offered alternative bargains (*e.g. would it be acceptable for airline B, with ten times the safety risk of airline A, to offer tickets at half the price if it is compliant with minimum international standards?*), but agree on the need for some constraints. CBA/VPF and estimates based on WTP are very relevant here.

[We have doubts about these two attempts to establish the role of CBA and VPF. We suspect that the first understates and the second overstates their contribution to these respective fields.]

On the employer/employee relationship:

- It is morally acceptable for an organisation to ask employees to carry out activities entailing risk on its behalf, but only if:
 - there is transparency, and diligence in risk management by employer;
 - those involved are empowered/enabled to control their own risk SFAIRP;
 - risk is reflected in compensation.

These views are consistent with those of, for example, a trade union that opposes additional safety precautions because it is concerned that the costs might risk the viability of the employment. However, they do not sit easily with HSWA for the same reason, or with the common law principle that does not allow the defence that an employee voluntarily accepted the risk.

People’s feelings about risk

- Factors [which] influence how people feel about risk [include:]:
 - public v private sector
 - trust in decision taker
 - degree of personal control over the risk
 - multiple fatalities vs. single fatality accidents
 - distribution of risk among individuals
 - confidence in regulation and control
 - the media.

As a matter of ethical principle, none of these affect the obligation an organisation has to an individual ... The ethical duty is not altered by the perceptions of the potential victims, although the way in which that duty is discharged, and where any agreed “bargain” is struck, may be profoundly altered.

Involving people in decisions

- In recent decades ... there has been a shift of public expectations on their place in important decisions about public policy, from:
 - “They” will take care of it and I don’t need to know, via
 - “Tell me” what’s going on, to
 - “Show me” the evidence this is what’s best, and now

- “Involve me” and let me have a say.
- As regards how this can be done, there is an increasing move on important policy issues away from traditional forms of consultation where proposals are published and comments invited, and towards more active processes, of which “citizens’ juries” are perhaps the best known.
- Two particular short cuts to understanding views of the interested parties that were frequently and roundly condemned as likely to be misleading by many participants in this research were:
 - using media coverage as in any way indicative of true public views, and
 - using self-selected respondents to surveys or consultation exercises (e.g. letters in response to a Green Paper, completed questionnaires on a web site or the claims of interest groups).

Implications for the railway, and the role of CBA

- The messages are:
 - ethical theory is not very helpful when considering how to take safety decisions – “right” and “wrong” lie in the context of the decision;
 - there is little criticism of the **principles** by which the railway takes safety decisions; but
 - the **practice** of safety decision-taking is unsatisfactory.
- It is true that these rules [underlying railway safety policy] are underpinned by a high degree of public consultation in arriving at numerical values. Extensive social and economic research has been used to determine people’s willingness to pay to avoid railway risks, and thus to arrive at the VPF used as the core of railway decisions balancing safety against cost. But this is a very limited form of involvement, because it presupposes a decision framework in which the industry and government decide, and the wider public has a right to consultation only on a small portion of the broad issues of principle. The WTP methodology frames the core question of safety decisions as “What is it worth to make a small change in risk?” This is much narrower than the questions that people are worried about. Consensus-building is framed much more widely and requires a better informed public. The current levels and trends in risk, options for doing something about them, who pays and who benefits and other issues would all be open for discussion in context.
- There is ... a strong ethical requirement to be competent. ... The view that has emerged from evidence at accident inquiries ... is that the industry has not always been competent. Not only is this an ethical failure; it contributes strongly to the loss of trust.

Framing the issue, and summary

- An alternative way of framing this issue might be that the railways and their regulators and government funding bodies have failed to recognise the

importance of building wider social consent into decisions within the current legal framework. Their only response to safety concerns has been to try harder to reduce safety risks, which has not addressed people's concerns about industry safety. The industry and government are busy digging a hole; their only response to concerns that it is the wrong sort of hole has been to dig harder.

- In summary, we have heard a remarkably consistent set of messages about current railway principles and practices ... We summarise these as follows:
 1. There is nothing much wrong with the principles currently used by the rail industry and its regulators to make safety decisions, within the limited framing of “industry and government should decide such matters”.
 2. The framing of decisions, as matters for industry and government, is not ethically sound. There needs to be a wider process of active consultation and engagement of rail users and of society more widely, to establish a broader based “social contract” whereby the balance between safety, performance and cost can be established.
 3. The industry has no ethical duty or moral right to make judgements about what society wants. The industry DOES have a moral duty to ensure that the wider debate about such matters is well informed, and also to act competently to ensure that the mix of safety, performance and cost is the best that can be delivered within the agreed “social contract”.

90. All of these observations are set by Elliott and Taig within the context of the railway, where the issue of trust in the risk-imposing organisation had become critical. However the theme that public involvement needs today to be wider than a few decades ago is general. So too, and no less important, are the comments they report that neither media coverage nor self-selected respondents to surveys or consultation exercises are in any way indicative of true public views; and their observation about needing to dig the right hole. We return to these issues later.

Engineering/ risk analysis perspectives

Hirst and Carter (2002) “The ‘worst case’ methodology for obtaining a rough but rapid indication of the societal risk from a major accident hazard installation”

91. Hirst and Carter set out an HSE methodology which seeks to overcome some of the excessive data requirements of constructing fully developed FN curves⁴⁴, and also to respond to some criticisms of the previous approach to the application of FN curves, by introducing a more consistent “integrated” interpretation. Our concern here is with their proposed approach to quantifying societal risk – that is the mechanism by which more weight (per prevented fatality) should be given to accidents the greater the number of fatalities per accident.

⁴⁴ FN curves are graphs of the quantity “frequency of incidents with N or more fatalities” plotted against N.

92. The authors note that the expected number of lives lost from accidents at an installation, EV , where the number of fatalities per accident is N , is given by:

$$EV = \sum_{N=1}^{N_{\max}} f(N)N$$

However to use this as a measure of expected detriment would give an equal weight to all potential fatalities, regardless of the scale of the accident. The authors explain why and how they therefore “enhance” this equation as follows.

By not distinguishing between one accident causing 100 fatalities and 100 accidents causing one fatality over the same period of time, the EV fails to reflect the contrast between society’s strong reaction to major accidents that occur occasionally and its quiet tolerance of the many small accidents that occur frequently.

The view that more weight should be given to consequences of accidents than to their frequencies is widely held. In fact many countries in Europe disregard numerical estimates of frequencies almost completely ...

Recognising this, risk assessment practitioners have suggested using instead of the EV an “enhanced EV ” which gives greater emphasis to the number of fatalities. For example Okrent (1981) suggests [an] “equivalent social cost” [in which] the number of fatalities [is] raised to some power $a > 1$. Quoting other sources, Okrent notes that values of “ a ” as high 2 or 3 have appeared in the literature, but he adds that adoption of a value at the higher end of this range would prohibit many existing technological endeavours and would be beyond what society could afford.

At this stage we make the decision to define an enhanced EV , which we shall call the Risk Integral (COMAH) and denote by RI_{COMAH} , as follows:

$$RI_{COMAH} = \sum_{N=1}^{N_{\max}} f(N)N^a$$

93. The authors subsequently explain their choice of value for a as follows.

We have calculated the factor by which the EV is enhanced, with different values of “ a ” and over ranges of values of N_{\max} and $f(N_{\max})$ that we expect to encounter in practice. Having done so we have decided to set $a = 1.4$.

The justification for our choosing this value of “ a ” is illustrated in the following table, which shows the results of five of the cases we examined, spanning a range of N_{\max} with $a = 1.4$. The values of $f(N_{\max})$ were chosen so that all five case have the same value of EV .

N_{\max}	1	10	100	1000	10000
Scale aversion enhancement factor [RI_{COMAH}/EV]	1	1.9	3.6	6.9	13.9

It can be seen that with this choice of “ a ” the scale aversion enhancement factor is between 1 and 10 for the great majority of the cases that we expect to encounter and will exceed 10 only in exceptional circumstances. We believe this to be reasonable.

Greater enhancement may be appropriate for particular installations where the adjacent population has sensitive components, such as schools and hospitals.

94. While this HSE paper shows integrity and technical competence and has clearly been written with the public interest very much in mind, at the level of policy analysis it poses a problem.

95. It stops abruptly short of “Involve me [the public] and let me have a say”. There is no suggestion of any empirical basis for the factor 10, derived from public preferences. It provides a pure example of policy determined by expert opinion. More specifically, it accepts the fact that “the view that more weight should be given to consequences of accidents than to their frequencies is widely held” as a basis for policy, with no evidence on whether or how such a view is reflected in public preferences.

96. It is uncontentious that, other things being equal, and up to a point (both important qualifications) large accidents generate more media attention and public criticism

than multiple small accidents. However it is by no means clear what an analysis from first principles would imply for how this should be handled in practical policy.

97. The House of Lords debate of the Railways and Transport Safety Bill included the following comment in debate, which was generally supported:

Several years ago I asked a Minister ... why the value per unit of a person killed or injured was higher if many of them were killed at the same time. The Minister said that Ministers did not like the publicity attached to a large accident. I shall not say which government were in power at the time as that has been the situation for years, but not liking bad publicity is about the worst possible reason that one could give for attaching a higher value to a fatality. However, in recent years Ministers have taken a much more robust approach, which is excellent.”
(Lords Hansard, 2003, [5 June] Column GC271)

98. The Government response, while not explicitly referring to accident size was that:

If you have lost a loved one, it does not matter whether that occurred in a road, rail or aviation accident. That is the direction in which the Government are moving. ... For many years we have published an annual report which sets out the value of preventing a highway fatality. ... We think that there should be the same standards for rail safety as for road safety. That is the principle that we adopt. (Lords Hansard, 2003, Column GC273)

99. This Government position is not consistent with Hirst and Carter.

Bandle, Golob and Bristow (2003) “Determining the Degree and Form of Regulation: The approach of the UK Health and Safety Executive”

100. This presentation covers the R2P2 approach and presents in outline some consultancy work on “gauging” societal concerns.
101. As in R2P2, the HSE’s perception of risk is presented as “individual risk” which is about tangible harm to individuals and “societal concerns” which are about harm “to the social fabric”. The latter are then defined wholly in terms of lack of public trust in the institutions, the regulation and the regulated bodies.
102. This is a potentially complete model, but since the role of “individual risk” in health and safety regulation is confined to the statistical risk and (very crudely, by an adjustment for cancer) some adjustment for the pain and suffering associated with the particular hazard, everything else (only a part of which can sensibly be described in terms of “harming the social fabric”) is included in societal concerns. Many major issues, such as ethical concerns about upper tolerability limits, or the distinction between informed and considered preferences and media panics, or the welfare objectives of regulation, are thus hidden, rather than exposed to debate.
103. The presentation states that societal concerns are handled at present by a combination of “professional judgement”; “engagement with stakeholder”; and “estimated scale of consequences”, which is double counting to the extent that the importance of “scale of consequences” is handled at present entirely as a issue of professional judgement. However it is noted that there is a need for a “more systematic, analytical approach” as well as “openness and transparency”.

104. The analytical approach then presented is confined to the well documented array of emotive attitudes to particular attitudes. The presentation says fairly that this is “based on core findings from established social science risk research”, but this approach does not appear to contribute more than warning signs of potential trouble ahead – which are already well provided, for example by Department of Health (1998). As with the central Whitehall initiative discussed earlier, the focus is on the problems for government of risk communication, as distinct from the more fundamental, logically prior problems of identifying the public interest.

105. A complex “tree” of characteristics (including for example “global impact”, “history of bad advice”, “potential for catastrophe”, “does not stop if activity stops”) is structured to build up through a series of “gates” to “societal concern” at the top of the tree. One output is the categorisation or “gauging” of hazards according to six key gates, as illustrated below for nuclear power and bicycles, (the scale for scoring having a minimum of 1):

Gate	Nuclear power	Bicycles
G1: Informed choice	6	2
G2: Large perceived risk	6	3
G9: Outrage	6	4
G12: Dread	6	2.75
G16: No trust in knowledge	5.5	2
G17: No trust in managers	5	1

106. This form of analysis has some value. However it contributes little to the challenge of handling societal concerns in the public interest, in particular standard setting. For advance on this front, the need in our view is for progress in understanding the characteristics of societal concerns themselves, in contrast to already heavily researched characteristics of hazards which trigger some kinds of public reaction.

107. To put it another way, there seems to be an ambiguity in the HSE’s objectives. At one level the HSE is trying to understand societal concerns and why it is not always loved, and what it might do to ease these problems. Less clearly, but implicitly, it appears also to be interested in integrating societal concerns into policy, to provide regulation which better reflects the public interest. For the latter it needs to be made very explicit what forms of societal concerns it is taking into account and to examine how these should impact on policy.

108. It is a proper, indeed central role for a regulator to try to bridge the “gap” between policy and “societal” expectations. However there are two sides to the gap and the “gauging tool” appears to be confined to minute examination of societal responses to a given policy framework, with no analysis of how policy should reflect public preferences in the first place. The TOR framework is an excellent foundation, but it needs further refinement if societal concerns are to be

adequately handled in policy development, as distinct from being handled solely as a public relations challenge.

A public administration/ public law perspective

Hood, Rothstein and Baldwin (2001, 2004) “The Government of Risk: Understanding Risk Regulation Regimes”

109. This book develops the concept of regulation regimes, their anatomy, why they differ, how they respond to external pressure, and implications for policy and institutional design. The book is structured around nine examples of UK regimes⁴⁵ as case studies.
110. It examines for each regime the regime content (defined by size, style, and structure) and regime context (defined by type of risk, public preferences and attitudes, and organised interests). Each regime is further considered in terms of three components, of standard setting, information gathering and behaviour modification. This is a complicated structure, and the components of information gathering and behaviour modification, despite their control theory pedigree, do not fit easily with many regimes. However the content and context dimensions are robust and the control components serve well enough for the authors’ purposes. The analysis contains a wealth of empirically well researched insights into the regimes and excellent cross references to the literature.
111. The authors investigate how the regime contents appear to be moulded by the three elements of regime context. (“Type of risk” is defined in terms of ‘market failure’, defined in turn as poor information for those at risk and/or inability to opt out). “Response to public preferences and attitudes” is defined as ‘opinion responsiveness’, defined in turn as following the [considered and informed] preferences of the public at large. “Response to organised interests” is defined as responding to ‘interests, lobbies and experts’.) The authors find that the size and style⁴⁶ of the nine regulatory regimes is best predicted by the organised interest model, with the market failure and opinion responsiveness models having some, but less explanatory power.
112. The authors also devote a chapter to “regime development under pressure”, testing various hypotheses against the four of their sample of nine regimes which have been exposed to strong pressures, in particular for greater transparency and openness.

⁴⁵ The nine examples, of which two fall under HSE, are dangerous dogs, radon in the home, radon in the workplace, ambient benzene, benzene in the workplace, paedophile offenders released from custody, local road safety, and pesticide residues in food and water.

⁴⁶ The regime *structures* were generally less easy to explain in terms of any of the three contextual elements.

113. Much of this material is relevant to societal concerns, in particular the chapters on the two contextual elements of “public preferences and attitudes”, and “organised interests”, and their analysis of how regimes respond to pressure. The authors do not extend their analysis to the comparison of regulatory outcomes against any social welfare criterion; the social desirability or otherwise of the facts they portray is left for the reader to judge. However their descriptions of how these elements influenced the nine regimes studied, in both static and dynamic terms, provide salutary case studies. The book also provides a valuable framework for further analysis of how societal concerns are best perceived defined and how they might best be handled.

DISCUSSION

114. We here discuss:

- What are societal concerns?
- What is the appropriate policy response?

We follow this with a brief application to the three case studies presented at the launch of R2P2, and a review of work needed to progress the handling of societal concerns.

What are societal concerns?

115. R2P2 is frank in defining societal concerns as risks or threats which “could have adverse repercussions for the institutions responsible.” (R2P2, paragraph 25) The formal position is that adverse repercussions are bad because they reduce public trust, which makes regulation less effective. While this is true, the parallel problem that such repercussions are politically embarrassing to governments and to agencies is unspoken. However on health and safety at work governments normally want above all else a quiet life. Blame-avoidance is an important objective of any human institution in the public eye, and is one important element in the evidenced-based analysis of societal concerns.

116. However, as already noted, R2P2’s more formal definition of societal concerns is ambiguous in another sense: it suggests that societal concerns are everything not covered by “individual” risk; but that includes many concerns that do not have materially “adverse repercussions for the institutions”.

117. Ball and Boehm-Christiansen offer a 12-fold categorisation of societal concerns that is valuable from a theoretical perspective. However we have found in the literature no categorisation tied to operational needs. We therefore categorise societal concerns under the following five headings, which we believe help to unravel many of the issues.

118. Five categories of societal concern are as follows.

- i) *Shared ethical preferences*: These do not make life awkward for the regulator, but they extend well beyond individual risk and are an important contribution to good regulation. They are usually, perhaps always, about distributional issues and, although not universally shared are typically near enough so within British society not to create significant controversy. One example is the concept of a low upper tolerability limit to the risk to which people should be exposed by activities undertaken for the common good. Others are a general acceptance, at least in most European countries, that health and safety benefits should be distributed according to welfare criteria, and not according to individual willingness to pay (which would imply greater benefits for the rich than the poor); and that children merit a high degree of regulatory protection than adults.⁴⁷
- ii) *Institutional self-interest*: It is inevitable that parties will often “play the safety card” if it may help their case (whatever the case’s other merits). This may be observed in regulated monopoly behaviour in supporting the case for investment (with cost pass-through to the company’s customers); it appears sometimes to be pressed by unions in resisting changes in working practices; it is the basis of NIMBY; and it may be used by any institution for publicity.
- iii) *Single interest objectives*: Many pressure groups such as PICK, referred to earlier, railway victims groups, and groups opposed to MMR, press a particular altruistic objective such as eliminating a particular hazard, often for very understandable reasons, while seeing other interests, such as costs or impacts on related hazards, as issues for others to pursue.⁴⁸
- iv) *Conflicting ethical world views*: These are enduring differences of world view that are not changed in any substantial way by debate. While rarely if ever important in the fields of HSE concern, they are a major issue in some others, especially in fields of concern to the green NGOs (GM crops; world trade agreements; recycling and waste discharges or dumping; nuclear waste; global climate change).
- v) *Public anger or anxiety*: These are usually media amplified concerns. Sometimes they are well founded (as with early concerns about government complacency over BSE), and sometimes ill founded (as with the paediatrician’s home vandalised because of confusion with the word with

⁴⁷ It is tempting to wonder whether recent policy concern that the UK’s road safety record, while among the very best in Europe on average, is poor with regard to child casualties, has any connection with there having been no differential in CBA treatment, nor in any other formal analysis, between the valuation of preventing child and adult casualties.

⁴⁸ These concerns are driven typically by people who have no especially strong world view of how society should be governed, but have strong views on their particular issue. This is usually very different from the groups discussed below under “conflicting ethical world views”. A possible exception is the animal rights movement, which in some forms (e.g. the RSPCA) is analogous to a victims’ group, but in others (such as SHAC) appears to be driven by deeper, anti-establishment beliefs.

paedophile⁴⁹), and are often not unequivocally either side this fence - except in the eyes of the main protagonists. They are sometimes ephemeral, as with the scare in 2002 about acrylamide in food cooked at high temperatures (Lofstedt, 2003), but may persist for much longer, as with concern over the MMR vaccine, and about railway safety management. They are tactically exploited, for good or bad, by the groups noted under categories (ii) to (iv) above, and may lead to the creation of single interest groups (as in the case of MMR), but they are in any case widespread - and much researched.⁵⁰

119. Two categories of social cost which may be imposed by high profile societal concerns are:

- i) Direct diversion of resources, in terms of public enquiries, diversion of government time, legal costs, loss of trust in the service with consequent loss of commercial business and, sometimes, disproportionate political or regulatory reaction. These costs are not mentioned in R2P2.
- ii) Reputational cost and associated loss of trust in government institutions, as stressed in R2P2 and subsequent HSE statements.

What is the appropriate policy response?

120. Each category of societal concern demands a policy response, but these may differ markedly.

121. A coherent set of policy responses needs to start from a statement of the ultimate welfare objective, but there does not appear to be any such HSE statement. However, as we noted in section 0 above, the Risk Support Team suggests that good regulation requires that the regulator “capture structured, informed and considered views”. It was suggested in HM Treasury (1996) that “the protection of consumer interests should generally reflect consumers’ informed and considered preferences”.⁵¹ The government’s current Multi Criteria Analysis Manual (DETR, 2000, section 2.6) suggests that “A broadly satisfactory criterion which appears to underlie many CBA valuations is that they should reflect the **informed** preferences of people as a whole, to the extent that these preferences can be measured and averaged.” A similar concept is quoted by Wolff: “RCBA [Risk CBA] has been said to embody a principle of hypothetical

⁴⁹ BBC News: UK: Wales, 30 August, 2000.

⁵⁰ A recent example being the media headline “Britons urge tighter meat imports”, reporting that, according to a MORI poll, “91% of respondents want the government to take urgent action about over illegal meat imports. The poll was commissioned by “a coalition of animal welfare bodies” (BBC News, 3 March 2003).

⁵¹ Although that report also drew a distinction between consumer protection and the protection of third parties. It is not clear that such a distinction in this context is important. In practice the TOR regime is widely seen as applicable to consumer interests, and the concept of informed and considered preferences, while more complex when applied to third party protection, seems no less relevant in that context.

consent. [Leonard and Zechkauser (1986)] That is, it produces the effects which people would agree to had they been in full possession of the facts.” Wolff goes on to note: “this makes it appear ethically very robust indeed, drawing on the two powerful ethical traditions of utilitarianism and social contract, which often appear to conflict. That is, the main objection to utilitarianism is that that it victimises individuals, whereas contractualism requires the agreement of all.”

122. Ball and Boehm-Christiansen commend rational field theory as a method of eliciting considered views. Elliott and Taig note the need for considered views to be elicited, commenting on the need for deliberative techniques, as opposed to responses to lobby groups or media opinion.⁵²

123. We take it as a working assumption that the ultimate objective of HSE regulation, subject to obvious constraints and conditions, such as protecting Ministers from embarrassment and maintaining the agency’s standing, is to reflect the HSE’s best judgement of people’s informed and considered preferences.

i) Shared ethical preferences

124. This category of societal concerns is conspicuously under-researched.

125. Some of these concerns are conceptually straightforward and fit within a CBA framework, either as constraints or as values. One conspicuous example in the TOR framework is the concept of an upper tolerability limit – the ethical principle that although it is acceptable to impose risks on people for the common good (from hazardous plants for example), or in the workplace as workers or customers, these risks should never be more than very small; and probably that, as the risk approaches a tolerability limit, the balance of cost and risk reduction changes in favour of risk reduction. Also conspicuous in R2P2 is the concept that the case for regulation depends upon the questions of choice and controllability: that people’s use of stepladders in their own homes (as distinct from the design and labelling of the product itself) should not be regulated.

126. Less clear cut is whether the strength of regulation, if applied at all, should depend upon the *degree* of choice and controllability. This looks like a issue amenable to empirical study, and indeed some of our own work has touched upon this. Wolff suggests that, even if those at risk have the same aversion to two risks, they may still believe that more should be spent to reduce one risk rather than the other, because of the moral nature of a corporate body being more heavily responsible for risks in one mode. We explained above that we see no case on this account for spending *ex ante* more than those at risk are willing to pay for the risk reduction, but there may be an arguable ethical case for spending *less* if (as

⁵² One disturbing finding reported by Hood et al (p 91) is that “many regulators we interviewed thought opinion-responsiveness meant listening to protestors and organized critics, not discovering and following the preferences of the public at large *à la* George Gallup.”

perceived for example of road risks) there is a significant degree of individual controllability.⁵³ This merits empirical study.

127. Among the case studies emphasised by the HSE, the decision to regulate outdoor centres, despite a high VPF, might be explained in terms of a shared ethical preferences for an exceptionally high degree of protection for young people in vulnerable situations controlled by commercial or charitable institutions.

128. A further problem area is cases such as those illustrated above in discussing Wolff's analysis, where deaths can be attributed, ex post, to a specific high level policy decision about for example train protection technology or allowing babies to fly in aircraft on parents' laps. Is there an *ethical* case, reflecting people's considered preferences, for spending materially more on reducing hazards of this kind? The case does not seem clear cut and also merits empirical study.⁵⁴

129. The appropriate policy response is to identify and accommodate shared ethical preferences.

ii) *Single interest objectives; and*

iii) *Institutional self-interest*

130. Safety will always be exploited by stakeholders to protect or promote quite different financial or reputational ends. The appropriate policy response is to recognise this and generally not allow such motives (as distinct from sound evidence which supports the stakeholder's objectives) to sway policy decisions. The regulator needs to be able to sift good evidence from bad.

131. The gas mains example presented by the HSE at the launch of R2P2 appeared clearly to contain an element of a monopoly industry using safety arguments (the threat of embarrassing - or trust destroying - explosions which might kill those nearby) to gain approval for a very large investment programme, charged to its current consumers. However there were other factors (such as removing the

⁵³ Some road risks are faced by blameless victims, such as the driver or passenger killed by another vehicle which misjudges a poorly laid out road junction or bend, or which for any reason crosses a non-barriered central reservation. Other victims such as the pedestrian who does not look all ways, or driver who drives at the edge of safety, could be said to be failing to "pay" their own proper contribution of time and care. Whether any "average" figure for the proportion of lack of care attributable to road accident victims is debateable. However it is hard to believe that such a figure would greatly exceed 50 per cent. This might justify reducing the VPF for some public expenditure purposes by a factor of 2, or perhaps 3, but the current de facto reduction of a factor of about 10 would seem hard to justify on these grounds.

⁵⁴ The installation of TPWS on the railway (£500 million, at a cost per VPF of over £10 million) would be an interesting case study. The need for Great Britain to install such a system was regarded by some - for example railway engineers in continental Europe - as a moral issue, and it is not implausible that the informed and considered opinion of people in general would be that more should be spent to save life in cases of this kind, because they are symbols of the kind of society in which we live. However it is less clear that these opinions would support increasing the VPF by a factor of more than say 2 or 3, in the knowledge the money could be sent to save that many more, no less deserving lives at risk from other hazards.

uncertain risk of a catastrophic, unmanageable failure rate of steel pipes), which were also relevant. It would have been reassuring to have had the arguments clearly separated and assessed.

iv) *Conflicting ethical world views*

132. These are generally well known, the most conspicuous divide being between those committed either to environmental preservation or to market freedom as a dominant principle of public policy. It is a field where debate is mainly in terms of “stories”. The appropriate policy response, in principle, is for the government to have its own ethical preference for the public good, and to argue its case as and when there is pressure for policies which conflict with this. In practice there is some tendency, worldwide, for public sector regulatory agencies, like other institutions, to adopt to some degree a set of preferences which reinforces their own role. However these conflicting ethical world views appear rarely (if ever?) to impose substantially on HSE’s areas of regulatory responsibility.

v) *Public anger or anxiety*

133. These aspects of societal concerns have been extensively researched, both in themselves and in the context of risk communication - e.g. the “media triggers” and “fright factors” listed in “Pointers” (Department of Health, 1998), and are now absorbed into the Whitehall Risk Programme work. The appropriate policy response is that of risk communication to restore the discussion to a basis as close as possible to evidence, shared concerns, and a common objective.

134. The handling, in regulatory analysis, of the potential societal concerns generated by high profile accidents should depend upon their nature. The direct diversion of resources, such as the costs of public enquiries and enforced overreaction, should be amenable to conventional evidence-based quantification. Empirical work on what triggers such direct costs and on their magnitude would be of value and needs to be factored explicitly into policy analysis. Assessment of the reputational consequences for public institutions is more judgmental, but should be no less explicit.

135. These anger or anxiety issues appeared to be relevant to all three of the cases presented at the launch of R2P2. The outdoor leisure centres case perhaps had a relatively low potential for direct diversion of resources and the issues may, as noted above, have fairly closely reflected shared societal concerns about young people. The gas mains case was perhaps less predictable, especially if there is a risk of a truly dramatic explosion for which Ministers or managers might be blamed if the major investment were not approved. The third case, of train protection, has since been extensively analysed. As recorded by Elliott and Taig, the main problems appear with hindsight to be general institutional issues and risk communication, although a failure to introduce TPWS (whether or not there is an

ethical case for it) might have been held to present politically unacceptable risks of public outcry following future accidents.

Work needed for further progress

136. The papers and books reviewed above differ in fundamental respects. Some appear to accept all opinions as equally valid; other stress the opposite. Differing roles and mechanisms are seen for risk communication and CBA. However none seeks to establish a fundamental policy objective.
137. The Whitehall Risk Programme is now addressing societal concerns in risk regulation and this is to be thoroughly welcomed. However even if a robust conceptual framework were to be established by the time that the Programme ends at end of 2004, which would be a remarkable achievement, the continued handling of societal concerns needs continuing research.
138. Despite the potential interests of other Departments in societal concerns, there is no body in central government, other than the HSE, which can clearly be expected to promote such work consistently in areas of HSE concern. However we note that HSE concerns in this field tend to be driven top down by political concern about blame (or maintenance of trust). This is understandable and inevitable, but it needs we believe *also* to be driven bottom up, with a longer time horizon, in a policy search for how best to serve the public interest.
139. The current Risk Programme and HSE initiatives on societal concerns are much concerned with the risk communication aspects and the long established literature on popular attitudes to different types of hazard. Risk communication is central to the handling of some aspects of societal concerns, and the established psychometric literature is important. However this literature contributes little to determining how regulatory standards and enforcement should be designed to best serve the public interest.
140. More work is needed on societal concerns, building on recent research. Our suggestions to help frame such work in the areas of HSE interest are as follows.
 - The CBA framework, in which people's aversion to small increases in risk are valued, is a fundamental baseline for evidence-based health and safety regulation in difficult cases.
 - However the value of individual risk aversion, and the cost of risk reduction, generally do not provide all the information needed for policy decision making. There are other factors, which are often largely (or perhaps wholly) covered by societal concerns. These may have implications for any one or more of the level of health and safety standards, the means of monitoring and enforcement, required management procedures, and risk communication.

- Societal concerns need to be much more clearly disaggregated and defined. The recent papers on the railway industry identify societal concerns in that context with lack of public trust in railway management. However from the HSE's perspective societal concerns cover a much wider range of issues.
- Also important are the extra costs arising from high profile accidents. R2P2 identifies a loss of trust, although it is not evident that this is a substantial issue (in terms of policy effectiveness) in the case of health and safety regulation.⁵⁵ However consequent upon high profile accidents there are often other large costs, which are straightforward social costs, and not reputational or ethical issues. Work is needed on identifying past costs and methods of projecting potential future costs.
- It is reasonable to give more weight to high profile accidents because of their largely media driven reputational consequences. However it is far from clear that this extra weight should be related in any mechanistic way to numbers of deaths. It seems improbable that, even in the single field of major hazardous plants, it is approximately described by a power law. Empirical work is needed on attitudes to and consequences of accidents of different scales, to establish or amend the current HSE conventions.
- It needs to be more explicitly recognised that media pressure, lobby group pressure, and self-selected responses to public consultation may diverge extremely widely from the informed and considered opinions of the public in general. This is because they are often based on misperceptions, or on self-interest, or on values which have only narrow, if passionate support. More work is needed on how informed and considered opinions might best be investigated, and in what circumstances.⁵⁶
- It is conspicuous that environmental examples (and experience) are more prominent than health and safety in recent research reports published by the HSE. This may reflect the extreme complexity and controversy surrounding some environmental, food and medical regulation, such as the problems raised by GM crops, global climate change, nuclear waste disposal, or MMR vaccination. However the societal concern problems faced by HSE appear to be, for the most part, conceptually relatively simple. This should offer scope for more rapid analytical advance on societal concerns in HSE's policy domains.

⁵⁵ In contrast to food and medical health regulation. It is hard to believe that the history of BSE has not contributed to the difficulties of handling the problem of MMR vaccination.

⁵⁶ There are many practitioners of deliberative consultation and the HSE has been a leader in making us of it. However interdisciplinary divides, perhaps a very cautious approach by public bodies, and a marketing orientation by commercial bodies have conspired to prevent the development of any widely recognised framework of best practice. Ball and Boehm-Christiansen commend rational field theory. Elliott and Taig mention citizens juries. We see virtue in the rigour of multi-criteria decision analysis. However markedly different techniques are appropriate to different circumstances. We noted in section 0 above our understanding that the Environment Agency has commissioned some work in progress on participatory risk assessment. This is an encouraging sign.

- For all applications, policy should start from a clear statement of the ultimate welfare objective.

CONCLUSIONS AND RECOMMENDATIONS

141. Some of the issues surrounding societal concerns are at the boundaries of conceptual thought, being tied up with debate about rationality, and with interdisciplinary boundaries and misunderstandings, and severe problems of differing conceptual frameworks and inconsistent or inadequate terminology.⁵⁷
142. However in the areas of policy concern to HSE, and given the established baseline of the TOR framework, the *conceptual* problems posed by societal concerns do not look profound – although work is needed to resolve them much more clearly. HSE’s concerns are in this respect more straightforward than those faced by some regulators in other fields such as the environment, food, or medicine. Thus HSE’s policy domain is well placed to take a leading role in developing a clearer understanding and more formal handling of societal concerns.
143. Our working assumption is that the ultimate objective of HSE regulation, subject to obvious constraints and conditions, such as protecting Ministers from embarrassment and maintaining the agency’s standing, is to reflect the HSE’s best judgement of people’s informed and considered preferences. This working assumption needs to be tested, if necessary modified, and made explicit.
144. Three conclusions stand out with regard to the role of cost benefit analysis.
- As has long been widely recognised by policy practitioners, reducing factors to monetary values can never capture all of the important considerations in any substantial public policy decision.⁵⁸
 - From the evidence of this study, there is nothing in the societal concerns debate which sensibly implies any lessening of the role of CBA; what is needed, primarily, is a more systematic handling of those issues which, by wide consent, cannot sensibly be valued explicitly in monetary terms *ex ante*.

⁵⁷ A good discussion of the issues from a sociology perspective is presented by Duncan (2000), at the early stages of the ESRC CAVA research project on Care, Values and the Future of Welfare. It is noteworthy that the recently launched Journal “Rationality and Society” suggests that the rational action paradigm has emerged “as the inter-lingua of the social sciences ... It is the one paradigm that offers the promise of bringing greater theoretical unity across disciplines such as economics, sociology, political science, cognitive psychology, moral philosophy and law. The paradigm is also important for efforts to solve pressing social problems, because it provides the theoretic basis for most public policy analysis.” While it may offer the promise of greater unity, there is as yet little evidence of progress to this end.

⁵⁸ This has been a consistent feature of Treasury guidance. In the current guidance (HM Treasury, 2003, paragraph 2.9) the stages of appraisal include: “Consider unvalued impacts (both costs and benefits), using weighting and scoring techniques if appropriate.”

- *Some* of those factors which might be included under the heading of societal concerns, such as for example a greater concern for children, or to others who have no choice about exposing themselves to the risk, might with further research be included within the CBA framework.
145. Contrary to the presentation in R2P2, the roles of voluntariness, controllability and benefits appear to be issues of societal concern much more than issues of individual risk aversion. They may have little effect on individual aversion to the risk, but a strong bearing on people's views on whether *and how* the hazard should be regulated.
146. This user/citizen distinction is also important when views are being sought from respondents who are not typical of those at risk, either because of the nature of the hazard (e.g. a hypothetical hazardous plant, or railway risk if they do not use the railway), or because of the nature of those at risk (e.g. children, or the mentally infirm, or others who cannot realistically themselves be respondents).
147. We see considerable scope for progress in the understanding and hence handling of societal concerns in HSE's policy areas. This requires action, probably led in the medium to long term by the HSE, in three areas:
- Clarification of what societal concerns are. This is partly an issue of terminology, as it is not quite clear from R2P2, or any other source, what should or should not be included in the term societal concerns. However it is more substantially an issue for analytical clarification, to disaggregate clearly the several different categories of societal concerns and identify in *qualitative* terms what influence they should have on policy decisions. Such clarification may lead to a sound evidential basis, in qualitative terms, for some familiar apparent anomalies in safety regulation (such as that between road and train safety), although appropriately designed empirical work would be needed to indicate whether, as seems likely, the anomalies are carried too far.
 - Empirical research into shared ethical concerns. Some of this may be precisely quantitative. It is for example possible that some factors, as noted above, might be valued in a sufficiently general form to be included within the CBA framework. With other factors, it should be feasible to obtain at least a broad *quantitative* guide to help align policymaking more closely to the public interest.
 - Wider development and application of methods of consultation in specific areas to capture the informed and considered preferences of people in general.

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Valuation of health and safety benefits

Dread risks

It is by now well-known that people typically fear the prospect of premature death by some causes considerably more than others – see for example Slovic, Fischhoff and Lichtenstein, 1981; Thomas, 1981; Mendeloff and Kaplan, 1990; McDaniels, Kamlet and Fischer, 1992; Savage, 1993; Tolley, Kenkel and Fabian, 1995; Jones-Lee and Loomes, 1995 and Sunstein 1997.

In the light of this, the UK Health and Safety Executive (HSE) commissioned a research programme comprising three separate studies.

In the first study, by the University of Newcastle upon Tyne, the focus was principally on causes that typically result in instant (or near-instant) death, such as road or rail accidents. In addition, individual attitudes were viewed primarily from the perspective of people's 'self-focused' preferences concerning personal safety.

By contrast, the second study, carried out by a team drawn from the University of East Anglia, Durham and Queen Mary, London, considered – amongst other issues – causes of death typically preceded by protracted periods of pain and discomfort, such as lung or breast cancer. In addition, the second study sought to investigate the public's attitudes to factors such as the victim's age and the question of blame or responsibility for the cause of death concerned. As a result, the focus was directed more towards people's preferences in their role as citizens, expressing their views and attitudes with respect to general principles of social decision-making concerning life-saving interventions.

Finally, the third study - carried out by Michael Spackman of National Economic Research Associates (NERA) – was aimed at summarising and evaluating the extensive body of work undertaken to date by sociologists, psychologists, philosophers and economists on the important but arguably somewhat elusive and nebulous concept of 'Societal Concerns', to which extensive reference is made by various regulatory agencies including the HSE itself.

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