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Did people "buy" what was "sold"? A qualitative evaluation of a contingent valuation survey information set for gains in life expectancy

R. Baker [a], A. Bartczak [b], S. Chilton [c], H. Metcalf [c,*]

[a] Yunus Centre for Social Business and Health, Glasgow Caledonian University, Cowcaddens Road, Glasgow G4 OBA, UK
[b] Warsaw Ecological Economics Center, Faculty of Economic Sciences, University of Warsaw, ul. Dluga 44/50, 00-241 Warszawa, Poland
[c] Newcastle University Business School, 5 Barrack Road, Newcastle upon Tyne NE1 4SE, UK

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ABSTRACT

A number of stated preferences studies have estimated a monetary value for the gains in life expectancy resulting from pollution control, using a Value of a Life Year (VOLY) approach. However, life expectancy gains are a complex concept and no attempt has been made, to date, to investigate peoples' understanding of what it is they are being asked to value. Past practice has been to focus on the outcome of a policy i.e. a gain to the average person of *X* months', providing no details on how the individual receives, or experiences this gain, a potentially important attribute to value. This paper sets up and reports the results from a structured debriefing exercise to qualitatively investigate an alternative approach which explicitly emphasises how this gain is delivered (on-going reductions in the risk of death). We find that, for the majority of respondents, the approach is effective in communicating the on-going nature of the gain and reduces or eliminates the use of the (incorrect) heuristic that it is an 'add-on' at the end of life, in poor health. Further refinements are required, however, to communicate the cumulative nature of these risk reductions and the lack of impact on quality of life. The lesson for stated preference studies in general is that structured debriefings can be very useful, highlighting such issues as the persistence of ill-defined attributes and the difficulties that respondents may encounter setting aside their preferences over attributes of the good that should not be included in the valuation.

1. Introduction

The monetary value of health benefits or costs to individuals from different environmental regulations has been increasingly requested by government departments in the European Union countries and the USA for use in cost-benefit analyses of these programmes. Desaigues et al. (2011) note that all valuation studies before 1996 calculate the economic cost of mortality as a number of premature deaths due to pollution multiplied by the value of prevented fatalities (also called 'Value of Statistical Life' (VSL)). This practice is supported by the fact that the underlying theoretical framework for the valuation of a one-period risk reduction (Jones-Lee, 1976) is fully specified and well established. However, life expectancy gains from pollution control arise from multi-period i.e. on-going risk reductions over a lifetime, for which a valuation model or framework (termed the Value of a Life Year, or VOLY) has not been established in the formal sense.[1] These risk reductions to individuals within the affected population generate the population-based estimate of life expectancy, which expresses how many more months/years an average individual of a particular age can expect to live. So, for example, a 40 year old male in the UK has a life expectancy of 38 years (although some will die before they reach 78 while others will live longer).

Abbreviations: CVM, contingent valuation method; CBA, Cost-Benefit Analysis; LE, Life Expectancy; VOLY, Value of a Life Year; VSL, Value of Statistical Life; WTP, Willingness to Pay.

* Corresponding author. Tel.: +44 (0)1912081702.
E-mail addresses: Rachel.Baker@gcu.ac.uk (R. Baker), bartczak@wne.uw.edu.pl (A. Bartczak), susan.chilton@newcastle.ac.uk (S. Chilton), hugh.metcalf@newcastle.ac.uk (H. Metcalf).

[1] Approaches such as those in Mason et al. (2009) establish a procedure to calculate a VOLY indirectly from a VSL, which is not the same concept.

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Coupled with this, a general concern exists about the availability of sound estimates and the degree to which reliable methods have been developed for the empirical estimation of a VSL (and, by extension a VOLY). These concerns are for example reflected in the US Environmental Protection Agency-Science Advisory Board current advisory (US EPA-SAB, 2007) which recommends weighting mortality risks sourced in the literature by their reliability in any meta-analysis of such studies for policy values and calls for more empirical evidence on the relationship between the VSL and the VOLY. This is despite the fact that a number of advantages of using the VOLY over the VSL approach have been highlighted in several studies (see e.g. Brunekreef et al. (2007), Hammitt (2007) and Desaigues et al. (2011)). Recognising both the problems with and desirability of a direct VOLY estimate for air pollution reduction, The European Union commissioned a study[2] which had, as a major aim, to address some key methodological issues associated with the VOLY.

This paper reports on one of the key challenges addressed within, namely that of information provision and, specifically, its impact on respondent interpretation and understanding of the benefits i.e. life expectancy gains being valued. Whilst there has been some attention to this issue in the environmental literature, the issue of respondent unfamiliarity with the good has been largely unaddressed in the mortality valuation literature, most likely because the VSL approach focuses on outcomes of instant (albeit premature) death which is arguably relatively well understood, often from causes with which the respondents are familiar e.g. road accidents.[3] Confirmation of respondent understanding can be thought of as an additional validity test, complementing more familiar ones that are usually applied to quantitative survey data, such as scope sensitivity (Carson and Mitchell, 1993), the effect of subjective, as opposed to objective, probabilities on values (Whitehead, 2005) and the effect of demographic and other independent variables in regression analysis of WTP (Wang and Zhang, 2008).

We identified the potential for *ex post* debriefing as a tool by which to explore this issue. Whilst common practice in CVM studies it is most often used to establish the validity or otherwise of WTP estimates and to understand why respondents acted as they did. Often, it is fairly informal in nature. By structuring this exercise more formally and making it more in-depth, we aimed to provide insights into respondents' interpretation and assimilation of the *information* with respect to the "good", what they perceive it to be and hence what it is they have valued. Note here an important subtlety – the aim of the debriefing study is to establish what is valued by the stated preference survey and not to 'test' whether each individual respondent fully understood, particularly in a technical sense, the information provided, arguably an unreasonable expectation. Put another way, it is the survey (or rather the information set) that is 'on trial' and not the respondents. It would seem that a necessary condition for such an information set is that it places respondents in a position whereby they are "buying" what the survey is "selling". Therefore, a precursor for an assessment of the "success" or reliability of the resulting valuation exercise is that respondents can be judged to have at least a sound intuitive understanding of the goods main characteristics and how changes in its level of provision might affect their wellbeing.

If Payne et al.'s (1999) constructivist interpretation of contingent valuation is accepted, then the issue of respondent understanding of the information set is of crucial importance. They argue that a central role of any elicitation procedure is to aid the respondent in arriving at 'well-constructed' preferences and that respondents must give thorough consideration to the most critical information and not be unduly influenced by irrelevant information or features such as survey design characteristics or framing. Three approaches were available to us in respect of the type of information to provide. The first, which certainly avoids information overload, is to describe the good in very general terms, mirroring past practice. Here, *no* details are provided as to how the change comes about, instead it focusses solely on the outcome for the *average* person exemplified by the following: *"The chance for a man/woman of your age to become at least 75 years old is x per cent. On average, a 75-year old lives for another 10 years. Assume that if you survive to the age of 75 years you are given the possibility to undergo a medical treatment. The treatment is expected to increase your expected remaining length of life to 11 years. Would you choose to buy this treatment if it costs y and has to be paid for this year?"* (Johannesson and Johansson, 1996, 1997)[4] *"By reducing the general level of air pollution that causes wear and tear and faster ageing, everybody could live longer. That would mean that you (and everyone else in your household) could expect to live about X months longer in your (their) normal*[5] *state of health"* (Chilton et al., 2004)

Whilst arguably reducing the cognitive burden on respondents, the cost to the validity of the resulting willingness to pay (WTP) estimates of the value of a life year (VOLY) is unknown, but anecdotal evidence from our own previous experience and that of colleagues suggests that many respondents adopt the heuristic that it is a simple 'add-on' at the end of life, most usually in poor health and value this accordingly, as opposed to what is actually delivered (changes in the risk of death over time).

A second approach (described in Section 2) would be to describe it in very precise, technical terms, perhaps based explicitly around Eq. (2) in Section 2. This would seem infeasible.

A third approach, and the one adopted, is, as noted, to provide fairly detailed information[6] to respondents.

The motivation for the study reported in this paper is the results from two previous UK VOLY studies[7] (Desaigues et al., 2007, 2011; Chilton et al. 2011). In both studies, carried out on a convenience sample of members of the public in Newcastle upon Tyne, sample size was identical (152) and demographic characteristics very similar. The only major difference between those studies was the nature and provision of the information set presented. Both information sets employed the same pictorial/graphical depictions of life expectancy changes (see Section 2), but the second study (Chilton et al. 2011) had a longer value construction phase, with

[2] Project no: 502687 'New Energy Externalities Developments for Sustainability' [NEEDS].

[3] Of course, a number of VSL studies have taken care to establish the degree of respondent understanding of what is meant by a change in the risk of death (e.g. Krupnick et al. 2002; Cameron and De Shazo, 2013). Unfortunately, using a quantitative approach to explain the change in a VOLY framework would necessitate showing to respondents the difference between the original (policy-off) and new (policy-on) risks *distributions*. This approach was not adopted for perhaps obvious reasons and meant, therefore, that, we could not draw on insights from this literature in our own inquiry.

[4] As far as we are aware, the 1996 survey was the first to ask explicitly about the valuation of a life expectancy gain.

[5] Respondents had previously discussed what "normal" state of health mean for them in different stages of their lives.

[6] This had been checked for major cognition and comprehension problems (as opposed to the type of 'understanding' assessed in the debriefing study) during the *survey development phase* which utilised a combination of focus groups and individual verbal protocols. This procedure, in line with other studies, is not directly set up to assess the type of 'understanding' investigated in the subsequent debriefing study, reported in this paper.

[7] These two surveys can be requested from us from the contact author for this paper, should they wish to compare the two information sets.

additional consistency and understanding checks built in (including a verification of respondents' understanding of a life expectancy gain prior to the valuation) to facilitate a deeper understanding of the information provided. The quantitative results of those two surveys differ significantly suggesting that respondents in the two surveys were "buying" different goods although given that the two studies employed small samples it is difficult to definitively prove this. Our purpose here is *not* to establish which information set was 'better',[8] but it is possible to highlight a couple of differences that suggest the results from the study employing the 'enhanced' information set are more reliable (although this cannot be taken as proof that it was understood – this is the role of the debriefing study reported below).

The response set from the first study was characterised by a low degree of scope sensitivity (1.4), in that WTP for a 6 month life expectancy gain was only 40% higher than that for a 3 month gain (i.e. a doubling of the life expectancy gain). In the second study, the degree of scope sensitivity was 2.2.[9] Secondly, the prevalence of true zero bids in the first study seems quite low (e.g. 7% for the 3 month gain) relative to the second study (26%) – one might have expected more or less the same proportion of respondents to have little or no interest in the good in question.

Focussing then on the information set from Chilton et al. (2011), one important aspect is the VOLY elicitation question itself. Generally, one of two approaches is adopted: either to ask respondents to directly value a specific life expectancy gain or, alternatively, to value a reduction in their risk of dying over an N year period (Morris and Hammitt, 2001; Krupnick et al., 2002; Alberini et al., 2004). Both are in fact equivalent (Hammitt, 2007), the latter simply values life expectancy changes indirectly (technically defined in Section 2). But respondents are not explicitly made aware of this. Theoretically speaking this should not matter but it might matter empirically if the provision mechanism (outcome) is of interest to the first (second) set of respondents. The information set from Chilton et al. (2011) in fact allows respondents access to both pieces of information.

We now turn to the systematic, in-depth debriefing, qualitative study in two countries (UK and Poland) of this information set. Section 2 provides a formal definition of life expectancy and the qualitative-based method of presentation used in the survey (i.e. Figs. 1–3 below, as conveyed to respondents in the information set). Section 3 establishes the aims and objectives of the debriefing study, followed by the results in Section 4. Section 5 presents an assessment of the implications for stated preference studies valuing life expectancy gains. Section 6 concludes.

2. Defining a change in life expectancy

2.1. The epidemiological-based definition

Changes in average life expectancy are generated by changes in existing hazard rates (risks of death) to individuals making up that population over their lifetime – hence the emphasis on valuing individual risk reductions in some VOLY studies to date, as noted earlier. It is possible to specify more formally this intuition in that life expectancy (LE) (Eq. (1)) is given by the area under a survival function, $S(t)$, given the probability that individual survives until at least time t:

$$\mathrm{LE} = \int_0^\infty S(t)\mathrm{d}t, \tag{1}$$

The general properties of the mortality and survival functions are well-established (see, for example, Jenkins (2005)) and will not be expanded on here. The key point is that changes in the hazards, or risks, faced by an individual over her/his lifetime changes the area under the survival function i.e. changes life expectancy. Notably, a specific gain in life expectancy can be generated as a result of an infinite number of different perturbations in the hazard function but, for illustrative purposes, Eq. (2) presents the basic definition of remaining life expectancy, LE, in discrete time, for a 40-year-old, expressed for convenience in decades, in which p_i represents the existing hazard rate for a given decade:

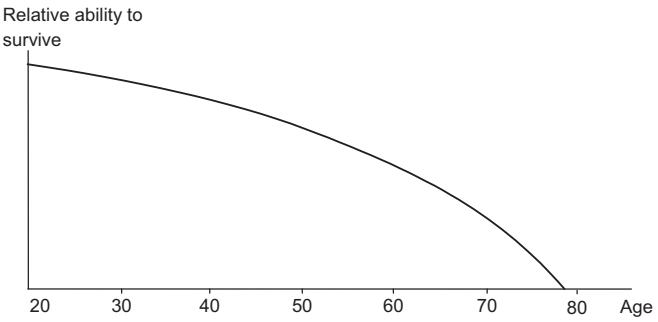

Fig. 1. 'Ability to survive' curve (average 20 year old).

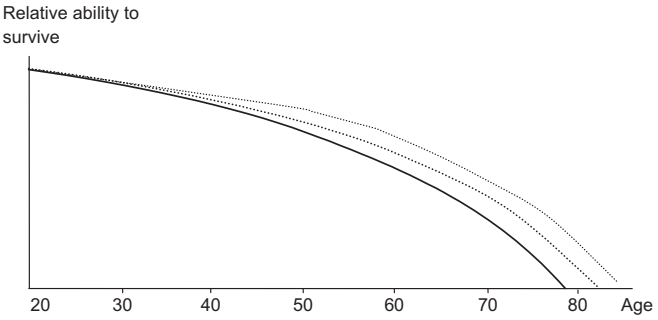

Fig. 2. 'Ability to survive' curves following different reductions in air pollution.

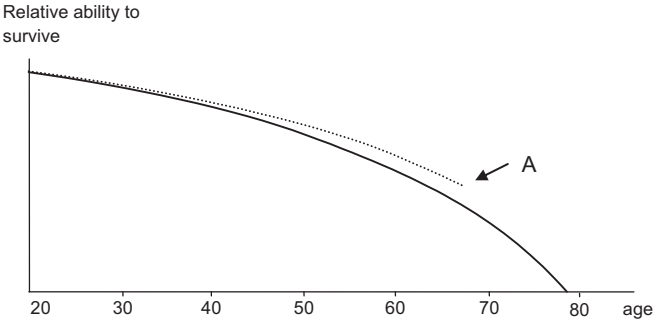

Fig. 3. 'Ability to survive' curves following a return to the original level of air pollution.

[8] Thus the usefulness of seeing both information sets side by side is therefore limited, but any interested readers should request the full CVM study protocols from the original authors.

[9] Theory suggests that, even accounting for diminishing marginal utility, WTP for risk change should be approximately proportional. Whilst these gains may seem small, particularly the 3 month gain, (in fact, they are rather larger than what many interventions delivering life expectancy gains deliver) which may have impacted on respondents' perceptions of them and how they approached its valuation, it is nevertheless the case that those in the second study seemed less affected by this aspect.

$$LE = 10(1-p_{40}) + 10(1-p_{40})(1-p_{50}) + 10(1-p_{40}) \times (1-p_{50})(1-p_{60}) + \ldots \quad (2)$$

with $p_{90} = 1$, implying that for the purposes of this exposition, all people will die not later than age 90. In turn, Eq. (3) reflects the change in life expectancy derived from a programme such as particulate air pollution reduction (LE_{PR}), in which the hazard rate reduction, k ($k \in (-1,0)$) is a constant and proportional to the initial level of the hazard rate (as evidence in Pope et al. 2002 suggests is the case):

$$LE_{PR} = 10(1-p_{40}(1+k)) + 10(1-p_{40}(1+k))(1-p_{50}(1+k)) + \ldots, k \in (-1,0) \quad (3)$$

As noted earlier, it is not surprising that CVM practitioners do not present information to survey respondents in this manner. The challenge is to communicate it in a manner that could be understood and assimilated by the average respondent. We now describe the key features of the method used, along with a brief description of associated procedures[10].

2.2. The CVM survey definition (Chilton et al., 2011)

Here, we outline only the main components of the information set, effectively the 'survey' definition of life expectancy gains. Firstly, participants were given some basic information regarding the health effects of air pollution, including our increased vulnerability as we age and there was some discussion about perceived air quality in their neighbourhood. They were then introduced to the diagrams, along with clear, verbal explanations of what they signified. These diagrams were based around a so-called 'ability to survive' curve which depicts the physical ability of the body to survive as a person ages. It simply reflects the intuition (and fact) that as people age, they become more susceptible to illnesses and accidents until at some point we can no longer expect to survive. Fig. 1 shows such a curve for an average 20 year old,[11] preceded by the accompanying text which was read out to respondents.*"The graph shows the ability of the body to survive as a person gets older. The vertical axis shows the relative ability to survive and the horizontal axis shows a person's age. So, starting from now [POINT Y AXIS], the older a person is, the less able they are to survive illnesses, including those caused by the impacts of air pollution. So if you look at the ability to survive when you are 60 you will see that it is lower than when you were 50.The curve represents the situation we have today with current levels of air pollution. So, an average baby boy born today faces a curve like this and will expect to live until they are 78. A (20 year old) faces a curve like thisWe can use this sort of graph to illustrate what would happen following if the cost of living increased and air pollution was therefore reduced".*

This was followed by an explanation of how a reduction in air pollution impacts the curve i.e. shifts it outwards and upwards, increasing the expected age of death (Fig. 2). It was emphasised that the smaller the risk reduction the smaller the shift. To the extent that this pictorial representation displays an increasing vertical gap between the original and the post − pollution reduction 'ability to survive' curves and hence indirectly the original and the post − pollution reduction survival curves − which is precisely what would result from an on-going proportionate reduction in the hazard rate.*"If air pollution is reduced, there is less damage to the body. Thus, people are more able to fight off the effects of illness so they would age a little slower and are more likely to survive longer. We have represented this by drawing lines that give people an increased chance of survival at each age and have drawn several lines to show the effects of reducing pollution by greater and greater amounts. People will age less rapidly and suffer relatively little wear and tear from air pollution compared to with current levels. So if we look at a 60 year old again we can see that their chances of survival becomes higher and higher the more air pollution is reduced [DRAW LINES ACROSS TO VERTICAL AXIS].The effect of this is to move out the survival curve and this means that life expectancy will therefore increase. So for our average baby boy if air pollution is decreased by 60% from current levels then his life expectancy of 78 would increase by about 6 months to 78 and a half. We have had to exaggerate the gap between the lines on the diagram so you can see the effect. But you can see that if we increased the cost of living by only a small amount, then air pollution would be reduced by a lower amount, and the gain would be less, say 1 month or 3 months [POINT TO LINES].[OVERLAY] The next diagram shows that, due to slightly less wear and tear, we are slightly healthier at each age than we would otherwise be and this feeds through to an increase in our life expectancy. Note that the gain is not just a few months at the end of life when people tend to be in poor health. It's a little bit extra at each age due to a slowing down of the ageing process.The benefit begins for a person as soon as pollution is reduced and continues over time. In other words the benefit of being on a higher survival curve builds up gradually up to the point where they receive the full amount. So for example when they are 60 their ability to survive has increased by some amount following the air pollution reduction and likewise at 75. This particular graph shows the situation for a 20 year old but the same principle applies to someone of any age"*

As can be seen in the above text, in order to emphasise the cumulative (on-going) and increasing nature of the gain, it was stressed that while most of the risk reduction and hence the effect on life expectancy, occurs towards the end of a person's life, *conditional* on them reaching this stage, some benefit accrues immediately the risk reduction is implemented.[12] Fig. 3 served as an 'en-route quiz' to check how respondents were assimilating the information so far, although they had been encouraged to ask questions and/or seek clarification as they went along if they wished to. They were asked what would happen to air pollution levels and hence the 'Ability to Survive' curve if the air pollution policy ceased at point A and current levels of air pollution resumed (the correct answer is that it would approach but not coincide with original life expectancy). Initially, some respondents answered this correctly while others did not. Further clarification was provided as necessary, providing a vehicle by which to ensure all respondents were aware of the correct answer.*"One more thing to note is what would happen if we chose to go back to the old, or current, cost of living and hence less stringent regulations. We would return to current levels of air pollution. We would move down off the survival curve with the higher cost of living, say from point A, to a situation where*

[10] Full protocol is available on request and may be helpful to those interested in the full information set − space considerations preclude its reproduction here.

[11] Individual 'ability to survive' curve diagrams were provided to respondents according to their own age group. Note that this is not a survival curve in the epidemiological sense (as in Section 2).

[12] It was also pointed out that the change in expected age of death was magnified for illustrative purposes and did *not* constitute the addition of a substantial number of years at the end of life.

we had a lower ability to survive. However, because we have already received some of the increase in life expectancy we don't go back exactly to the old curve. Our new life expectancy would be somewhere between the two, point B for example."

Whilst it is the case that policymakers only have evidence on average life expectancy[13] it is possible that an individual's WTP may depend on how they perceive themselves relative to the average, in particular in terms of their health, genetics and other circumstances. Depending on this, it might be the case that the (perceived or actual) shift in their personal 'ability to survive' curve would differ significantly more or less than the average shift. Therefore, participants were asked to rate their own health state (now and over time) to that of an average person. Information was provided on how any air pollution reduction might affect people of average, below average and above average health in order to highlight the uncertainties that surround an individual's gain in their own life expectancy. Thus, depending upon their health, genetic make-up and general lifestyle and lots of other things, including where they live, the effect of air pollution may have a much greater or much smaller impact on them individually. Uncertainty was emphasised to counteract the heuristic that the life expectancy gain was a 'certain' addition to life at the end. Chilton et al. (2011) report that explicit attention was not drawn to irrelevant (to policymakers, at least) benefits such as impact on quality of life or the environment as in earlier piloting it seemed to highlight these features to some respondents that may otherwise not have considered it. We therefore adopted this approach to ensure that the information set remained constant across their study and our study.

Taken as a whole, the information set presentation lasted approximately 35 min, after which WTP values were elicited. Participants then proceeded to the qualitative interview.

3. The qualitative debriefing study

When CVM respondents provide a WTP value they are being asked to express, in money terms, the value of the externality – in this case changes in life expectancy – provided by policy (here, air pollution reduction). If the resulting value is to be used in a cost-benefit analysis of only this policy deliverable – with other benefits such as reduced levels of illness or environmental benefits valued separately, or not at all, as is usually the case – then elicited values should not be augmented by consideration of other impacts such as, for example, in the case of air pollution reduction, consideration of the impact on others, environmental benefits or impacts on quality of life. In the spirit of Payne et al. (1999) these are effectively irrelevant and should not influence responses. Nevertheless, a combination of evidence and experience suggests that at least some respondents may be incorporating irrelevant information in their valuation of life expectancy gains. In order to draw any general (or context specific) lessons for CVM, it is first necessary to identify whether our respondents augment their values with irrelevant information.

Therefore, there were two distinct aims to this qualitative investigation. The first was to ensure that respondents understood the key characteristics of the 'good' as defined by us, in particular the *cumulative and uncertain nature of the gain* i.e. that the gain in life expectancy for each individual is uncertain and is a result of cumulative (i.e. on-going and increasing) changes in their chances of survival over their lifetime as opposed to an 'add-on' at the end of life, and further, that the reductions in risk of death begin almost immediately on inception of the policy, but with most accruing later in life. The second was to assess the impact, if any, of *irrelevant factors* on their perception of the good and its subsequent valuation. In order to facilitate these aims, we devised a structured debriefing interview based around a set of cards, followed by some open-ended questions, described below, focussing on respondent comprehension and understanding.[14]

3.1. Procedures

Prior to the debriefing study, participants completed a CVM study to value one and six month gains in life expectancy using the same procedures and stimuli as in Chilton et al. (2011) i.e. interactive discussion based on open ended questions, the figures described in Section 2 above and some structured questions to check for comprehension and understanding. This served as a starting point for individual-based qualitative interviews, providing the data for the analysis reported below. One of the key tests will be whether this information set communicated that it was (cumulative) risk reductions generated these gains.

Debriefing within CVM studies can take a number of forms, ranging from structured/closed ended (specific questions at the end of the survey to be answered and recorded) to more an open ended, qualitative approaches, including probing by the interviewer to check for misunderstanding, WTP reliability and so forth. Within our debriefing exercise while we include an exploration of the WTP responses, the primary purpose of which is to serve as a medium with which to (indirectly) explore respondent understanding of the good. Further questions were designed to try and access this issue more directly.[15]

Interviewers (study authors) used a semi-structured interview schedule that began with a warm up question asking for a very general response to the information set, following which respondents were asked to complete a simple 'card-sort' procedure about the factors they took into account in formulating their WTP values, the main function of which was to stimulate and structure the discussion. Respondents were asked to arrange the cards into three piles corresponding to whether they had made use of each factor in when constructing their WTP.[16] The three piles were labelled "Used this Factor", "Did not use this factor" and "Did not use but seems to matter now" and their arrangement of the cards was used as a natural prompt for open ended discussion.

There were 13 cards, each listing a separate factor. These factors were defined by us and comprised a mix of actual characteristics of the good and extra (so-called irrelevant) factors which we knew were likely (from previous CVM studies, both of air pollution reduction and more generally) to be considered important to respondents during the value construction process, but which were irrelevant to the policy deliverable.

Five cards described attributes which are central to the delivery of a life expectancy gain. These cards were: *"my increased ability to survive"* (reflecting the cumulative nature of the gain and the reduced risk of dying); *"my health and genes" (*reflecting a major

[13] And hence would use the average in any calculations of aggregate life expectancy gains.

[14] This mirrors the practice adopted in studies such as Baker and Robinson (2004). These researchers employ a range of methods from schools of qualitative thought, chosen to suit the particular research objectives.

[15] The full debriefing qualitative interview script is available on request.

[16] Although some of these cards would be considered 'valid' and others 'problematic', no signal was sent out regarding the researcher's views on the *correctness* of each card.

factor in underlying uncertainty in respect of any individual gain); *"number of months"* (length of expected gain); *"my budget"; and "paying for the rest of my life"* (reflecting the need for on-going payment if the full life expectancy gain is to be realised).

The remaining eight cards described factors such as: "*effects on other people"; "my quality of life"; and "environmental issues"* which, if chosen as important factors by respondents, could have led to them to embellish the good in some way,[17] potentially inflating its value. In addition, selecting the card *"whether air pollution policy will work"* indicated a respondent brought their own concerns to the exercise, in this case scepticism towards the scenario presented to them. The rest of the cards were not relevant to understanding life expectancy gains but were issues identified in earlier piloting as important to at least some respondents. These cards are: *"other information I have heard about air pollution"; "the level of air pollution where I live"; "my general luck in life"; "my risk of dying from air pollution"*.

Once sorted, respondents were asked to take the cards that they had indicated were relevant to their valuations and rank order them according to importance. Using the participants card-sort as a starting point, the interviewer then asked participants to explain why they were important and how they influenced their value construction. General probes were:

- *"Why was it important?"; "In what way did that matter to you?"; "What were you thinking about here?"*

Respondents were also asked say a little about any key attributes they '*did not use*' to investigate reasons why they were not important and to confirm that they understood the cards.

The card-sort was followed by open-ended questions and the interview concluded with a small number of '*debriefing questions*' relating to various aspects of the exercise, the most central to this paper being two questions designed to explore whether respondents actually 'bought' the 'good' that we 'sold' – the essence of a contingent valuation. If they did, then this is a necessary – but not of course not sufficient – condition for a reliable valuation.

- *So you said you would pay £/PLN X for say a 6 month gain in life expectancy. If you were to explain to a friend what you had 'paid for', how best would you describe it to them?*

And at the end of the interview:

- *Some people have described the gain in life expectancy as an additional 6 months at the end of their life. Would you agree with that?*
  - *Why? Why not?*

The interview schedule formed the common core of all interviews, and was designed to generate the type of qualitative data necessary to answer our specific research objectives but was treated as a flexible research tool so that new themes or issues could be accommodated and explored if they arose.

3.2. Sample

The main study sample consisted of 49 interviews administered with 24 British and 25 Polish citizens. The main study was preceded by 12 pilot interviews, 6 in each country.[18] The purpose of the pilot interviews was to refine the interview schedule based on the comprehension and comments given by the pilot respondents and to identify the nature of the data we might expect to collect. This is a qualitative sample and as such the aim is to include respondents with different characteristics (age, gender etc.), who are likely to have a range of different views and experiences, rather than to generate a representative sample of the population. Respondents were recruited by a market researcher in Newcastle upon Tyne in the UK and Warsaw in Poland. There is some evidence in the literature to suggest that demographic characteristics such as gender and age may impact how respondents react to such information and assimilate it to provide a valuation (e.g. Avitia et al., 2011; Nielsena et al., 2003) while other studies suggest such characteristics do not matter (e.g. Krupnick et al., 2000; Sundström and Andersson, 2009); Blomquist et al. (2011) find evidence in support of both positions, in respect of age. *A priori*, we had no evidence from previous studies regarding information assimilation when valuing life expectancy gains so, while our sample is not in anyway representative and therefore cannot be subjected to any quantitative testing in this respect, we tried to ensures a reasonable variation in such factors should they matter. A range of income levels were included and just under half of each sample were under 40. Over half of the sample were women in each country (55% in Poland and 63% in the UK).

3.3. Data analysis

The interviews were audio recorded and transcribed verbatim. For the purpose of data analysis transcripts were imported into NVivo qualitative software (QSR, 2007) and a series of participant attributes were associated with each transcript (age, gender, WTP values, and country). Analysis followed standard qualitative procedures (see, for example: Mason, 1996; Silverman, 2001). The first stage was familiarisation with the transcripts and involved reading and re-reading and listening to audio recordings. Next, qualitative data were categorized using initially broad coding categories before refining and re-defining categories and introducing sub-codes. Early coding was carried out by all team members and was based on an initial subsample of transcripts which was used to derive a common coding frame. Each transcript was then coded by one of the authors and a small subsample (6) was coded by two authors to ensure consistency. An iterative process followed, including discussion of emergent themes at regular meetings of the authors to ensure that the coding scheme was both relevant to the research questions and grounded in the data. Coded text was examined and interpreted through similar discussions between authors. These steps were iterative, repeated and overlapping rather than discrete, consecutive tasks. Constant comparison techniques, derived from grounded theory (Glaser and Strauss, 1967) were employed to critically consider thematic categories.

4. Results

Results, reported here, are based on the qualitative data from the interviews described above. On average each individual interview took around 20 min. For expositional purposes, we report the results of the card-sort separately, although data from both parts of the interview both were used simultaneously in our overall assessment of how respondents reacted to our information set.

[17] Embellishment of the good is not a new phenomenon and is not confined to life expectancy gains and is almost certainly present in many valuation studies. Chilton and Hutchinson (1999) discuss the concept in detail and highlight the role that focus groups can play in determining both its presence and influence.

[18] The final pilot group in the UK included only two respondents and as no changes were made to the qualitative interview script used in the subsequent main study and hence they were retained in the main study.

Table 1
Percentage of respondents indicating each attribute as an important influence on their WTP.

Cards	British	Polish
1[a] – My budget	96	80
2[a] – My increased ability to survive	52	58
3[a] – My health and genes	74	68
4[a] – Number of months	79	58
5[a] – Paying for the rest of my life	66	51
6 – My risk of dying from air pollution	48	20
7 – My general luck in life	9	13
8 – The environment	37	31
9 – Whether air pollution policy will work	39	37
10 – My quality of life	70	66
11 – The level of air pollution where I live	30	60
12 – Other information I have about air pollution	18	28
13 – Effects on other people	26	47

[a] As noted in Section 3.1, aspects central to the delivery of a life expectancy gain.

Table 1 contains an 'overview' of how each factor (card) was treated by respondents in the sense of whether it influenced their valuation, although analysis of the transcripts provides richer insights as will be shown below. In general terms, selecting the first five cards containing relevant characteristics might be viewed more favourable, while selecting the irrelevant factors might be viewed as less favourable. Indeed, at this most basic level, key factors[19] featured more prominently in people's minds than exogenous or contextual effects, with one exception – 'quality of life' (card 10) providing us with the first indication that the most important irrelevant factor affecting respondents' valuation was 'quality of life'. This initial impression was further verified in the analysis of the data as a whole.

In the section that follows we describe the central themes emerging from the data in both the UK and Poland. Quotes illustrating our findings are identified by a respondent's age, gender, stated WTP amounts and country.

4.1. Cumulative and uncertain nature of the gain in life expectancy

There is evidence in the coded interview transcripts that the cumulative nature of the gain in life expectancy had been partially understood. Respondents' comments revealed an appreciation of the continuous nature of the gain as opposed to describing it as an add-on of life at the end. Of course, it was rarely described in exactly those terms in respondents' accounts. This is unsurprising since, although the notion was described to respondents using visual aids and examples as described above, we avoided technical terms. Examples of quotes which we judge as indicative of such understanding are presented in Table 2.

However, while these respondents certainly seemed to notice the gain was not at the end of life, there is little explicit evidence that they had taken on board the fact that the distribution of this gain is not constant but is in fact increasing, although there is some evidence elsewhere in the transcripts that a small minority of respondents – notably in Poland – grasped this fact (see Table 3).

The uncertainty of the gain is another key element that respondents must grasp if the protocol is to be judged as successful in generating understanding. Uncertainty was in fact mentioned by respondents with respect to two different issues (Table 4): the uncertainty of life expectancy and uncertainty concerning the length of a described gain, both of which are appropriate. A reasonable number of respondents compared themselves to the average person in their age group and noted that in their case the length of the life expectancy gain could differ. Some respondents underlined the fact that life expectancy in itself is uncertain, particularly in Poland, where external risks such as car accidents, crime or fate were often alluded to.

4.2. Quality of life

Less than half of respondents stated that concerns such as "the environment" (card 8) and "effects on other people"[20] (card 13) affected their valuation (see Table 3). However, as noted, our main concern here is the impact on their understanding of the good and, in this respect only one of these factors clearly stands out – quality of life. In both samples, a number of respondents did not disentangle this from the gain in life expectancy and clearly indicated that they considered it to be an integral component of the good, described in terms of how a reduction in air pollution might affect health or quality and/or likelihood of outdoor exercise. In some respondents' minds, the gain in life expectancy would arise *because* quality of life/health would be improved throughout their life by air pollution reduction. For other respondents – particularly in Poland – quality of life seemed to be an additional and sometimes more important benefit than the gain in life expectancy. Table 5 contains quotes reflecting these features.

5. Discussion

In this paper we have demonstrated that a focused, qualitative debriefing study can be a valuable aid in assessing respondent understanding of a complex good or, more correctly, the capability of the survey information set to "sell" something that can reasonably be understood by respondents, even allowing for the fact that at least some attributes will remain ill-defined despite careful attention paid to this issue in the survey design stage. This is, of course, a necessary, but not sufficient, condition for a successful valuation but it is an important one. As observed earlier, respondent must also be able to assess how it affects their welfare in order to monetarise the change.

Whilst this paper was primarily methodological in its aims, it is also the case that some substantive insights with respect to the valuation of life expectancy gains from an environmental intervention – here, air pollution reduction – were uncovered. In the final subsection we draw first on these and then on some broader observations to highlight lessons that can be learned in respect of the stated preference valuation studies.

5.1. Insights into stated preference study design

5.1.1. Valuation of life expectancy gains

Perhaps the most significant finding from the debriefing study was that, reassuringly, most respondents appeared to understand the continuous nature of the life expectancy gain over time and that the gain was in some way uncertain. This constitutes an important step forward and means that such respondents are not constructing their WTP responses for the certainty of extra months/years at the end of life i.e. an "add-on". However, only some of these same respondents verbalized an explicit understanding of its cumulative nature i.e. that this gain increased over life as opposed to a constant

[19] Two cards ('my budget' [card 1] and 'paying for the rest of my life [card 5]) – are aspects of the valuation exercise rather than attributes of the life expectancy gain itself (the focus of the information set being tested) – and so will not be considered further in this paper.

[20] While almost 50% of the Polish sample considered this card important, when probed during interview, the majority said that excluding this factor from a valuation process would not change their stated WTP.

Table 2
Quotes illustrating understanding of the continuous lifetime effect.

Perception	Quotes
Continuous gain over lifetime as opposed to an 'add-on' of life at the end	*"I know it would be stretched out over the time. "*1 month = £25; 6 months = £100; female; 48 (UK)
	*"It's a gradual decline in my health that would catch up with me at the point of 72. Therefore, those gradual benefits I've gained throughout the years of my life, it has compounded and added onto the end."*1 month = £0; 6 months = £50; male; 33 (UK)
	*"I was simply thinking that it increases my ability to survive in general, that each day somehow I have a chance for a better life, and let's say each month we could collect from that up until 6 months (gain)."*1 month = 300 PLN; 6 months = 600 PLN; female; 29 (PL)
	*"It means when I was thinking about that, I was thinking that at the very end of my life I would have these 6 additional months. But I think, that if I talk about that with someone, I suspect, that I would try to show that he/she would get those days every year, somehow longer. Summing up, we do not know if we will live till 60, 80 or 30. But it's beneficial for a 40 year old as well – he/she would get something from it."*1 month = 60 PLN; 6 months = 300; female; 21 (PL)

Table 3
Quotes illustrating the increasing nature of the life expectancy gain.

Perception	Quotes
The gain distribution is increasing	*"I think it is a matter of the survival curve explanation. It shows that it is 6 months at the end of life. But it is possible to explain that as 4 months more at the age of 45. Because it's not like that you need to survive 70 years to get 6 months more. It's possible to live only until 40 and then get proportionally less; I do not know about 4 or 5 months. "*1 month = 100 PLN; 6 months = 200; male; 29 (PL)
	*"I think it is a life extension. Through the whole life period. 'Cause in this year I could get 1 day, in one year 2 days in the other and so on."*1 month = 300 PLN; 6 months = 1500; female; 50 (PL)

Table 4
Example quotes: the uncertainty of receiving a gain in life expectancy.

Perception	Quotes
Uncertainty of the length of LE gain	*"Again, I thought 6 months was worth having, but there again, I said that that perhaps for somebody who was below average [health] they, although they may gain the average, it may be less than that, so I was thinking there was enough uncertainty for me with one month that I was thinking, well, it could be a couple of weeks and you know the actual variability between people is wide."*1 month = £25, 6 months = £100; male; 45 (UK)
	*"It could be longer life but not necessarily about half a year. It could be one year, but it could also be three months."*1 month = 12.5 PLN; 6 months = 25PLN; female; 26 (PL)
Uncertainty of LE in general	*"Well, it's what I thought of that as my health and genes and I kind of think, no, I'll probably have a heart attack or stroke because that's what's in the family. It's in the family because my mum does the family tree and she gets death certificates all the time and there all heart attacks and strokes, heart attacks. So, with this kind of thing, would it be worth paying a lot of money for a month or year when I'll probably have a heart attack anyway."*1 month = £25, 6 months = £100; female; 48 (UK)
	*"If I am not going to die in a car accident when I am 40, that… in theory…, so I will die, it is a fact… but life quality from when I am 20 till 40 would be better, I would have less illness, at each stage of my life."*1 month = PLN; 6 months = (PLN)

gain each year, implying more information/explanation is required on this aspect.[21] We have not observed systematic differences in understanding of the life expectancy gain across samples from Poland and the UK in this survey. So the use of the information set is not, in this case, country/culture-specific. In a broader sense, such a finding has positive implications for the practice of benefits transfer (Navrud and Ready, 2007) in the context of air pollution reduction, whereby survey values from one site or sample is 'transferred' econometrically to another, either within or across countries.

A second, more concerning, finding was that many respondents apparently conflated quantity of life expectancy gains with quality of life improvements, seeming to 'add in' the value they attached to this factor when stating their WTP. There are at least three potential reasons for this. First, the concept of quality of life is a more familiar and concrete entity compared with shifts in an abstract 'ability to survive' curve and the default heuristic may reasonably be to continue to focus on something they understand. Second, the environmental nature of the intervention naturally lent itself to the

[21] Assuming WTP reflects the discounted benefits to respondents, then a better understanding of this aspect would further enhance the reliability of the valuation.

Table 5
Quotes illustrating perceived improvement in quality of life.

Perception	Quotes
Quality of Life as part of the good respondents bought	*"I would say to help everyone, not just me personally. This £100 I'd help everyone to an extra six months, or six months of better quality of life. I think the quality of life is such an important thing, you know."*1 month = £20, 6 months = £100; female; 70 (UK)
	*"I have an allergy. It can turn into asthma. I considered that. It is a life comfort, my life quality, isn't it? It would be better."*1 month = 300 PLN; 6 months = 600 PLN; female; 29 (PL)
	*"For sure we can gain something through life, 'cause when pollution decreases, we would feel better and daily life would improve. We would be healthier, so we would benefit the whole time."*1 month = 0 PLN; 6 months 30 PLN; female; 25 (PL)
Quality of Life as a mechanism to gain in LE	*"I decided to take that from the egoistic point of view and I take my health into account above all. If there was such a possibility that pollution would not reach us, then things would be different, our organs would last longer."*1 month = 0 PLN; 6 months = 150 PLN; male; 30 (PL)
	*"If you have got a higher chance of survival then you might get more of the benefits on top for longer. So, if you do get to that stage you'll obviously be able to fight it better or just be in a better, in a healthier state."*1 month = £25; 6 months = £100; female; 48 (UK)

(not incorrect) assumption that there must be environmental benefits as well.[22] Finally, the general description in the CV studies in Desaigues et al. (2011) and Chilton et al. (2011) – and, by necessity, our qualitative study – of the chronic effects of air pollution on the body contained the phrase "*we are slightly healthier at each age*". Considering the implications of our qualitative findings for future econometric analysis of quantitative data in CVM studies are to highlight the need for scalar variables to capture or control for the influence of quality of life. It seems clear that careful descriptions of the context in which life expectancy gains are achieved help people to understand the good, but the price the analyst pays is the potential for additional, irrelevant factors to be brought to bear in respondents' valuations. Our conclusion is that this trade-off must be made, and that at least at this stage it is better to try to measure its impact than to try and reduce its impact *a priori*. Particularly in the case of complex goods where respondents may well be asked to process a great deal of information (as here) to help them conceptualise the good, the detrimental impact of cognitive overload and fatigue on the actual valuation may well outweigh any (possibly small) advantages from removing such contextual effects. This is for future research.

Additionally, respondents' quotes obtained from this qualitative study could be used in future studies to improve the information set by using language more familiar to the public, whilst still retaining its scientific validity. For example, instead of technical descriptions some colloquial phrases in Table 4 have the potential to be adapted to communicate continuous character of the gain, such as for example: "*life extension through the whole life period*", "*prolonging youth*", "*benefits through the years of my life*", or "*it would be stretched out over the time*". Some of the other quotes such as: "*Because it's not like that you need to survive 70 years to get 6 months more. It's possible to live only until 40 and then get proportionally less*" or "*I could get 1 day, in one year 2 days in the other and so on*" could be a base to develop ways of better communicating the cumulative character of the life expectancy gain.

A potential weakness of the qualitative approach used here is the potential for the analysis, whilst moving back and forth between the data and the thematic analysis, to 'over-fit' the data to the emerging coding framework or model. The application of constant comparative techniques associated with grounded theory (Glaser and Strauss, 1967), whereby the analyst systematically searches for deviant cases which do not fit the coding structure or emerging themes, is one approach to the avoidance of such a problem. An alternative approach could be to split the data – using half to develop a conceptual model and the remaining data to validate or refine the model. This is a possibility for future research using larger, respondent samples, representative of the population.

5.1.2. Alternative methods

Morgan et al. (2002) apply the notion of 'mental models' to the issue of risk communication to similar effect as our approach. They use qualitative methods to elicit lay beliefs and construct mental models about complex risks, such as climate change. These are then compared with expert models to highlight gaps or areas of current knowledge that can be built on. The design of risk communication is then based on what is known about both the scientific, technical models as well as what is known about lay understandings or gaps in public knowledge. Thus, it may be fruitful to set up future debriefing studies that more formally linked them to the concept of mental models, in order to further exploit their potential.

Alternatively, it may be better for future researchers to 'accept' confounds, such as we found between quantity and quality of life and to utilise methods which accommodate this, for example conjoint analysis (discrete choice experiments). Whilst we have used CVM studies as the starting point for our investigation, nothing in our methodology or findings would preclude the use of choice experiments. This technique is of particular use where multiple elements are to be valued and attributes of the good are traded-off, and would accommodate situations where an intervention has impacts on both quantity and quality of life expectancy. The inclusion of quality of life as an attribute gives it legitimacy as part of the good to be valued. Of course, our findings would have the same implications for choice experiments concerned with valuing life expectancy gains only. Therefore, the objectives of the valuation exercise, the specific nature of the good valued and how values will be used in analysis and policy will be crucial to any study design.[23]

[22] Note that it is policymakers and researchers that insist on this "separate" valuation approach (albeit for well-founded reasons) which contrasts with the joint nature of the bundle that is actually delivered.

[23] In reality, the main quality of life improvements from air pollution interventions arise from the reduction in acute events, such as respiratory illnesses lasting a few days or hospital admissions for the elderly. One approach might be to value these in addition to life expectancy gains, as in Chilton et al. (2004).

There is some data to suggest that people have preferences over different risk distributions which generate the same life expectancy gain (Nielsen et al., 2010). Thus, there may be a case for the inclusion of quantitative information on the underlying risk changes which generate the shift in the 'ability to survive' curve to help respondents understand better the increasing nature of the gain. However, the challenge inherent in this is significant. A mixed methods approach may be most desirable in the future, one where respondents have access to both types of information to help them more fully understand the various, and complex, components of a life expectancy gain with a view to generating a VOLY that captures more, and not less, of these aspects. Another mixed-methods approach that may also be viable would be a two-stage procedure, such as that employed in Chilton et al. (2006), whereby a context-less value for a risk reduction is elicited, followed by a contextual one, the assumption being that any difference between the two would reflect the impact of the particular context in which the life expectancy gain was generated.

6. Conclusions

To conclude, the ultimate goal of improving respondent understanding in our work is to obtain valid and consistent WTP measurement. Our sample was too small to conduct such an investigation directly, however, it may be recalled that a CVM study utilising this enhanced instrument generated data with a higher degree of consistency than an earlier comparator CVM study. The aim of this study was primarily to assess whether, after exposure to an enhanced information set, respondents were in a better position to value the good reliably than they otherwise would have been and, effectively, "bought" what was "sold". The increased prominence given to the debriefing element of the CVM exercise has enabled us to assess this.

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