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**VALUING HEALTH CARE BENEFITS:
WHAT FACTORS INFLUENCE RESPONSES TO PREFERENCE
ELICITATION QUESTIONS?**

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Abstract

This paper provides a comprehensive categorisation of potential influences on responses to benefit valuation questions typically used in health economics. In doing this, potential sources of influence and bias on the valuation techniques are explored and consideration is given to the extent to which, for each source, the implications and solutions have, and have not, been researched. The paper demonstrates that responses to valuation questions are likely to be sensitive to a wide range of influences, both those we see as appropriate and those that represent possible sources of bias. An area where further work is required concerns the appropriateness and importance of including, within the valuation, preferences relating directly to the scales used to infer value. For example, with reference to the time trade-off technique (TTO), valuations typically represent a combination of preferences for the avoidance of the health state in question and preferences over time. Does the time preference component of the TTO valuation represent a source of bias or is it fundamental to the concept we are seeking to value? Similar issues exist for all valuation techniques commonly employed in health economics.

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INTRODUCTION

This paper considers the process of ‘valuation’ of benefits in health economic analyses and categorises the potential influences upon responses to valuation questions. More specifically, the main aims of the paper are to provide a comprehensive categorisation of potential influences on benefit valuations and present these within a general conceptual framework. In doing these, other aims are to educate students and practitioners about all of the potential sources of influence and bias on the valuation techniques they might use and consider the extent to which, for each source, the implications and solutions have, and have not, been researched, so mapping out a research agenda. Several authors have provided reviews of valuation techniques used in cost-utility analysis (for example, Torrance, 1986; Richardson, 1994; Dolan et al, 1996; Nord, 1992) and others have focused on the use in a health context of willingness-to-pay techniques (Diener *et al.*, 1996; Olsen & Smith, 2001; Klose, 1999), including conjoint methods (Ryan, 1999; Ryan & Farrar, 2000). This paper is broad in its coverage in that it is concerned with all valuation techniques commonly used in health economics, regardless of the economic evaluation approach. Given the very limited opportunity for data to be collected on revealed preferences in the health care environment and the resulting dominance of stated preference approaches, the focus for this paper is on stated valuations for hypothetical health scenarios.

The paper initially considers the ‘targets’ or ‘stimuli’ for benefit valuation in health economics, under both cost-utility and cost-benefit frameworks. For example, when constructing quality-adjusted life years (QALYs) the target for valuation is the ‘health state’ which is then used to weight life-years to reflect states considered worse than ‘full health’.¹ The full range of valuation techniques commonly used in health economics is described. The paper sets out a generic framework for the preference elicitation process used in health economic analyses and considers the core aspects of the ‘signal’ we are seeking to identify (i.e. the respondent’s strength of preference over the stimulus in question). The next section provides an overview of the possible influences on responses to valuation questions, where potential sources of bias in the valuation process are identified. The paper then provides a discussion of the importance and effect of an integral bias in benefit valuation techniques, that being preferences relating directly to the scales typically used in health economic analyses to infer value (e.g. the scale of ‘duration’ when using the time trade-off technique). This is followed by some thoughts on possible empirical work that might be conducted in this area.

VALUATION ‘TARGETS’ AND TECHNIQUES

There are a number of potential targets for a valuation process used in the assessment of benefits in health economics. These vary depending on the framework for the evaluation (i.e. cost-utility or cost-benefit analysis).

¹ Issues concerning valuation or weighting to reflect equity considerations in the measurement of health programme benefits, such as the adjustments to QALYs to incorporate ‘fair innings’ type arguments as put forward by Williams (1997), are outside the scope of this paper.

Cost-utility analysis framework

Quality-adjusted life years

If a cost-utility framework is adopted, then the focus typically is on the ‘health state’ as the target and the valuations on health states are used to weight life-years in the construction of quality-adjusted life years (QALYs). A number of alternative techniques have been put forward as possible routes by which valuations can be elicited, some of which are choice-based (such as the time trade-off) and some of which involve no choice context (such as the visual analogue or rating scale). The focus in this paper is on choice-based techniques *alone* since a necessary requirement of the valuation scale is that it has meaningful interval properties, allowing the summation of benefits. The rating scale is thought not to meet this ‘weak interval criterion’ and so is unlikely to possess interval properties (Richardson, 1994). Other commentators have provided support for this position (Read *et al.*, 1984; Nord, 1991; Bleichrodt & Johannesson, 1997), suggesting that a rating scale should only be used to identify the ordering of health states or programmes.

The three choice-based techniques that can be used to estimate a value on a health state are the time trade-off (TTO), standard gamble (SG) and person trade-off (PTO). A brief description of each of the three techniques is given in Box 1.² The standard gamble is the classical method of measuring cardinal preferences based directly on the fundamental axioms of expected utility theory (von Neumann and Morgenstern, 1944). Whilst the framing and methods of administration of both the TTO and SG exercises can vary considerably, for example with the use of props (such as the probability wheel in the SG case) to aid respondent understanding, the preference elicitation process is relatively straightforward for both. The PTO has only been considered for use in health state valuation more recently (although the technique, under the name ‘equivalence of numbers’ was originally developed by Patrick *et al.* in 1973) and there exist several potential variants of it, as described by Pinto Prades (1997). Box 2 provides a description of some of the variants of the PTO instrument.

In principle, the PTO can provide valuations on discrete health states, and so can be used in a traditional sense to construct QALYs (see Box 2). However, the technique also explicitly considers movements between health states (for example, taking people from adverse health situation A and returning them to full health) but still within a cost-utility framework.

Healthy-year equivalents

² The descriptions refer to the situation where the state is considered to be better than death; the case for the vast majority of states. The procedures require some modification in situations where states are viewed as worse than death. For details of these modifications see Drummond *et al.* (1997).

Within a cost-utility framework the healthy-year equivalent (HYE) has emerged as an alternative to the QALY as an aggregate measure of health benefits, although in an applied context it is rare to see HYE's used.³ A number of authors have discussed this development (Meherrez & Gafni, 1991; Gafni & Birch, 1997; Morrison, 1997; Bleichrodt, 1995; Reid, 1998) and so only brief details are provided here. The HYE was developed in part as a response to some of the problems of QALYs, notably the separability assumption upon which QALYs are based.⁴ The HYE provides a direct valuation on a health profile over time, and so includes simultaneously issues of health state values and duration. It is also then able to incorporate the value of movements between states, and issues of prognosis are dealt with explicitly since the future health states to be experienced are described to the respondent.

Where HYE's are used, the target for valuation is the profile of health states over time and this is valued using a modified version of either the standard gamble method or the TTO. These alternative uses of the SG and TTO to value profiles of health states are described by Drummond *et al.* (1997). There has been some discussion of the extent to which the two-stage SG and the TTO approaches represent equivalent valuation mechanisms (Buckingham, 1995; Rittenhouse, 1997; Morrison, 1997; Loomes, 1995) but the debate is not central to this paper and is not discussed further here.

Cost-benefit analysis framework

Where broader sets of benefits are considered, for example, where there is a desire to capture 'process' and 'non-use' aspects of health care programmes, in addition to improvements in health outcomes, then willingness-to-pay (WTP) methods might be employed. Using this method the value attached to a health care good (either in total or in terms of a change in that good), for any individual, is represented by the maximum amount of money that individual would be prepared to pay for the good (or change) to be available. The target of valuation, then, is simply the good and, consequently, its characteristics. For example, a health care good could obviously be described solely in terms of the health gains it would be expected bring about. But, such a description may also include aspects related to the care process and could even allow in other aspects,

³ The likely reason for this is the practical difficulties associated with their use: valuation is required for of all potential health outcome paths that might result from the interventions in question. Given the complexity and uncertainties typically associated with health care procedures, a very large number of valuation exercises would, in principle, be required for every economic evaluation undertaken. Added to this is the heavy cognitive burden placed on respondents who are asked to simultaneously consider entire paths of health states, possibly over varying time intervals. However, some researchers have been undaunted by the difficulties and have reported empirical estimates of HYE's in clinical settings (for example, Sculpher & Barbieri, 2001).

⁴ This assumption indicates that a defined period of time (say 10 years) in a given health state (for example, with a value of 0.8) has a QALY score that is given by the product of the health state value and the duration in the health state (i.e. 8 QALYs in this example). Thus, the process does not permit the respondent to incorporate their preferences over the duration of the health state into the valuation process.

such as caring externalities, which the respondent might experience as a result of the good being available for other people.⁵

Once again, there are issues in the WTP area with respect to different elicitation methods (such as payment scales, bidding games or take-it-or-leave-it approaches) leading to different results, how much information respondents can reliably process, and the extent to which the presentation of different amounts of information will influence WTP responses. These are discussed below.

PREFERENCE ELICITATION PROCESS

Figure 1 shows the core components of the preference elicitation process used in health economic analyses (shown as rectangular boxes in Figure 1). The process begins with the stimulus in question being defined. The nature of the stimulus will, of course, vary depending on the economic evaluation approach in question. For example, in constructing QALYs the stimulus is usually a health state description, which would typically be presented using an off-the-shelf health classification system (e.g. EuroQol EQ-5D).⁶ The stimulus will then be provided to a respondent who considers how desirable (or more accurately, undesirable) the described scenario is. A formal preference elicitation technique will then be employed, and the response to the preference elicitation question is taken as a direct measurement of the individual's valuation.

The core 'signal' that we are seeking to identify through this process is the respondent's preference relating to the stimulus in question, for a given perspective, as shown in Figure 1 (as solid ovals). An effective valuation measurement process is then characterised by:

- (a) variation in responses across individuals in line with variation in underlying preferences for the same stimulus,
- (b) variation in responses within individuals in line with variation in the characteristics of the stimuli presented,
- (c) variation in responses within and between individuals in line with variation in the perspective adopted in the valuation exercise.

Preferences concerning health matters (i.e. health states, movements between health states, health care programmes, etc.) are known to vary across individuals and appear to be shaped by a wide range of factors, including experience of ill-health in general or experience of the specific condition in question (Jansen *et al.*, 2000), the life-stage of the respondent at the point the question is asked, levels of education, employment status, etc. (Kind *et al.*, 1998). This paper takes individual preferences for health matters as given

⁵ The importance of externalities has been recognized within the context of cost-utility analysis (Labelle and Hurley, 1992), but (to the authors' knowledge) this has not been followed up empirically.

⁶ An alternative approach is for direct valuation to be obtained from patients relating to the health state they are currently experiencing. In such circumstances the stimulus is the current health being experienced by the patient and the stimulus presentation step in the preference elicitation exercise is not required.

and is not concerned directly with the factors that have helped to form such preferences.⁷ The interest here in individuals' underlying preferences for health issues is as one factor (albeit a highly important factor) that helps us to understand variation in responses, across individuals, to preference elicitation questions. A preference measurement instrument that fails to uncover such variation would be of limited use.

Similarly variation in the characteristics of the stimulus, for example in the extent and/or severity of the ill-health state in question, is likely to be associated with variation in preferences. For example, one evidently expects a respondent to place higher valuations on health states that are defined as being less severe, all other things equal, and this clearly represents a central source of variation that we are looking for the preference measurement instrument to capture. This will be revealed through the comparison of responses to different stimuli from the same individual.

The final 'legitimate' source of variation in responses to such valuation questions is when the perspective of the question itself is altered. For example, an individual perspective might be adopted, where the respondent is asked how he or she would react when faced with a choice task in which they are directly involved. This is commonly the situation when both the TTO and SG instruments are used. For example, in the TTO the respondents are asked to imagine *themselves* in the health state in question and to consider how many years of their remaining life they would be willing to sacrifice in order to be returned to full health.⁸ An alternative viewpoint is when the decision is being taken on behalf of others who form part of a group or society more broadly. In this situation the individual responding to the preference elicitation question would typically not feature as a potential beneficiary of the intervention in question.⁹ This is commonly the situation when the PTO instrument is used. In the WTP literature too there has been some debate as whether respondents should take a selfish or more social perspective (O'Brien and Gafni, 1996; Olsen and Donaldson, 1998). Although this may depend on the purposes of analysis (e.g. whether one is examining provision of health care within a privately or publicly funded system), there have been no direct comparisons of WTP measures using each perspective. The question of the appropriate perspective to adopt in health economic analyses is currently an issue of debate (for example, see De Wit *et al.*, 2000), and is not directly addressed in this paper, but is recognized as one of the factors helping to explain variation in responses to valuation questions.

FURTHER INFLUENCES UPON RESPONSES TO VALUATION QUESTIONS

⁷ However, we do accept that preferences relating to health issues may not be fully articulated at the point when the preference elicitation questions are asked, and that the process of investigation and elicitation itself may facilitate preference articulation by the respondent (Dolan *et al.*, 1999; Dolan & Cookson, 2000). These issues are discussed later in the paper.

⁸ TTO exercises have been conducted where the respondent is asked to respond not for themselves but on behalf of others in society with the result that the change in perspective alters the response given to the question.

⁹ However, a study conducted by Richardson & Nord (1997) showed that where respondents were potential beneficiaries of the intervention then the elicited valuations, using PTO questions, were higher.

Having identified a set of factors that represent ‘legitimate’ influences upon responses to valuation questions (i.e. the signal we are trying to detect), in this section of the paper we now identify other potential influences and consider whether they represent further components of the signal or potential sources of noise. These are shown in Figure 1 (by the dashed ovals). A distinction is made between factors that are features of the preference elicitation exercise, and as such are under the control of the investigator, and factors that relate to the respondent, most of which are outside the investigator’s influence. Exercise-specific influences include *generic issues* such as the process used to elicit preferences (e.g. interviews or postal questionnaire) or *technique-specific issues* such as the reference point used in a time trade-off question. Respondent-specific factors include characteristics of the respondent such as their degree of articulation of values with regard to health matters at the point they are asked to respond to the valuation question.

Influences relating to the preference elicitation exercise

There has been much discussion of the importance and influence of contextual issues in preference elicitation exercises that are, by definition, largely within the investigators control (Dolan *et al.*, 1999; Dolan, 2000). A principal concern here is the degree of discussion, deliberation and reflection upon responses to valuation questions that is both encouraged and allowed by the researchers (Dolan *et al.*, 1999). The presumption on the whole is that the greater the opportunity provided to respondents to reflect on their answers, the higher the quality of the data (i.e. the response is more likely to be an accurate reflection of the individual’s preference). The rationale is that some potential sources of bias (such as misunderstandings of the stimulus information presented and failures to comprehend the nature of the preference elicitation exercise) will be minimised, and the process itself will allow a greater degree of articulation of the individual’s values with regard to health matters. Responses to preference elicitation questions have been shown to be sensitive to such contextual factors (Dolan *et al.*, 1999).

A general issue that has relevance across all preference elicitation techniques is the specification of ‘reference points’. Under this general heading there are two separate sets of issues: (1) the values given to the components of the comparator in the choice question, and (2) the framing of the question in terms of gains or losses. Let us consider the component value issue first. Taking TTO as an example, the most commonly employed reference points are a 10 year duration in the health state to be valued and ‘full health’ as the comparator health state. However, the sensitivity of health state valuation scores to variation in the duration in the health state has been shown by a number of authors (for example, Dolan & Gudex, 1995). Likewise with SG; in specifying the nature of the SG exercise, a reference point that has to be defined is the number of years in the health state in question, most commonly 10 years duration. As part of the PTO exercise, reference points to be defined are the number of people in the comparator group, typically 10 when a life-saving base case is used, and the severity of the condition facing those in the comparator group. On the latter issue, the European Disability Adjusted Life Year (DALY) project (Robinson *et al.*, 2001), which used PTO to estimate disease weights, chose a comparator of ‘quadriplegia for the rest of one’s life’ (with chaining to

‘death’ in order to convert scores onto the required 0 to 1 scale). That study found PTO health state values consistently close to full health, even for states with moderate to extreme levels of impairment. One interpretation of this result is a high degree of sensitivity of responses to PTO questions to the comparator reference point used. The same has been shown for the use of WTP to value close substitutes in health care; asking respondents to provide ‘absolute’ values for each of A and B leads to different results than asking for a valuation of A relative to B, or vice versa (Donaldson *et al.*, 1997a; Donaldson *et al.*, 1997b).

The framing of question in terms of losses or gains is potentially another important influence on responses, as Kahneman and Tversky (1979) indicate. Empirical work has, in general terms, shown loss aversion to be a prevalent characteristic in most individuals, making people more sensitive to losses than to gains, as indicated by Bleichrodt (forthcoming). This issue has been explored most directly in the context of WTP situations where comparison has been of questions framed in terms of ‘willingness to pay’ and ‘willingness to accept’, with the finding of substantial variation (Hanemann, 1991; Knetsch, 1995). In TTO the respondent is asked to consider the *gain* in health status (from the health state in question to full health) and weigh this against a *loss* of life years. An attitude of loss aversion, will mean that the loss is given greater weight by the respondent (relative to the gain). Since the loss is on duration (i.e. the scale used to infer value) this will have the effect of leading to an upward bias in the TTO value (Bleichrodt, forthcoming). In the case of SG, the respondent is posed a question involving the possibility of both a *gain* (i.e. the improvement in health status from current health to full health, with probability p) and a loss (i.e. the prospect of immediate death, with probability $1-p$). If the individual is loss averse then, once again, the loss is given greater weight and so the value of p (i.e. the probability of receiving the *gain*) will be subject to an upward bias, as will the value placed on the health state (Bleichrodt, forthcoming). The loss aversion issue also arises in the context of PTO where the most commonly used scenario is for the choice to be framed in terms of gains (see Boxes 1 and 2). The PTO question typically focuses on how many people in one group should receive an *improvement* in their health, in order the social benefit to be similar to 10 people receiving a different level of *improvement* in the other group. However, variation in the reference point appears to have a dramatic effect on the valuation elicited, as shown by Pinto Prades (1997). Respondents, unsurprisingly, view the opportunity to ‘save lives’ very differently from the prospect of ‘sacrificing lives’.

The hypothetical nature of the preference elicitation task being posed inevitably means that issues of presentation are of great importance. There are two separate presentation issues: those relating to the framing and description of the stimulus itself, and those concerned with the presentation of the preference elicitation technique. Most of the empirical work in this area has focused on the latter. Alternative approaches to the presentation of the TTO exercise exist, for example, in terms of whether props are used and if so which props (Torrance, 1986), and this has been shown to have an effect on responses to the TTO question (Dolan *et al.*, 1996). It is clear that similar concerns arise in the presentation of both the SG and PTO exercises (Torrance, 1986).

One of the central factors relating to the WTP preference elicitation exercise, that has the potential to influence the value placed on a given health care programme, is the preference elicitation mechanism used. For example, the use of a contingent valuation exercise is very different from a study that relies upon revealed preferences to estimate value, and several investigators have demonstrated considerable variation in estimates derived from different WTP approaches such as open-ended versus take-it-or-leave-it (Johannesson *et al.*, 1991) and open-ended versus payment scales (Donaldson *et al.*, 1997c).

Influences relating to the respondent

In addition to the respondent's underlying preference relating to the stimulus in question, a number of other factors concerning the respondent might potentially influence responses to valuation questions. These are indicated in Figure 1, which provides a full listing of all exercise and respondent related factors. Many of the respondent-specific factors are influenced by study context and design issues. For example, the respondent's understanding of both the stimulus information and the preference elicitation technique, their degree of articulation of preferences with regard to health matters, and their level of engagement in the whole exercise will all be driven, to some degree, by the context in which the data collection is undertaken and the level of discussion and debate that is available. Opportunities for dialogue, either with other respondents or with the researchers themselves, allow for clarification on the task being posed.

In addition, the scale itself used in each of the techniques is unlikely to be a neutral factor in the process of eliciting preferences. In TTO the scale used to infer value is 'longevity' and so the respondent's attitudes towards their own survival will have a bearing on the response provided to the TTO question. Similarly, the scales used in SG and PTO to infer value (i.e. 'risk of death' and 'the number of persons benefiting from the alternative programmes', respectively) are potentially an important influences on responses. For example, in the SG case, an important reason why people deviate from expected utility is that they do not evaluate probabilities linearly either because they weight probabilities in a systematic manner or because of risk attitudes that are incorporated in the responses provided. In the case of WTP, there is likely to be variation across subjects in an exercise, regardless of the sampling frame, in terms of the marginal utility derived from money, which itself will be influenced by the individual's own initial level of financial wealth. Respondents are, therefore, likely to have varying attitudes towards the intrinsic scale used in WTP to infer value (i.e. money) and this variation may represent an important influence on the values estimated for the health care programmes in question. The specific issue of preferences relating to the scale used to infer value is explored more fully in the next section of the paper.

Another factor relating to the respondent that may influence the answers they provide to a TTO valuation question is the assumption made with regard to re-allocation of lifetime consumption. For example, an individual who is to some extent consuming out of accumulated wealth would be expected to consume at a greater rate if he or she knew for certain that their life expectancy were to be reduced. This represents a potential source of

bias in responses to TTO questions. However, as Dolan & Jones-Lee (1997) demonstrate, since most people consume out of current income, the extent to which the rate of consumption can be varied is highly constrained, and so the effect of reallocation is likely to be very small.

PREFERENCES RELATING TO THE SCALES USED TO INFER VALUE

As indicated above, it is possible that individuals, when responding to health care valuation questions, will exhibit preferences relating directly to the scales being used. This issue potentially poses problems for all the valuation techniques currently at our disposal.

A number of researchers have considered alternative valuation techniques, either from a conceptual point of view or through a comparison of data. For example, Nord (1992) provides a review of five alternative approaches to valuation of health states for use in constructing quality-adjusted life years: rating scale, standard gamble, TTO, PTO and magnitude estimation. In terms of the techniques of interest in this paper, his review indicated a reasonably consistent finding of higher values for standard gamble than for TTO, a finding that has also been shown by other investigators (for example, Torrance, 1976; Wolfson *et al.*, 1982; Read *et al.*, 1984; and Hornberger *et al.*, 1992). As Bleichrodt & Johannesson (1997, p156) suggest,

“The worrying implication of these findings is that QALY based decision making may lead to different policy recommendations depending on which of the ... methods is used to elicit the quality weights.”

Nord (1992) hypothesizes that the differences in values elicited using the alternative techniques may result, in part, from the fundamental difference in the nature of the valuation process. This issue is now discussed further in this section of the paper.

Time trade-off

One possible influence on responses to the typical TTO question is the respondent's personal rate of time preference. In virtually all TTO exercises reported in the literature, this issue is not explicitly addressed. There are two possible interpretations of this lack of consideration of this issue in most of the empirical work: (1) an assumption (albeit implicit) of constant utility returns to the respondent for each additional life-year experienced; or (2) researchers see one of the advantages of the TTO instrument as its ability directly to incorporate attitudes to time in the valuation placed on the health state. Alternatively, some researchers have acknowledged the fact that responses to TTO questions include a component relating to time preference but see this as a source of bias and something that needs to be filtered out from the response to the questions (Stiggelbout *et al.*, 1994; Martin *et al.*, 2000).

The interpretation most commonly seen is the implicit assumption of constant utility returns, given the lack of explicit consideration of issues of time preference (see Figure

2). Under this scenario, the value placed on the year that would take the respondent from 0 to 1 is assumed to be the same as the value on the year going from 9 to 10. If a respondent indicates that she is willing to forgo 1 year (from a total of 10 years) in order to move from an ill-health state to full health then the value placed on the ill-health state is simply $9/10 = 0.9$ (on a scale from 0 to 1 where 0 is equivalent to death and 1 is full health). Therefore, the interval between the value on the health state and full health is proportional to the number of years sacrificed (relative to the maximum specified in the TTO exercise). Under an assumption of constant utility returns to life years, the ill-health state value is thought *solely* to reflect the individual's preference to avoid the particular ill-health state. The use of responses in this manner to estimate a value on a health state ignores the fact that most individuals have a personal rate of time preference that is non-zero (Cairns & van der Pol, 2000). A positive rate of time preference would imply that later years are seen as less valuable than immediate years and so, in the context of TTO, the loss in utility associated with the sacrifice of years is unlikely to be proportional to the number of years sacrificed.

The second explanation, that the TTO instrument allows the direct incorporation of attitudes to time in the health state valuation, has not been discussed widely in the literature. Without adjustment for attitudes to time, it is the case that scores from a TTO exercise are likely to reflect the combination of preferences to avoid the ill-health state in question and time preferences at an individual level. Therefore, in the situation of a positive time preference rate, an approach that takes 'raw' scores from a TTO exercise (i.e. health state values that include time preference concerns) will tend to see scores that are systematically lower than those from techniques that do not incorporate concerns for duration in the same manner. As Nord (1992, p561) explains,

“people are generally less concerned with losses in the distant future than with losses in the near future (so-called positive time preference). It seems reasonable to assume this also of life years ... This points in the direction of relatively low weights for states of illness when the time trade-off technique is used.”

The importance of concerns for time preference in responses to TTO questions has been highlighted by a number of commentators (for example, Dolan & Jones-Lee, 1997; Nord, 1992; Read *et al.*, 1984; Dolan *et al.*, 1996). Some researchers, for example Dolan & Gudex (1995), have attempted to consider the magnitude of the problem and found that in, aggregate, rates of time preference exhibited by respondents to TTO exercises were very close to zero. They cite this evidence to support the validity of the assumption of the TTO method that there is no discounting. However, the sample in that study was small ($n=39$) and some of the implied valuations for short periods were counter-intuitive and so further work to explore this issue is required.

Other researchers have gone further and sought to introduce adjustments to 'raw' TTO scores to reflect individuals' attitudes towards time (for example, Stiggelbout *et al.*, 1994; Martin *et al.*, 2000). The method by which this is achieved is described in a textbook on medical decision-making (Sox *et al.*, 1986) but has rarely been implemented in practice. The method is based on the use of certainty equivalent (CE) questions, alongside the

TTO questions. The CE question asks for the number of years in full health for certain (the *certainty equivalent*) that he or she considers equivalent to a gamble involving a 50% chance of a long and a 50% chance of a short length of life in full health. The method is based on the assumption that subjects who value nearby years higher than years further away will accept CEs that are less than the expected value of the gamble. The value on the probability in the CE question can then be changed (e.g. to 25% and then to 75%) and the subject's CEs plotted to show the curve representing the utility associated with life years. The degree of concavity or convexity of the curve (parameter r) can then be calculated and the *adjusted TTO* value is the 'raw' TTO valuation raised to the power r (Miyamoto & Eraker, 1985).¹⁰

Standard gamble

Given that the SG does not use duration as the scale by which value is inferred, it is not associated with the same concerns relating to attitudes towards time as the TTO. That is not to say that duration is ignored in the SG exercise; part of the information bundle provided to respondents is the length of time they will experience the ill-health state in question (for the 'certain' alternative) and the possible duration in full health (as one of the outcomes of the gamble). With SG, the length of time in either health state is a constant (i.e. it is the same for both the ill-health state in question and full health) and so the assumption is that the value elicited for the ill-health state is independent of the durations specified. This assumption has, however, been challenged with evidence indicating that short intervals in poor states are viewed very differently to extended intervals in the same poor states. However, this issue is not the focus of this paper.

In place of duration, the SG uses the inverse of the probability of death as the scale to indicate value: the ill-health state is viewed as being poor when respondents consider a high probability of death as equivalent to the certainty of life in the ill-health state. There are two separate issues relating to the probability scale that might help us to understand responses to the SG question: 'probability weighting' and risk attitude. The weighting of probabilities by individuals has been established for health and monetary outcomes whereby individuals transform probabilities into *decision weights* (Quiggen, 1982; Wakker & Siggelbout, 1995). The basic idea is that people do not treat probabilities in a linear manner, as proposed by expected utility theory, but that people transform probabilities into weights because of psychological misconceptions of numerical probabilities or as part of a conscious and deliberate choice on the part of the decision-maker. This issue is explored by Bleichrodt (forthcoming) as a potential explanation for differences between SG and TTO utilities. Empirical evidence indicates that the probability weighting function is variable between individuals but is on average best represented by an inverse S-shape whereby small probabilities tend to be over-weighted and larger probabilities under-weighted. This is in agreement with the common finding that a small probability that changes 'impossible' into 'possible' (e.g. $p=0.1$ instead of $p=0$) or a high probability that changes 'possible' into 'certain' (e.g. $p=1$ instead of $p=0.9$) receives more attention than a probability that merely changes possibility into a

¹⁰ Further detail on the method is shown graphically in Sox *et al.* (1985), and Miyamoto & Eraker (1985) provide the detail of the mathematics.

higher possibility (e.g. $p=0.6$ instead of $p=0.5$). The implication of this is that, in general, since the probabilities reported in SG exercises tend to be towards the top end of the scale, the utilities elicited using SG will be biased upwards by probability weighting.

However, the issue of probability weighting is concerned with the respondent's perception of the probability scale and not their preferences directly concerning the scale. A separate potential influence on responses to the typical SG question is the respondent's attitude towards risk. In line with our discussion of TTO, there are two possible positions to adopt with regard to risk attitude and SG: (1) an assumption can be made of constant utility returns to the respondent for each additional unit of risk incurred; and (2) researchers view the SG instrument as directly incorporating attitudes to risk in the value placed on the health state, and this is seen either as a positive aspect of SG (i.e. risk attitudes are fundamental to the concept we are seeking to value) or as a negative consideration (i.e. preferences relating to risk represent a source of bias).

Under the former scenario, the assumption being made is one of constant utility returns for each unit change in the *risk of death*. That is to say, the move from a 0% chance of death to a 10% chance has the same disutility as the move from 90% to 100% (see Figure 3). For example, if a respondent indicates that she views a 20% chance of death as equivalent to the certainty of the ill-health state then the value placed on the ill-health state is $1 - 0.2 = 0.8$ (on a scale from 0 to 1 where 0 is equivalent to death and 1 is full health). Therefore, the interval between the value on the health state and full health is proportional to the level of 'risk of death' that the respondent is willing to incur. Under an assumption of constant utility returns to units of risk, the ill-health state value *solely* reflects the individual's preference to avoid the particular ill-health state. The use of responses in this manner to estimate a value on a health state ignores the fact that most individuals have a personal preference to avoid risk in health scenarios and so, in the context of SG, the loss in utility associated with the increasing risk of death is unlikely to be proportional to the increasing risk of death.¹¹

Virtually all commentators take the view that the SG instrument directly incorporates attitudes to risk in the value placed on the health state, and this is widely seen as a positive attribute of the technique (Wakker & Stiggelbout, 1995). It is the case that scores from a SG exercise are likely to reflect the combination of preferences to avoid the ill-health state in question and to avoid the risk of death. Therefore, if respondents typically exhibit risk aversion attitudes in contexts relating to their personal health, an approach that takes 'raw' scores from a SG exercise (i.e. health state values that include risk concerns) will tend to see scores that are systematically higher than those from techniques that do not incorporate attitudes to risk in the same manner. Once again Nord (1992, p561) explains,

¹¹ Regret theory provides another explanation as to why respondents may shy away from the gamble in SG questions, hence leading to high health valuations on health states (Loomes & Sugden, 1982). This theory suggests that individuals are averse to 'regret' which may occur if they take a gamble and lose, and hence end up with the worst outcome of immediate death.

“choice may then be affected by aversion to risk and reluctance to ‘gambling with own health’ ... Such underlying attitudes will tend to strengthen to subjects’ preferences for high probabilities of survival in the gamble alternative and hence point in the direction of relatively high weights on states of illness when the standard gamble method is used.”

Person trade-off

The PTO technique uses the number of people in a given health programme as an indicator of the value of that programme, relative to a reference point. Using the PTO-1 design (as described earlier and because it is most commonly employed), the respondent is asked how many people (z) who are in chronic health state (A) should be returned to perfect health in order to produce the same social benefit as returning to perfect health y people (typically $y = 10$) who are about to die. The ill-health state is viewed as being poor when respondents consider a small number of individuals in the chronic state to be equivalent to 10 people at risk of immediate death. An extreme position would have values for both z and y of 10, indicating that the ill-health state A is viewed as being equivalent to death, and so is given the value of zero. However, unlike the TTO and SG approaches to valuation, the PTO does not have the linear relationship between the response provided to the question (i.e. the value given for z) and the value inferred on the health state or health programme. As Figure 4 shows, there is diminishing marginal utility associated with the health state as the number of beneficiaries of the programme (i.e. the value on z) increases. This results from the fact that the valuation elicited from the PTO (for PTO-1 at least) is calculated as:

$$y * 1 = z * [1 - U(A)] \text{ or } U(A) = 1 - [y / z]$$

Therefore, unlike the TTO and SG, the PTO does not assume constant utility returns to the respondent for each additional unit increase in the measurement scale (i.e. number of people).

A potential influence on responses to PTO questions is the respondent’s concerns relating to the distribution of health benefits in a population. There seems broad agreement amongst researchers that PTO valuations do incorporate these broader preferences but there is some dispute as to whether this is seen as a positive aspect of PTO (i.e. concerns relating to distribution are fundamental to the concept we are seeking to value) or as a negative consideration (i.e. such preferences represent a source of bias). As Nord (1992, p562) explains:

“When person trade-off is used, distributive considerations become a serious confounding factor. Subjects may consider that all or most of a budget should be spent on any one patient, regardless of how much worse off this individual is than others. Such considerations will tend to limit differences in weights between serious and less serious conditions. It will work in the opposite direction if the subjects wish to distribute health as uniformly as possible and consequently think that those who are worse off must have priority regardless of the relative quality

of life. The net effect of such distributive considerations is difficult to evaluate and will vary with social values.”

Willingness to pay

With WTP a potential influence on responses will obviously be the marginal utility of income. This issue has been researched with respect to its distributional implications in health care evaluations (Donaldson, 1999), where, generally, it is assumed that richer people have a lower marginal utility of income than do poorer people, thus raising challenges with respect to aggregation. However, an issue which has not been researched, and of more relevance to this paper, is the extent to which, within individuals, different marginal utilities of income apply to different amounts of WTP stated. For example, it is assumed that for an individual stating a WTP of \$100 for a good and only \$10 for another good, 10 times the utility is derived from the former as for the latter. Variation in the marginal utility of income within individuals as income levels change would challenge this assumption commonly made when using WTP.

DISCUSSION

The focus for this paper has been the identification of factors that influence responses to benefit valuation questions applied in a health context. A distinction has been drawn between factors that we see as legitimate influences upon valuation responses and those that might be defined as illegitimate. Fundamental to this debate, with reference to TTO, is the question of whether it is appropriate for the valuations resulting from TTO to be a combination of preferences for the avoidance of the health state and preferences over time. That is, does the time preference component of the TTO valuation process (that stems directly from the scale used to infer value) represent a source of bias or is it fundamental to the concept we are seeking to value? Given that economic evaluations will typically include discounting of future costs and benefits (including QALYs calculated using unadjusted TTO scores), there is clearly a concern that some double counting of time preference is incorrectly taking place.

In parallel to the conclusion relating to TTO, the debate on SG centres on the question of whether it is appropriate for the valuations resulting from SG to be a combination of preferences for the avoidance of the health state and attitudes to risk in life-and-death situations. That is, does the risk attitude component of the SG valuation process represent a source of bias or is it fundamental to the concept we are seeking to value? Unlike the debate on TTO valuations (where discounting is employed to account for societal time preference), with SG there is not commonly an attempt to adjust the results of economic evaluations to account for societal concerns for risk.

Richardson (1994, p17) discusses this issue:

“it is the risk situation created by the SG that has made it attractive to many analysts. However, while it is true that many medical interventions involve risk, this usually takes the form of a particular (known or unknown) probability of a

transition to a particular health state. By contrast, the risk introduced by the (N-M) standard gamble is part of the technique for measuring the 'utility' ... of the health state itself ... The counter argument is that the SG at least introduces an element of 'risk' ... and that measurement under risk is desirable. However, the risk modeled by the usual SG is the result of a singularly unrealistic situation in which the individual faces instant death as a possible outcome from one of the two choices. The context is totally dissimilar from a health scenario involving the possibility ... of, for example, some non-life-threatening disease. The empirical evidence on risk behaviour ... reveals such a diverse, context-specific range of behaviour that these two situations must be regarded as being quite distinct."

If one supports this line of argument then the incorporation of the highly context-specific risk attitude incorporated within the SG approach must be considered a source of bias and is not fundamental to the core concept for which we are seeking to elicit a value. However, (to the authors' knowledge) there has been no discussion in the literature of attempts to 'filter out' the concerns relating to risk in responses to SG questions in order to allow an adjusted SG value on a health state to be estimated.

The conclusions relating to both TTO and SG are mirrored in the case of PTO but with PTO the focus is on distributional issues rather than preferences concerning duration and risk. The issue here centres on the question of whether it is appropriate for the valuations resulting from PTO to be a combination of preferences for the avoidance of the health scenario and concerns for distribution of health benefits. Richardson (1994, p19), in considering the choice between the TTO and PTO techniques, suggests that:

"In principle, the choice between the two techniques would therefore depend upon a judgement concerning the importance of incorporating libertarian or paternalistic values as the basis for measuring the quantity of output."

The justification for 'filtering out' concerns relating to the distribution of health benefits that are incorporated within PTO valuations is less obvious. However, attempts to separately introduce equity considerations into benefit measures such as QALYs through the application of 'equity weights' need to be considered carefully where PTO approaches have been used to estimate the health state valuations.

Where WTP techniques are used, the assumption is almost always made that where an individual states a WTP of \$100 for a good and only \$10 for another good, he/she attaches 10 times the utility to the former as to the latter. The effects of variation in the marginal utility of income within individuals are, therefore, commonly ignored. The reason for this is that, relative to total income, the amounts concerned (i.e. the responses to WTP questions) are so small that their impact in marginal utility of income is thought to be minimal, and thus a constant rate can be assumed. But (to the authors' knowledge) this proposition has not been tested and in some situations distributions of WTP values have included sums that represent substantial proportions of total incomes (for example, see Donaldson *et al.*, 1998).

CONCLUSIONS

Responses to valuation questions posed using techniques commonly applied in health economics are likely to be sensitive to a wide range of influences, both those we see as appropriate and those that represent possible sources of bias. This paper has provided a comprehensive categorisation of potential influences on benefit valuations. This represents fertile ground for future research with three important questions that need to be addressed.

1. What are the aspects of responses to valuation questions that we wish to filter out before the valuations are used to inform health care resource allocation questions?
2. What is the magnitude of the problem, i.e. to what extent are the biases important or are they minor influences on valuation responses?
3. Where potentially significant problems exist, how might valuation data be adjusted in order to remove such biases?

Whilst these questions apply to all valuation techniques, for some techniques a number of these issues have been explored. An area where further work is required concerns the appropriateness and importance of including, within the valuation, preferences relating directly to the scales used to infer value.

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Box 1: Choice-based health state valuation techniques

Time trade-off (TTO)

Two alternatives are offered. Alternative 1 is state i for time t followed by death; alternative 2 is full (or normal) health for time x . Time x is varied until the respondent is indifferent between the two alternatives, at which point the required preference value for state i is given by $h_i = x / t$.

Standard gamble (SG)

The subject is offered two alternatives. Alternative 1 is a treatment with two possible outcomes: either the patient is returned to normal health and lives for an additional t years (probability p), or the patient dies immediately (probability $1 - p$). Alternative 2 has the certain outcome of chronic state i for t years. Probability p is varied until the respondent is indifferent between the two alternatives, at which point the required preference value for state i is p .

Person trade-off (PTO)

The subject is asked a question of the following kind: 'If there are x people in adverse health situation A and y people in adverse health situation B, and if you can only help [cure] one group, which group would you choose?' One of the numbers, x or y , can be varied until the subject finds the two groups equivalent in terms of needing or deserving help. The undesirability (disutility) of situation B is x / y times as great as that of situation A.

Box 2: Variants of the PTO technique applied in a health context

In the basic PTO exercise (described as PTO-1 by Pinto Prades, 1997) the respondent is asked how many people (z) who are in chronic health state (A) should be returned to perfect health in order to produce the same social benefit as returning to perfect health y people (typically $y = 10$) who are about to die. The value on A is then derived from:

$$y * 1 = z * [1 - U(A)]$$

For example, imagine that a respondent indicates that the number (z) is 100 (an equivalence of 1 in 10). As the benefit of returning to perfect health somebody who is in A is $1 - U(A)$, and the benefit of returning to perfect health somebody who is about to die is 1, this person is saying that

$$10 * 1 = 100 * [1 - U(A)]$$

and so we can say that $U(A) = 0.9$. In PTO-1 we arbitrarily set $y = 10$ and then ask about z . An alternative approach (i.e. PTO-2) is to focus attention on establishing a value on y , having arbitrarily set a value for z , typically at 1000. This would involve asking about the number of fatalities that the respondent is willing to accept for curing 1000 people with a certain chronic condition. However, as Pinto Prades (1997, p73) indicates, and shows through his empirical work:

“if preferences are reference dependent, as Prospect Theory suggests, starting with y and asking about z may not be the same as starting with z and asking about y .”

Figure 2: Time Trade-off

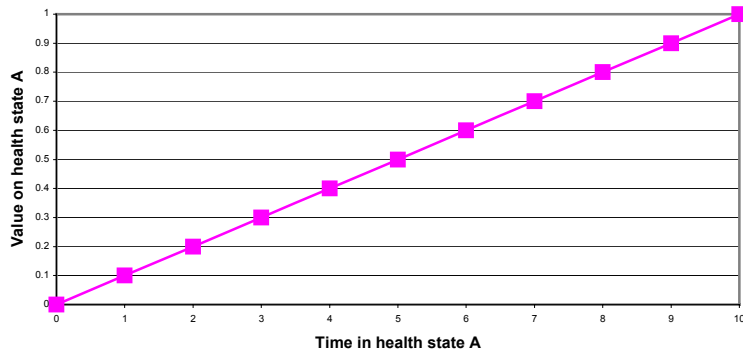


Figure 3: Standard Gamble

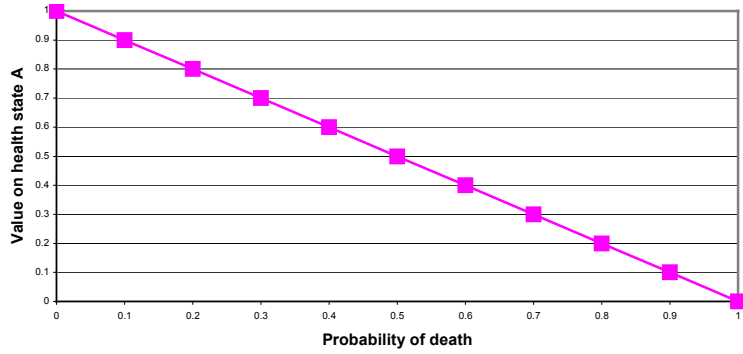


Figure 4: Person Trade-Off

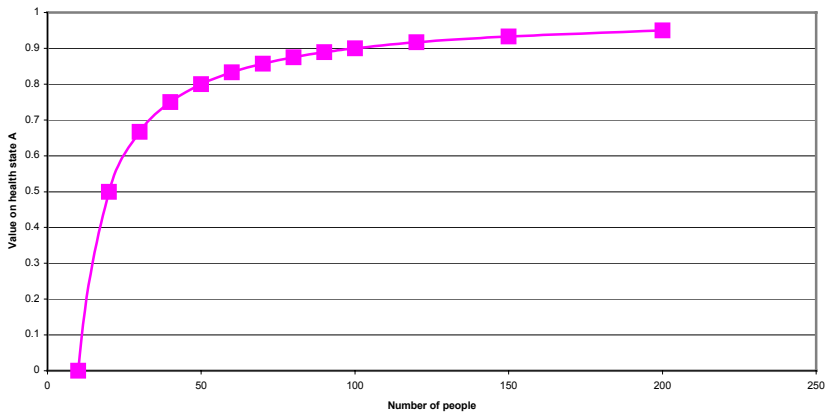


FIGURE 1: INFLUENCES UPON RESPONSES TO PREFERENCE ELICITATION QUESTIONS

RESPONDENT FACTORS

ELICITATION EXERCISE FACTORS

