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Using a relativities approach to value the prevention of non-fatal work-related accidents and ill health

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Introduction

In instances where the introduction of new legislation is an option government departments are required to undertake a regulatory impact assessment that must include an assessment of the associated costs and benefits (Cabinet Office, 2000). In addition, the government's recently defined 'science and innovation (S&I) strategy' requires each government department to assess the impact of government action, in order to develop a knowledge base that will inform future interventions (DTI, 2000).

The aim of the Health and Safety Executive (HSE) is to ensure that risks to people's health and safety from work activities are properly controlled. There are various instruments that have been used in order to improve workplace health and safety, including carrots (e.g. the argument that 'good health is good business'), sticks (the threat of prosecution), and neutral instruments that simply raise awareness of firms' legal requirements or good practice. The intended benefits associated with interventions implemented by HSE are reductions in the levels of work-related accidents and ill health, which cover a very wide range of events.

To properly assess the costs and benefits of alternative health and safety interventions it is necessary to define a generic measure of outcome that allows the relative efficiency of different interventions to be estimated. As in the evaluation of health care technologies, the two main alternatives are the use of either generic health–related measures of outcome, such as the quality adjusted life year (QALY), or monetary valuations.

There is a considerable body of work aimed at the valuation of safety, though the majority of the research relating to workplace risks is concerned with fatalities (Gerking et al, 1988; Day, 1999). However, most health and safety interventions are not aimed at preventing fatalities, rather non-fatal injuries and ill health. Non-fatalities have been mainly valued in the context of non-work related events, such as road accidents (Jones-Lee et al, 1995; Persson et al, 1995). Such valuations do not cover the breadth of variation in the types of events experienced in the workplace, but equally importantly, they do not account for the context of the event as the prefix 'work-related' could have a considerable impact on the public's valuations of similar events.

The aim of the current study was to define and test a process for the valuation of the benefits associated with the prevention of non-fatal work-related accidents and ill health. The process of development was to include the identification of the factors influencing respondent's valuations and to define an effective means of presenting such information. an additional objective was to ensure that the final valuation process could be replicated simply and inexpensively, to enable HSE to obtained separate valuations of the specific effects of alternative health and safety interventions without great expense.

The next section of this paper describes the context-specific advantages and disadvantages of the general methodologies available for the valuation of health-related benefits. The methods section describes the chronological development of the study and preliminary results are presented in the next section. The paper concludes with a discussion of the chosen approach in the light of the stated objectives.

Background

The background to the study covers two broad areas. Firstly, a brief resume of the alternative methods available for valuing the benefits associated with health and safety interventions is provided. Secondly, the practical issues concerning the valuation of such benefits are described.

The alternative methodological approaches

The first option considered was the use of QALYs to describe the outcomes of alternative health and safety interventions, against which a general monetary value for a QALY could be applied in order to value the outcomes. However, there is ongoing criticism of QALYs in the health care field due to their singular concentration on the health effects of a condition, without regard for process effects or distributional issues. In the field of health and safety it may be argued that the non-health outcome effects are of even greater concern than in the health care field, where issues such as the cause of the event or the social status of the affected worker may be relevant attributes in the valuation process. Though the QALY is still developing as a research tool, and it is likely that at some point it will account for non-outcome effects, the current criticisms have contributed to the continuing quest for a satisfactory approach to obtaining monetary valuations for the effects of health care interventions (accounting for health outcomes, processes and distributional concerns), primarily willingness-to-pay (WTP) techniques.

The main research effort in the health and safety field in the past has been around the monetary valuation of preventing deaths (or statistical fatalities), using either the revealed preference approach, the willingness-to-pay approach, and the relativities approach. Previous revealed preference approaches, based on regression models of wages, have included explanatory variables describing non-fatal risks, which enabled the estimation of a wage premium for the existence of non-fatal risks. Arabsheibani and Marin (2000) included a variable describing the excess rate of non-fatal injuries, whilst Shanmugam (1997) included two such variables: ‘injury’ describing the average probability of injury risks and a subjective variable ‘danger’ that described exposure to dangerous or unhealthy conditions.

In valuing the prevention of non-fatal events the revealed preference approach is only able to value such generally specified non-fatal risks because sufficient data describing particular risks is unlikely to be available. The revealed preference approach also suffers due to the inherent difficulties in accounting for all the determinants of wage rates, and the assumption that workers are well informed about workplace risks. For these reasons most economists appear to favour the WTP approach to valuing changes in risk (Arabsheibani and Marin, 2000).

WTP studies have the advantage that researchers can (attempt to) isolate the relevant wealth/risk trade-off, as well as providing respondents with sufficient information to make an informed valuation (though the provision of information does not mean that respondents will provide considered responses).

The final option with regard to obtaining monetary valuations for the prevention of non-fatal events is the relative valuation approach. This method estimates the ratio of the value of preventing one event relative to another, rather than asking respondents to provide direct monetary valuations of alternative preventative measures. The estimated ratios for alternative events are applied to a 'peg' monetary valuation in order to estimate the corresponding monetary values.

Having considered the basic format of the main alternatives, the two most feasible applications appeared to be either a WTP study or a relative valuations (relativities) study. A more detailed consideration of these two approaches was then undertaken, which is described in the following section.

Practical issues affecting the choice of valuation technique

In the health care field, the majority of WTP studies obtained only use values for interventions, primarily because the most common sampling frame consisted of patients (Olsen and Smith, 2000; Diener *et al*, 1998). A similar approach in the area of health and safety would survey workers at risk of the event of interest. Such a sample population is also the optimal population for obtaining values for specific interventions, because they will be aware of the context of the proposed interventions and the cognitive load for respondents can be minimised. However, such an approach would require the identification of a separate study population for every type of workplace in which alternative interventions to reduce the risk of similar events could be implemented. On reflection, the advantages of such detailed valuations were outweighed by the prospective research efforts required.

In addition to use values, monetary valuations should also reflect the value of an intervention to persons who may be at risk at some point in the future (option values), as well as the external value of an intervention to persons who will never seek employment in the relevant position. Option values and externalities may be of more relevance to valuation studies of work-related health and safety than health care. This is because the former are primarily concerned with preventative measures to reduce the risk of events that are generally perceived to be 'caused' by a third party, whilst the latter generally value treatments for certain events that will be provided on an individual basis. The study population was defined, therefore, as a representative sample of the general population that would provide aggregate valuations for use values, option values and externalities.

The relativities and the WTP approaches both require the specification of a contingent market. The contingent market in a relativities study consists of three elements: a description of the commodity to be valued, definition of the certainty or risk associated with the commodity, and the time period. The contingent market for a WTP study also requires the specification of the payment vehicle for the stated WTP (Smith et al, 1999).

As part of the process of describing a realistic contingent market it is necessary to use a realistic payment vehicle that seems reasonable to respondents, even if they do not approve of it (Smith et al, 1999). In the context of asking the general population to pay for improvements in work-related health and safety the two main choices appeared to be indirect out-of-pocket payments (such as specifying an increase in weekly shopping bills), and additional taxation. During the deliberation over the appropriate payment vehicle, the prospective sensitivity of WTP responses to variations in the effectiveness of the proposed interventions was considered. Drawing on previous valuation work undertaken in the health and safety field, it was noted that even the most thoroughly

conducted studies using face-to-face interviews and valuing the prevention of fatalities encountered the problem of insufficient sensitivity to the size of risk reductions (HSE, 2000). As a result it was concluded that the likelihood of developing a WTP approach that could distinguish between alternative levels of risk for non-fatal events (that respondents are likely to have more difficulty valuing than fatal events anyway), in a format that is relatively simple to replicate, was beyond our expectations.

At this stage of the described process of elimination, based on the theoretical and practical requirements of the alternative approaches, the relativities approach was the only remaining contender. The main issues around this approach concerned the choice of an appropriate peg against which non-fatal work-related accidents and ill health could be valued. Such a peg was required to have been valued in a credible manner, as well as to provide a realistic choice option compared to work-related accidents and ill health.

In identifying a suitable peg, in line with current opinion (Arabsheibani and Marin, 2000), a preference for WTP-based valuations was stated. The main area of research in this field has been in the valuation of the prevention of road deaths and two large UK-based studies have estimated broadly similar monetary values (HSE, 2000). It was also felt that road deaths and work-related accidents and ill health would provide a realistic choice scenario because preventative programmes in both areas are funded by the government.

On this basis, it was decided that the relativities approach offered the strongest prospect of estimating a valid set of monetary valuations.

Methods

As in a WTP study, the relativities approach requires the specification of the contingent market, which should be sufficiently understandable, plausible and meaningful to respondents (Johansson, 1995). If the full range of information regarding the contingent market is not provided then respondents are likely to define missing data themselves, so that the analyst does not know what each respondent was actually valuing (Mitchell and Carson, 1993). In addition to presenting all the relevant information, it must be presented so that all the respondents can understand the definition of the market.

The first stage of the development of the contingent market was based on a series of discussion groups consisting of firstly, university staff, and then randomly invited members of the general population. An e-mail invitation, offering an incentive payment of £10 per attendee, was sent to the entire staff of the School of Health Related Research at the University of Sheffield (c.200 people). The primary aim of these discussion groups was to identify a set of characteristics of accidents or cases of ill health, occupations and workers that might influence people's views of the priority that should be given to the prevention of alternative forms of work-related accidents and ill health. The format for the groups involved the provision of some background to the study followed by a general discussion of health and safety and HSE. The groups were then asked to discuss factors that should influence the prioritisation of HSE's funds. When this unprompted discussion appeared to be ending, the group were provided with a list of potential factors, with examples scenarios, and asked for their opinions with regard to the factors that had not been mentioned previously. The list of potential factors is presented in Table 1.

The output from the first set of discussion groups was analysed with the objective of specifying a set of attributes of work-related accidents and ill health that were relevant

factors in the opinions stated regarding such events. Possible attributes discussed in the groups were analysed on the basis of the number of unprompted references, and the strength of agreement between the respondents within a group, as well as across the three groups. Using these analyses, the final decision over the choice of attributes was made by the three authors.

For the second stage, 100 people from the electoral ward of Netherthorpe, Sheffield, were randomly selected and invited by letter, including an incentive payment of £15 per attendee, to attend the general population groups. The purpose of this second set of groups was to provide further feedback on the issues around the construction of a clear and concise survey instrument, but also to provide some indication of the direction and strength of preference between the events being valued. The format for the second set of discussion groups consisted of an introduction to the study, followed by a brief general discussion of health and safety and HSE. The first structured section involved the sequential presentation of five general occupations to the groups (nurses, manufacturing-, construction-, clerical & secretarial-, and waste disposal-workers). The groups were asked to describe what characteristics they associated with the occupations, with the aim of identifying any hidden attributes that respondents might apply to descriptions of general occupation within the survey instrument. Draft questionnaires were then distributed and the groups were led through the questions and asked to comment on any aspect of the document, including their acceptance of the questions being asked and the format of the questions, as well as their actual answers.

Thirdly, prior to conducting the main survey, a pilot study of staff employed at the Health and Safety Laboratory (HSL) was undertaken to further inform the final survey instrument. 100 copies of the draft questionnaire were distributed to both scientific and support staff (80:20 split). Four versions of the questionnaire (25 of each) were distributed to test two alternative presentations of the same questions, as well as two alternative forms of ordering the questions. The output from the pilot survey was analysed descriptively to inform the final survey of the direction and magnitude of the preferences between the chosen comparisons.

In line with the objective of the study to create an inexpensive valuation process, and because the development stage for the survey instrument indicated that the required valuations could be obtained using a postal questionnaire, the main study was conducted as a postal survey. The sample for the survey was again randomly selected from the electoral ward of Netherthorpe. 240 copies of the survey were distributed over a three-week period, 150 without incentives and 90 with the offer of entry into a prize draw. No reminders were sent out.

The data collected from the main postal survey were analysed descriptively to show the responses to the specific choices included in the final questionnaire, but the main analysis consisted of logistic regressions that were run for each of the final comparisons. The primary output from the regressions were the relative valuations for the median respondent, which provided the baseline relativity that was applied to the peg monetary valuation to estimate the relevant valuations for the included events. The level of stimulus that will result in a given proportion of respondents choosing the stimulus is calculated by:

$$x = \frac{\log(y/1-y) - \alpha}{\beta}.$$

Where *x* is the number of stimulus events required to compensate for 100 of the comparator events, *y* is the proportion of interest, α is the coefficient for the constant and β is the coefficient for the comparator.

The proportion of respondents choosing the stimulus when equal numbers of each the stimulus and the comparoator are presented was calculated by:

$$y = \frac{\exp(\alpha + \beta x)}{1 + \exp(\alpha + \beta x)}.$$

Results

The results are presented in sections relating to the development stages of the final survey instrument, concluding with the presentation of the preliminary data collected from the main survey.

University staff discussion groups

Sixteen members of staff, consisting of a balanced mix of academic and non-academic personnel, attended three group meetings. The principal issue raised by all groups was that detailed information about the event (accident or case of ill health) was required in order to make an informed decision, including descriptions of impact of the event on the person's quality of life, the duration of the impact, whether it is a recurring event, and the cost/burden to society in treating the event. Group 1 raised the point that they would give greater priority to preventing events for which the impact was uncertain, which had unknown effects. Group 2 also mentioned that they would probably give priority to events that were measurable, as well as being interested in the time-off work due to the event. In all three groups there was some discussion over the 'dread' factor and whether such a factor is relevant, with the majority deciding that it was a factor, though it was recognised that it would be difficult to describe dread as it will be a subjective opinion based on an individuals knowledge about an event.

Regarding the specification of other characteristics relevant to prioritisation there were a number of areas that were raised consistently and gained general agreement within the groups. Initially, the third group seemed unlikely to account for anything other than health benefit, though as the discussion progressed various characteristics were mentioned by some of the participants. A couple of participants mentioned that more vulnerable workers should be protected, an issue that was discussed in relation to how easy it is for workers to see risk and avoid injuries/ill health. Groups 1 and 2 also raised this point, whilst group 1 cited the opportunity for workers to control risks and to change jobs as a potential contributory factor to priority setting.

All three groups raised the issue of the 'replaceability' of the worker, an issue that was linked to the availability of replacement workers, the cost of training new workers and the associated skill level. All groups also mentioned the family circumstances of the worker should be taken into account, though groups 1 and 2 were more vociferous about this factor, particularly about pregnant women. The 'knock-on' effects of an event were mentioned in groups 1 and 3, which involved a discussion of the impact of the present shortage of nurses versus other workers on the general productivity of society.

Groups 1 and 2 cited the chemical industry in particular as an area for priority due to the nature of the risks in that industry, whilst group 1 mentioned that unknown risks are an important characteristic. The visibility of risk (whether workers are fully aware of the

risks, relating to the risk attitude of the worker) was prompted in groups 1 and 2, though only some members of group1 thought that such a characteristic was a relevant factor.

On the basis of the analysis of the data derived from the discussion groups, the following attributes that were chosen for inclusion in the first draft of the contingent market. The associated levels are presented in Table 2.

- Occupation
- Risk of event
- Age and sex distribution of workers
- Worker control over risk
- Impact of the event of the worker's life

The more specific results of the first set of discussion groups included the decision to describe more specific accidents or cases of ill health, such as an 'arm amputation' or 'severe asthma', rather than 'amputation' or 'respiratory ill health', along with a brief description of the health-related effects of the event. Regarding the inclusion of non-health-related characteristics, it was decided that attributes that involve subjective judgements and/or can be reasonably inferred from other stated characteristics, such as the social value of an occupation or family circumstances (inferred from age and sex information), were excluded.

The discussion of the presentation of risk was in line with previous research that showed that people are better able to deal with frequencies of occurrence, rather than probabilities (Viscusi et al, 1991; Desaigues and Rabl, 1995). Therefore the format for the presentation of risk was as the number of recorded events in a particular industry and the number employed in the industry. Furthermore, the presentation of risk was not based on actual risk frequencies in the industries included in the study, rather four categories of risk that were established to represent low risk in small industry, high risk in small industry, low risk in large industry, and high risk in large industry. Similarly, the age and sex distribution of workers was not based on real data, rather four categories describing combinations of mainly male and female workers with older and younger workforces.

Four categories describing the cause of the risk were described, each of which assigned the majority of the responsibility to the particular factor. The distinction between accidental actions and (implied intentional) violent actions was specifically raised during the discussion groups. The three levels attached to the final attribute, impact of worker's life, were specified in the context of the worker's employment opportunities, but also provide an implicit description of the long term health effects of the work-related accident or case of ill health.

General population discussion groups

Fifteen members of the general population attended two group meetings (out of 100 invitees). The groups had a balanced age and gender mix with a slight bias towards older respondents (42% aged over 60, 32% aged between 40-59, 26% aged between 18-39). Both groups accepted the need for government intervention to regulate workplace health and safety, and a number of anecdotes regarding work-related accidents were recorded. The discussion of characteristics associated with different occupations threw up a wide range of attributes associated with the five occupations. The groups had general views as to the sex of the occupations, such as clerical &

secretarial workers being a mixed workforce with a small majority of female workers, but the groups did not tend to associate specific age ranges with any of the occupations. Pay and skill levels associated with the occupations were also mentioned, though no broad agreement was reached on these levels for any of the occupations. Work conditions were described for all occupations (e.g. manufacturing workers were thought to work in poor and pressurised conditions and be subject to controlled working hours), whilst personal characteristics were ascribed to most occupations (e.g. nurses were thought to take 'no nonsense', but also to be caring, whilst construction workers were thought to be 'strong and macho').

The main element of the groups was a discussion regarding the questionnaires that were distributed to each group member. The questionnaire presented to the first group was designed to test the relevance of the five attributes identified as the main factors during the first set of discussion groups. Respondents were asked to make a series of five choices between the prevention of two events on the basis of increasing amounts of information relating to the chosen attributes, which were presented in the following order – occupation and health effects, age and sex characteristics, risk, worker control over risk, and impact of the event of the worker's life. After the addition of each new level of information discussion was encouraged with respect to the impact of new information on the decision-making process as well as the extent and format of the information presented.

The first response was that it was difficult to make the decision. In line with the university staff groups most discussion was exercised over the type of accident or ill health, with personal experience of the different events described being a prominent factor in the decision-making process. The stated occupations were barely mentioned, most likely because they were presented alongside the health effects. Each of the remaining four attributes were discussed in some detail by the group with at least one member of the group altering their decision on the basis of each of the non-health-related characteristics.

The responses from the first general population group provided sufficient evidence regarding the relevance of the chosen attributes, so the draft questionnaire presented to the second general population group was primarily designed to obtain feedback on it's suitability as a postal survey (though discussion regarding the attributes was also encouraged). Respondents were presented with an attribute-based description of the work-related accident or case of ill health and asked to make a choice between saving 100 of one event or 100 of the other event. Depending on their initial choice the respondents are guided to a separate table that provided a series of choices relating to the number of each event that could be prevented, with successively fewer numbers of the originally preferred option being preventable. The questionnaire was based on a previously employed design that had been used to obtain relative valuations for alternative patient groups.

Again, the group commented that the decisions were difficult to make. The group was generally able to make a choice between the alternative events assuming equal numbers of preventable cases. Specific reference was made to the 'Worker control over risk' attribute, that the one line description was not sufficient and that more detail was required. The format of the second part of the questions presented was criticised more comprehensively, to the extent that most group members found it confusing even after the intended process had been explained verbally. The main reason for the confusion appeared to be the fact that the questionnaire originally stated that an intervention could

prevent a specified number of events, but the respondents were then being told that one of the interventions could now prevent a smaller number of events.

The general consensus was that the questionnaire was far too complex and that most people would 'throw it straight in the bin'. At the end of this second set of discussion groups it was decided to ask respondents to make only a single choice with respect to each set of attributes and that an additional attribute representing the number of preventable cases for each event should be added.

Pilot study of Health and Safety Laboratory staff

Despite the decision to simplify the format of the final questionnaire it was still necessary to obtain empirical estimates of the direction and magnitude of choices between the prevention of the chosen events. It was decided, therefore, to undertake a pilot study of a similar questionnaire to that presented to the last discussion group using a motivated sample.

Staff at HSL work in the area of health and safety and so were more likely to respond to the questionnaire, as well as to understand it's content. The response rate was 31% (31/100), though this included 4 partially completed returns and 6 uncompleted returns. The survey consisted of six questions, two of which related to the 'peg' event of deaths in road accidents (versus stress in nurses and severe asthma in waste disposal workers). The other descriptors related to blindness in manufacturing workers, stress in clerical & secretarial workers, back fractures in construction workers, and finger amputations in agricultural workers. The results of the pilot study are presented in Table 3, which provided useful data on which to specify the relative choices to be used in the main survey.

An additional aspect of the pilot survey was the specification of attribute sets designed to test for the impact of the non-health-related attributes, for example, one question compared stress-related ill health in nurses that was due to the nurses' own actions with stress in clerical & secretarial workers that was caused by violent actions of the public. The expectation being that, ceteris paribus, most respondents would choose to prevent ill health in nurses. Whilst the majority of respondents did choose nurses, a substantial minority of respondents (34%) opted for a preventative intervention aimed at clerical & secretarial workers.

The pilot questionnaire also asked respondents to provide comments on the questionnaire, which most respondents did. One area in which the questionnaire was altered, as a result of the pilot study, was in the description of the 'worker control over risk' attribute. Some comments were received about the lack of realism of the statement that, in particular, the affected worker is mainly responsible for the risk of stress in nurses, which was changed to 'the nature and conditions of the work is mainly responsible for cause of stress'.

The vast majority of the comments related to the complexity of the task asked of respondents, which reconfirmed our decision to simplify the final survey, but also persuaded us to reduce the number of comparative questions asked. The final survey consisted of seven questions describing four different combinations of attributes. The chosen questions are presented in Table 4. The final question provides a test of consistency for the responses as the prevention of both asthma in waste disposal workers and stress in nurses are also included in questions 1 & 2, and 3 & 4, respective, where they are compared against alternative numbers of back fractures.

Main survey

Procedural problems prevented the distribution of sufficient survey questionnaires to reach the intended level of 100 responses. At the time of the last analyses 45 completed responses had been received from a distribution of 230 questionnaires (10 were returned 'addressee unknown') – a response rate of 19.6%. The response rate for the section of the survey that included the offer of entry into a prize draw was 31.4% (27/86), whilst the rate for the non-prize draw section was 12.5% (18/144) [$p<0.06$].

Table 5 presents the descriptive analysis of the data. The first three comparisons describe the prevention of unequal quantities of two events, consisting of the respondents making two choices in each comparison, which show that the median respondent is located in the middle choice category for all three comparisons.

In comparison with fewer cases of back fractures, the results indicate that the same proportion of respondents would choose to prevent 25 back fractures as opposed to 100 cases of either severe asthma or stress-related ill health. However, a higher proportion would prefer to prevent 100 cases of stress compared to 75 back fractures, than 100 cases of asthma compared to 75 back fractures. This result is consistent with the direct comparison of stress with asthma, which shows that 55% of respondents would prefer to prevent 100 cases of stress than 100 cases of severe asthma.

Further analysis of the survey data was undertaken in the form of logistic regression analysis. Separate analyses of the three 2-level comparisons were performed with the dependent variable in each case describing whether a respondent had opted for the prevention of the event for which fewer cases could be prevented (the stimulus). The single explanatory variable was the level of the stimulus, i.e. either 75 or 25. Table 6 presents the corresponding results for each of the analyses. The first column of results shows that a large majority of respondents would prefer to prevent the stimulus event when compared against equal numbers of the comparator event, though 8% fewer respondents would choose back fractures over stress, than would choose back fractures over asthma.

The second column shows the point at which the median respondent is indifferent between the number of events that can be prevented for either event offered. At this level there is only a small difference between the respondents with respect to the prevention of asthma and stress-related ill health. The median respondent was a lot less likely to trade off road deaths against back fractures.

The final column applies the relative valuations presented in the previous column to the midpoint of the published range for the valuation of the prevention of a road death, which was £1,000,000 (HSE,2000), showing that the prevention of the scenarios describing asthma and stress-related ill health are valued similarly at around £40,000, whilst the back fracture scenario is valued at £132,000.

Discussion

The objective of the study was to design a method for the monetary valuation of non-fatal work-related accidents and ill health. Preferably, direct monetary valuations for a range of non-fatal work-related accidents and ill health would have been obtained using WTP techniques, because such an approach would provide independent valuations of these states. The main disadvantage of the relativities approach is that it is dependent on obtaining a relevant and valid monetary peg in order to obtain relative valuations for other events. However, it was thought unlikely that as valid WTP values as those

obtained for the 'peg' event, deaths in road accidents that were estimated by a thorough and extensive study, could be obtained without great research costs.

Underlying the lack of confidence in obtaining valid WTP valuations was the preference for a general population sample. An alternative sample would be the workers at risk of the particular work-related accidents and ill health being valued, but such a sample was thought to be subject to a number of problems. Firstly, there may be ethical issues regarding the use of workers at risk of work-related accidents and ill health, which may not be analogous to sampling patients who already have a condition.

Secondly, the use of workers would require the generation of a separate sample to value each work-related accident or case of ill health. Thirdly, it may not be possible to generate a sufficiently large sample for some work-related accidents and ill health that are either only applicable in very limited workforces, or for which employers are not willing to co-operate to provide access to their employees.

Finally, workers have greater incentives to provide biased responses, who may have self-interest in inflating the value of the risks they face in order to increase the value of their occupation. Alternatively, workers may interpret a higher valuation as increasing the probability of the imposition of a safer working environment with the associated costs being transferred from their wages.

There is also a perspective that such policy information should be obtained not from people as consumers, but from people as citizens that are based on hypothetical scenarios concerning fellow citizens.

General population samples have been used in previous WTP studies for risk reduction interventions, but these studies have valued either fatal events (McDaniels, 1992) or non-fatal events for which everyone is at risk (road injuries) (Jones-Lee, 1995). All of these studies, to a greater or lesser degree, reported inconsistencies in the valuations obtained. The current aimed to value non-fatal events that the majority of respondents would never be at risk of experiencing. The process of estimating a monetary value for the certainty of preventing a number of such events, let alone a reduction in the risk of an event, was thought to be cognitively infeasible for most respondents – especially in the format of a postal questionnaire.

The relativities approach avoids the cognitive demands of attaching monetary values to the prevention of events, but rather asks respondents to concentrate their efforts on making the choice between the prevention of alternative numbers of two defined events. Though respondents in the discussion groups commented on the inherent difficulties in making such choices, they were in the main able to make considered responses that reflected their preferences. Also, whilst relativities choices are not uniformly acceptable to respondents, as demonstrated by comments received during all stages of the study, they may be more acceptable than questions asking respondents to place a monetary value on the prevention of an event.

The development of the relativities questionnaire through the use of discussion groups and a pilot survey provided the necessary data to refine our original list of potential attributes to those that appeared to have the greatest impact on people's choices between alternative work-related accidents or cases of ill health. The development stage was also crucial in terms of informing the format of the questionnaire, including the realisation that the originally intended format, in which the objective was to estimates each respondent's trade-off precisely, was unlikely to succeed in the form of a postal survey.

Despite the simplification of the survey instrument, the response rate to an unincentivised sample population was poor, whilst the response rate improved when the offer of entry into a prize draw was included the resulting rate was still beneath 30%. One factor influencing the low rate may have been the general appearance of the questionnaire, which was printed on standard A4 paper and fastened together with two staples down the left hand side. Despite the fact that the questionnaires were posted out in HSE envelopes (with logo), one respondent phoned up to enquire about the validity of the survey, citing the appearance of the questionnaire as the reason for his call.

It must be appreciated that the presented results are based on only 44 observations, so they only provide a guide to the relative valuations placed on the work-related accidents and ill health described by the general population. Moreover, the sample population was derived from a single electoral ward and a more representative sample would be required to validate the estimated valuations. The preliminary results obtained do endorse the chosen structure of the comparisons, with the back fracture scenario being deemed a significantly worse event than either the asthma or stress-related ill health. The magnitude of the comparisons (75 and 25 back fractures, and 20 and 1 road deaths) also appear to have been well-informed by the earlier discussion groups and pilot studies, as the median respondent always chose the stimulus event for the higher number of stimulus events preventable, whilst switching to the comparator event when the number of stimulus events was decreased.

Despite the position of the median respondent, there remains uncertainty as to whether the specification of only two response options for each stated comparison provides an adequate dataset on which to estimate the required relativities?

In relation to informing a more representative study, the use of only two response options does not enable a quantification of the uncertainty around the estimated regression line because the line passes directly through the mean value of the responses to the two options. At this stage, we are uncertain as to how we could use the data from the current study to inform the required sample size for a larger study.

If further work in this area were to be pursued, there are a number of interesting issues that could be developed, for example, the prevention of similar events in different populations could be explored either directly or indirectly to determine the extent to which other factors influence respondents choice. Furthermore, such scenarios could be compared against a less informed scenario that excluded the information relating to the occupation of the affected population. The difference in the monetary valuations obtained for the specific and generic populations could then inform relative weights that could be applied to other conditions. It would also be possible to compare the QALY loss in the generic affected population with the associated monetary valuation to derive a monetary value of a QALY.

The current study did not set out to evaluate the trade-offs between the specified attributes, but it is possible that a conjoint analysis, based on the attributes derived from the discussion groups, could establish such trade-offs. Alternatively, it may be possible to alter the set of attributes to include separate event and occupation attributes, which would enable the valuation of the prevention (through the estimation of the relative valuations) of all the events in all the specified occupations.

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Table 1 Potential attributes list, with examples, distributed within first set of discussion groups

Attributes of scenarios	Three example scenarios		
	Mental ill health	Fracture	Respiratory ill health
Occupation	Nurse	Construction worker	Waste disposal worker
Gender	Predominantly female	Predominantly male	Predominantly male
Age	Young	Middle aged	Near retirement
Skill level	Skilled	Semi-skilled	Unskilled
Pay	£20k	£25k	£15k
Risk of accident	Medium (1 in 2000 per year)	High (1 in 350 per year)	Low (1 in 10,000 per year)
Number of workers	0.5 million	2 million	50,000
Cases per year	240	5714	5
Visibility of risk to workers	Medium	High	Low
Time frame of injury/ill health	Short term	Immediate	Medium to long term
Public/private sector	Public	Private	Private
Worker responsibility for injury/ill health	Mixed employer/worker	Mostly worker	Mostly employer
Temporary/permanent injury/ill health	Temporary or permanent	Temporary	Permanent
Temporary/permanent contracts (affecting sick pay)	Mostly permanent	Many self-employed contractors	Mostly permanent
Ability to work after injury/ill health	Varied	Yes, in same job	Yes, in different job

Table 2 Attributes and levels used in relativities questionnaire

Attribute	Levels
Event and occupation	Blindness in manufacturing workers
	Stress in clerical & secretarial workers
	Stress in nurses
	Back fractures in construction workers
	Finger amputations in agricultural workers
	Severe asthma in waste disposal workers
	Deaths in road accidents
	Deaths in rail accidents
Health effects	Single level relating to the work-related accident or case of ill health
Risk	25 cases per year, 20,000 workers at risk
	250 cases per year, 20,000 workers at risk 25 cases per year, 1,000,000 workers at risk
	250 cases per year, 1,000,000 workers at risk
Age and sex levels	Mainly male, 50% aged under 30, 10% aged over 50
	Mainly male, 10% aged under 30, 50% aged over 50
	Mainly female, 50% aged under 30, 10% aged over 50
	Mainly female, 10% aged under 30, 50% aged over 50
Source of risk	Affected worker mainly responsible
	Employer mainly responsible
	Accidental actions of work colleagues of affected worker mainly responsible
	Violent actions of work colleagues or members of public mainly responsible
Impact of outcome	Majority of workers able to resume same job within month of accident
	Majority of workers require extended sick leave and return to different job
	Majority of workers forced into early retirement

Table 3 Results of pilot study of HSL staff

(prevention of) Blindness in manufacturing workers	Strongly preferred to	Asthma in waste disposal workers
Asthma in waste disposal workers	Strongly preferred to	Finger amputation in agricultural workers
Back fractures in construction workers	v. Strongly preferred to	Stress in nurses
Stress in nurses	Weakly preferred to	Stress in secretarial/clerical workers
Road deaths	v. Strongly preferred to	Stress in nurses
Road deaths	v. Strongly preferred to	Asthma in waste disposal workers

Table 4 Comparison questions included in final questionnaire

Event 1	Event 2
Incidents resulting in back fractures in construction workers.	Cases of severe asthma in waste disposal workers.
Accident is traumatic, victims unable to do heavy work.	Unpredictable and severe asthma attacks despite treatment.
Mainly male, 50% aged under 30, 10% aged over 50.	Mainly male, 10% aged under 30, 50% aged over 50.
250 cases per year, 1,000,000 workers at risk.	25 cases per year, 20,000 workers at risk.
Accidental actions of work colleagues responsible for accident.	Employer mainly responsible for not controlling cause of ill health.
Majority of workers forced into early retirement.	Majority take extended sick leave and return to different job.
Action can prevent 75/25 events*	Action can prevent 100 events
Incidents resulting in back fractures in construction workers.	Cases of stress-related ill health in nurses.
Accident is traumatic, victims unable to do heavy work.	Find stressful situations 'anxiety producing' and 'depressing'.
Mainly male, 50% aged under 30, 10% aged over 50.	Mainly female, 10% aged under 30, 50% aged over 50.
250 cases per year, 1,000,000 workers at risk.	250 cases per year, 20,000 workers at risk.
Accidental actions of work colleagues responsible for accident.	Nature and condition of work responsible for cause of stress.
Majority of workers forced into early retirement.	Majority take extended sick leave and return to different job.
Action can prevent 75/25 events*	Action can prevent 100 events
Deaths in road accidents	Incidents resulting in back fractures in construction workers.
Mainly male, 50% aged under 30	Accident is traumatic, victims unable to do heavy work.
3,500 cases per year	Mainly male, 50% aged under 30, 10% aged over 50.
Action can prevent 20/1 deaths*	250 cases per year, 1,000,000 workers at risk.
	Accidental actions of work colleagues responsible for accident.
	Majority of workers forced into early retirement.
	Action can prevent 100 events
Cases of severe asthma in waste disposal workers.	Cases of stress-related ill health in nurses.
Unpredictable and severe asthma attacks despite treatment.	Find stressful situations 'anxiety producing' and 'depressing'.
Mainly male, 10% aged under 30, 50% aged over 50.	Mainly female, 10% aged under 30, 50% aged over 50.
25 cases per year, 20,000 workers at risk.	250 cases per year, 20,000 workers at risk.
Employer mainly responsible for not controlling cause of ill health.	Nature and condition of work responsible for cause of stress.
Majority take extended sick leave and return to different job.	Majority take extended sick leave and return to different job.
Action can prevent 100 events	Action can prevent 100 events

* These questions were asked twice with alternative numbers of preventable cases in for Event 1 (the ordering of the comparisons was varied in the survey).

Table 5 Descriptive analyses of responses to main survey

Prefer to…	Mean	Lower 95% CI	Upper 95% CI
Prevent 100 asthma cases to 25 back fractures	0.289	0.23	0.35
Prevent 75 back fractures to 100 asthma cases, but 100 asthma cases to 25 back fractures	0.244	0.19	0.30
Prevent 25 back fractures to 100 asthma cases	0.467	0.39	0.54
Prevent 100 stress cases to 25 back fractures	0.333	0.27	0.40
Prevent 75 back fractures to 100 stress cases, but 100 stress cases to 25 back fractures	0.178	0.13	0.22
Prevent 25 back fractures to 100 stress cases	0.489	0.42	0.56
Prevent 100 back fractures to 1 road death	0.422	0.35	0.49
Prevent 20 road deaths to 100 back fractures, but 100 back fractures to 1 road death	0.244	0.19	0.30
Prevent 1 road death to 100 back fractures	0.333	0.27	0.40
Prevent 100 stress cases to 100 asthma cases	0.556	0.48	0.63
Prevent 100 asthma cases to 100 stress cases	0.444	0.37	0.52

Table 6 Results from logistic regression and implied monetary valuations for the non-fatal work-related accidents and ill health

Comparison	% choosing stimulus if preventable numbers are equal*	Median respondent: 100 comparator = x stimulus*	Implied value of comparator
Asthma vs Back fractures	0.82	29.24	£38,602
Stress vs Back fractures	0.74	31.06	£41,004
Back fractures vs Road deaths	0.99	13.20	£132,000

* The latter event in each of the comparisons is the stimulus.
† Based on a value of preventing a road death of £1,000,000 (HSE, 2000)