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Title: How robust are value judgements of health inequality aversion? Testing for framing and cognitive effects

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Key words
Health Equity; Patient Preference; Value of Life; Social Values; Cost-effectiveness Analysis

How robust are value judgements of health inequality aversion? Testing for framing and cognitive effects

Abstract

Background: Empirical studies have found that members of the public are inequality averse and value health gains for disadvantaged groups with poor health many times more highly than gains for better off groups. However, these studies typically use abstract scenarios that involve unrealistically large reductions in health inequality, and face-to-face survey administration. It is not known how robust these findings are to more realistic scenarios or anonymous online survey administration.

Methods: This study aimed to test the robustness of questionnaire estimates of inequality aversion by comparing the following: (1) small versus unrealistically large health inequality reductions; (2) population-level versus individual-level descriptions of health inequality reductions; (3) concrete versus abstract intervention scenarios; and (4) online versus face to face mode of administration. Fifty-two members of the public participated in face-to-face discussion groups, while 83 members of the public completed an online survey. Participants were given a questionnaire instrument with different scenario descriptions for eliciting aversion to social inequality in health.

Results: The median respondent was inequality averse under all scenarios. Scenarios involving small rather than unrealistically large health gains made little difference in terms of inequality aversion, as did population-level rather than individual-level scenarios. However, the proportion expressing extreme inequality aversion fell 19 percentage points when considering a specific health intervention scenario rather than an abstract scenario, and was 11-21 percentage points lower among online public respondents compared to the discussion group.

Conclusions: Our study suggests that both concrete scenarios and online administration reduce the proportion expressing extreme inequality aversion but still yield median responses implying substantial health inequality aversion.

Keywords
Health Equity; Patient Preference; Value of Life; Social Values; Cost-effectiveness Analysis

Introduction

1.1 Background

Health economists have developed questionnaires to measure how much people care about health inequality that may be considered unfair ("equity") relative to overall health ("efficiency") and methods to analyse the data building on the social welfare function (SWF); see for example (Abasolo and Tsuchiya, 2004, Abásolo and Tsuchiya, 2013, Dolan and Tsuchiya, 2011). The resulting estimates of health inequality aversion can be used in SWF-based frameworks such as distributional cost-effectiveness analyses (DCEA) to help decision makers evaluate trade-offs between improving total health and reducing health inequality that may be considered unfair (Asaria et al., 2015). These questionnaires find that members of the public are highly averse to health inequality, implying that health gains to disadvantaged groups are worth many times more than gains to better off groups. One study of members of the public in England, for example, estimated that the median respondent valued gains in life expectancy to the lowest social class 6.8 times more than gains to the highest social class (Dolan and Tsuchiya, 2011). In fact, a large proportion of respondents in previous studies – sometimes more than half – expressed extreme aversion to health inequality to the extent that they violate monotonicity (Abasolo and Tsuchiya, 2004, Abásolo and Tsuchiya, 2013).

However, such findings are likely to be influenced by framing effects and other cognitive biases which are well known to psychologists (Kahneman, 2011) (McFadden, 2001) (Blumenthal-Barby and Krieger, 2014). For instance, a number of studies have evaluated how preferences are influenced by the presentation of outcomes, such as relative versus absolute levels/risk (Kragt and Bennett, 2012) (Malenka et al., 1993), gains (such as cases detected) versus losses (such as cases missed) (Kühberger, 1998) and probability of life versus probability of death (Kim et al., 2005). Moreover, recent research has found that both numerosity (i.e. units used in the choice experiments, such as days or years), and unitosity (i.e. respondents' association of small units with small changes, and large units with large changes) can influence responses (Monga and Bagchi, 2012). However, such cognitive effects have not been thoroughly tested in the context of elicitation of health inequality aversion.

Results that are skewed by cognitive biases induced by the study design may not be sufficiently reliable to inform public policy making, as they may not generalise from the

study setting to real world policy settings. If the findings of academic work on health inequality aversion are to influence public policy decisions, then the direction and magnitude of potential cognitive biases need to be more thoroughly examined. Of the many possible cognitive biases we could have examined, we have targeted those that appear to be the most policy-relevant in terms of assessing the generalizability of findings from study settings to real world policy settings.

1.2 Aim

This study aimed to assess how far a standard questionnaire instrument for eliciting aversion to social inequality in health is vulnerable to large cognitive effects that make a substantial difference to the estimated degree of health inequality aversion. The four potential effects we examined were between: (1) realistic small health inequality reductions compared to unrealistically large health inequality reductions; (2) population-level compared to individual-level descriptions of health inequality reductions; (3) concrete compared to abstract intervention scenarios; and (4) online compared to face to face mode of administration. Only the second of these is a "framing effect" in the classic sense of using different ways of describing exactly the same decision problem. However, all four can be thought of as "cognitive" effects, in the broad sense that they relate to issues of cognitive psychology and information-processing, as explained below.

1.3 The four hypothesised cognitive effects

(1) Small versus unrealistically large health inequality reductions: Empirical studies typically use hypothetical scenarios that involve unrealistically large changes in health, such as hypothetical government programmes that will extend average life expectancy by several years and reduce inequality by a few years (Abasolo and Tsuchiya, 2004, Abásolo and Tsuchiya, 2013, Dolan and Tsuchiya, 2011). However, general population average health gains of this size are unrealistic in the short run, and unlikely to be achievable even with a massive and sustained "once in generation" programme of cross-government social, political and economic reform. In practice, the public policy alternatives actually considered by social decision makers deliver much smaller average health benefits to the population. For example, a case study of different ways of promoting uptake of the NHS Bowel Cancer Screening Programme among disadvantaged groups estimated incremental gains in general population average life expectancy of only a few hours (Asaria et al., 2015). This is because most people do not have bowel cancer and will gain nothing from the screening programme,

but a few people will gain many years of life. It is not known how far findings from studies of unrealistically large gains are applicable to more realistic settings involving small health gains. We hypothesise that using small health gains may substantially reduce the degree of inequality aversion. For instance, Olsen (2000) (Olsen, 2000) argues that a "minimum threshold quantity" of health gains may exist beyond which individuals' equity preferences take effect. Below this threshold, individuals may concentrate on the gains for some few. This was empirically demonstrated by Rodriguez-Miguez and Pinto-Prades (2002) (Rodríguez-Míguez and Pinto-Prades, 2002) who found that individuals prefer to concentrate on total health gains for smaller individual gains and express inequality aversion for larger individual gains. This may be because health inequality is a less familiar concept than total health, perceived at a less fine-grained level of detail. So respondents may see small reductions in health inequality as worthless while still seeing small total health gains as worthwhile.

(2) Population-level versus individual-level descriptions of health inequality reductions: Studies typically present health benefits in terms of the average change to individuals (e.g. 2 years per person). However, health benefits to a population can also be expressed in terms of total gains to the group (e.g. 2,000,000 person-years across a million people). We hypothesise that when average benefits are small – for example, a few hours per person – then framing the same health benefits in terms of population totals may lead to larger inequality aversion than using average health benefits per person. A number of factors may influence preferences in this context. For instance, gains expressed in larger units (i.e. years) compared to smaller units (i.e. hours) (Monga and Bagchi, 2012) may incline respondents to prefer population-level scenarios. Respondents may not consider a small health gain in hours as worthwhile compared to a gain in years. Also, the perspective of health benefits (i.e. individual- or population-level) may result in different value judgments – this was demonstrated by Gyrd-Hansen and Kristiansen (2008) (Gyrd-Hansen and Kristiansen, 2008) who found that spread of health gains were more pronounced with the societal (or population-level) perspective. Based on this, we hypothesise that using population totals may make the reductions in health inequality seem larger and more worthwhile.

(3) Concrete versus abstract intervention scenarios: Abstract scenarios are typically used, first, so that respondents do not bring their own unobserved cognitive "baggage" to the interpretation of the scenarios, and second, so that findings can be applied to multiple policy contexts. Arguably, however, respondents will always fill in the missing gaps in the scenario,

and abstract scenarios may be more susceptible to this problem than more tightly described concrete scenarios. Furthermore, it is not known how far people's "abstract" views about health justice are transferable to their "context-specific" views. When more concrete scenarios are given, and people are encouraged to think more realistically rather than abstractly, this may have an effect (in either direction) on the level of inequality aversion they support.

(4) Online versus face to face mode of administration:

Typical surveys of inequality aversion have been conducted face to face which is time consuming and costly. Increasingly, there is an interest in using online surveys to elicit social values of health (Shah et al., 2013); (Schwappach, 2003); (Rowen et al., 2016); (Linley and Hughes, 2013); (Norman et al., 2013); (Skedgel et al., 2015), partly because of the high speed, convenience and low cost of conducting the surveys though also because face to face administration may suffer from "socially desirability" bias (DeMaio, 1984).

There is a growing literature investigating differences between face-to-face and online survey responses, both in surveys of population opinion and those involving trade-off exercises. For instance, in a randomised study involving person trade-off value judgments of health states, Damschroder *et al* (2005) (Damschroder et al., 2005) found that trade-off values did not differ between computer-based and face-to-face elicitations. Similar findings were observed by Mulhern *et al* (2013) (Mulhern et al., 2013) comparing computer-assisted personal interview (CAPI) versus face-to-face interviews. However, Norman *et al* (2010) (Norman et al., 2010) found that value judgments of EQ-5D health states differed by modes of administration with the computer-based group choosing more extreme responses and having larger standard deviations compared to the face-to-face group. Some of these differences in valuation of health states may be explained by difference in sample characteristics, level of effort or commitment to provide considered response, the level of support available to comprehend the task, as well as by social desirability bias (Bowling, 2005). Despite this growing literature, there is a dearth of studies investigating the influence of mode of administration on value judgments of health inequality aversion.

We cannot determine *a priori* which mode of administration gives more appropriate results for use in policy making. On the one hand, an online private environment is closer to the ballot box where citizens cast their secret vote without having to justify their choice. On the other hand, online surveys may be less likely to reflect considered opinions, since questions

on social values require careful deliberation and are not topics that people are familiar with. Therefore, understanding the direction and magnitude of potential differences in findings between the two modes of administration is of interest. We hypothesise that using online surveys may lead to smaller inequality aversion relative to face to face administration.

1. Methods

2.1 Questionnaire

The basic questionnaire instrument used in this study (see Appendix 2) is adapted from (Abasolo and Tsuchiya, 2004, Dolan and Tsuchiya, 2011). It starts off by presenting background information about the current level of inequality in health between "the richest fifth" of people in England, who on average live 74 years in full health (i.e. quality-adjusted life expectancy, QALE), and "the poorest fifth", who on average live 62 years in full health (Love-Koh et al., 2015). Both groups are made up of around 10 million individuals.

The respondent is then presented with the choice experiment which consists of four *questions* (Q1-Q4), each with a different scenario or presentation (see below). Under each question (Q1-Q4), there are five *pairs* of hypothetical health programmes, A and B. Hence, by the end of the choice experiment, each respondent completes 20 paired choices, i.e. four questions (Q1-Q4) multiplied by five pairs of health programmes in each question.

At each pair, respondents are asked to choose between programme A and B, or indicate indifference. These programmes show the health gains received by the richest and the poorest fifth of the population and the total health gain for the two groups. It is assumed that the remaining three fifths of the population are not affected by any of the hypothetical health programmes. In the first pair in each question, programmes A and B produce the same amount of total health benefit across the groups but benefit the two groups differently: programme B offers a reduction in health inequality compared with programme A. In subsequent pairs, programme A remains the same, but the health gain to the worse off group in programme B becomes smaller and smaller – and so both the reduction in health inequality and the gain in total health in programme B become smaller and smaller. Hence, programme B always reduces inequality but offers less total health, except for in the first pair where both programmes produce the same total health. The degree of inequality aversion is captured by observing the point at which a respondent is indifferent between the two programmes. The

format of paired choices remains the same across the four questions (Q1-Q4); however, the scenario or presentation of the question changes (see below).

Participants had to respond to all choice pairs to complete each task, irrespective of whether they were pro-rich or strict egalitarians, i.e. there was no quicker route to completing the questionnaire by taking one or the other position, and there was no exit option available.

The first question (Q1) is the "large-average" presentation, which corresponds to the format used in previous studies. In this question, the first pair presents programme A giving a 7-year gain in life in full health to the richest fifth and a 3-year gain to the poorest fifth; and programme B giving a 3-year gain to the richest fifth, and a 7-year gain to the poorest fifth. In the subsequent four pairs, the health gains in programme A and the health gain to the richest in programme B are fixed, while the health gain to the poorest in programme B decreases gradually from 6 years to 3 years. Appendix 2 reproduces all questions in full.

All subsequent questions use the same background inequality across the richest fifth and the poorest fifth, and the same ratios of health gains (but scaled down proportionately). In the second question, the health gains are small and measured in hours per head. In the first pair, programme A gives a 7-hour gain in life in full health to the richest fifth and a 3-hour gain to the poorest fifth, while programme B gives a 3-hour gain to the richest fifth and a 7-hour gain to the poorest fifth. The gain for the poorest group under programme B at the fifth pair is 3 hours. Thus this represents the "small-average" presentation.

The third question represents the "small-population" presentation. In the first pair, programme A gives a 7,000-person-year gain in life in full health to the richest fifth as a group (consisting of 10 million people) and a 3,000-person-year gain to the poorest fifth as a group, while programme B gives a 3,000-person-year gain to the richest fifth and a 7,000-person-year gain to the poorest fifth. The gain for the poorest group under programme B at the fifth pair is 3,000 person-years. Note that, since each quintile is assumed to consist of 10 million individuals, 7,000 person-years amounts to 0.0007 years per head, which is equivalent to 6.132 hours per head. We use 7 hours in the second question instead of 6.132 hours in order to maintain the 7:3 ratio of benefits across the richest and the poorest.

The fourth question (used only in face to face mode of administration) introduces a more "concrete presentation" to the health inequality and the health programme, using a topic taken from (Asaria et al., 2014). A presentation is given on the different take up rates of bowel cancer screening by income groups, followed by a description of two health programmes on reminders to participate in screening: one that sends impersonal reminders to all eligible individuals (benefitting the richest fifth more), and another that sends personalised and GP-endorsed reminder letters to individuals in deprived areas who have a lower take-up rate (benefitting the poorest fifth more). Besides the concrete context, this question is exactly the same as the third question.

Before completing these four questions, respondents completed a set of questions on attitudes to the welfare state and income redistribution (Park et al., 2013).

2.2 Data collection

There were two samples. One was a "discussion" sample, where members of the public were invited to participate in a "citizens' panel" event involving: presentations by facilitators to introduce the questionnaire; facilitated discussions in groups of five or six; individual completion of the questionnaire; sharing the responses within the group; and opportunities to change the questionnaire responses. Two "citizens' panel" events were held with two different subsamples of participants: a 5-hour event including lunch, on Saturday 21st September 2013 (n = 29), in the City of York; and a 3-hour event with the same format and question order, but excluding lunch and post-lunch tasks not reported in this paper, on Saturday 22nd February 2014 (n = 23), at the University of York. Payments of £70 and £30 were offered per participant in the first and second events, respectively.

The participants for the citizens' panel were recruited through: (a) advertisements in a monthly free local magazine (*Your Local Link*) distributed to all homes across York (July and August, 2013); and (b) 810 leaflets distributed door to door in 10 of the most deprived streets in York. A quota was set so that each of 8 age/sex groups had a capacity for three to four participants, including one from a postcode with higher deprivation. Occupation information was also collected at the screening stage. Those with university academic/research jobs were excluded because they may have had previous training or exposure to handling similar tasks involving trade-offs between competing social values, and therefore may not have the same cognitive biases as the general public.

The second sample was an "online" sample which included 83 respondents. The first three questions above (large-average; small-average; small-population) were posted online (hosted by Smart-Survey). The survey was publicised on social media, the *York Local Link* magazine above and the website of the Centre for Health Economics at the University of York. Respondents could complete the survey anonymously, or leave their contact details. No remuneration was offered for taking part. To make the discussion and online groups comparable, we again excluded those with university academic/research jobs from the online sample using information on respondent occupation.

Research ethics approval for the study was obtained from the University of York Health Sciences Research Governance Committee.

2.3 Analysis

Prior to pooling across the two discussion group samples, we compared their results against each other and found no differences in the basic pattern of findings in terms of the level of inequality aversion.

Each of the main questions allowed us to distinguish five different types of value judgement, which correspond to five different principles of health justice (see Table 1). At each pair, respondents have three choices: programme A (A), programme B (B), or indifference (=). The "pro-rich" (AAAAA) always choose programme A while the "health maximisers" (=AAAA) are indifferent in the first pair but choose A subsequently. Collectively, we label these first two types as "non-egalitarian".

Table 1: Types of value judgement about health justice [about here]

Our third type of preference is the "trader" or "weighted prioritarian" (BXXXA), who chooses B in the first pair, then switches to A at some point (indicated by the XXX in the middle – see below). The term "weighted prioritarian" means people who give priority to the worse off but not exclusively. Hence, they will not violate monotonicity (any increase in individual health will result in an increase in social welfare, other things being equal). Strictly speaking, a respondent who switches to programme A only in the final pair (BBBBA) might be "leximin" rather than "weighted prioritarian", i.e. they give almost exclusive priority to the

health of the worse off group, but are willing to use a second principle such as health maximisation as a "tie-breaker".

The next category of respondents is maximin (BBBB=), who give fully exclusive priority to the health of the worst off by choosing programme B in the first four pairs but becoming indifferent in the final pair. This preference can be represented by the limit of a standard social welfare function as the inequality aversion parameter tends to infinity. Finally, we label respondents who prefer programme B in the final pair as "strict egalitarians" (BBBBB). This preference violates monotonicity and so cannot be represented using standard monotonicity-respecting social welfare functions. Collectively, we label these last two types as "strong egalitarians".

Within the "weighted prioritarian" type (BXXXA), we can distinguish seven distinct response categories by breaking up the XXX in the middle. The first of these (BAAAA) represents a trade-off point of 6.5 (since the respondent switches at some point between 7 and 6 units of health benefit). The second sub-category (B=AAAA) represents a trade-off point of 6 (since the respondent is indifferent at 6 units of health benefit), and so on down in half units to the seventh sub-category (BBBBA) which represents a trade-off point of 3.5. Similarly, the "pro-rich" and "health maximisation" categories represent trade-off points of >7 and 7, respectively, and the "maximin" and "strict egalitarian" categories represent trade-off points of 3 and <3, respectively. We thus obtain 11 separate response categories which can be ranked in order from the least egalitarian (>7) to the most egalitarian (<3).

The five value judgments discussed above can be represented as iso-welfare curves using the Atkinson Index (Figure 1). The x-axis and y-axis show the QALE in the richest and poorest fifths respectively. The initial QALE before the programme is 62 years and 74 years for the richest and poorest fifth respectively which would increase to 65 and 81 years respectively if programme A was implemented. The health distributions resulting from different value judgements are represented as diamonds in figure 1 while preference functions are represented as iso-curves.

Figure 1: Iso-Welfare Curves Representing Response Categories [about here]

These response categories can be converted into health inequality aversion parameter estimates by fitting a social welfare function through the two outcomes where the respondent is indifferent, and then solving for the inequality aversion parameter. Our aim in this paper is

to perform methodological tests of reliability rather than to estimate a health inequality aversion parameter for policy purposes. However, we compute implied weights to give readers insight into the magnitude of the inequality aversion parameters and to help those who wish to compare our findings with those of other studies. The appendix 1 includes a "lookup table" along with the calculations underpinning the conversion process.

To examine (1) small versus unrealistically large health inequality reductions, the first (large-individual) and second (small-individual) questions are used, within each of the two samples (citizens' panel and online). For (2) population-level versus individual-level descriptions of health inequality reductions, the second (small-individual) and third (small-population) questions are used, within each sample (citizens' panel and online). To explore (3) concrete versus abstract intervention scenarios, the third (small-population) and fourth (concrete) questions are used, within the citizens' panel sample. And finally, to examine (4) online versus discussion group mode of administration, the first, second, and third questions from the citizens' panel sample are compared with the corresponding questions in the online sample. In each case, the cumulative distribution across the 11 ordered response categories (from less to more egalitarian) are compared using the Wilcoxon rank-sum test. In addition, the proportions of non-egalitarian (pro-rich and health maximising) and strong egalitarian (maximin and strict egalitarian) responses are compared using the chi-square test.

2. Results

3.1 The sample

Table 2: Descriptive statistics of the discussion group and on-line survey respondents

[about here]

The first two samples had similar age and gender characteristics. Overall, the discussion sample was slightly more affluent than the other two samples. Respondents in both the two online groups were slightly more likely to have egalitarian social attitudes than respondents in the discussion group.

3.2 The distribution of switching point by question and by sample

Figure 2 shows the distribution of responses across the five principles of health justice, inferred from the switching points by question and by sample.

Figure 2: Inferred principles of health justice by question and sample design [about here]

Each stacked bar indicates the proportion of responses ranging from "pro-rich" on the left end to "strict egalitarian" on the right end. As can be seen, in the first three questions, the median respondent is "strong egalitarian" (i.e. "maximin" or "strict egalitarian") in the discussion sample but is always "weighted prioritarian" in the online sample. However, the median respondent in the discussion group sample shifts to "weighted prioritarian" in the concrete question (this question was not used on the online sample).

Table 3 presents the trade-off points of the median respondent and the implied equity weight to the poorest fifth compared with the richest fifth. In general, the discussion group had lower point estimates of median trade-off points; however, the confidence intervals (CI) of the trade-off points in the discussion and online groups always included the strong egalitarian trade-off point (3.0 or <3), and therefore the CI for the implied weights were undefined.

Table 3: Median response in different groups, with 95% confidence interval in brackets [about here]

Table 4: Non-parametric statistical tests: all respondents [about here]

Table 4 shows the results of statistical tests for the hypotheses. We adopt a conservative approach throughout and always reported two-sided tests. We use labels D and O for discussion and online groups respectively. Hence, D1 represents Q1 in the discussion group, and so forth.

Our first hypothesis was that small gains (small-average, Q2; and small-population Q3) would yield less egalitarian responses than unrealistically large gains (Q1). We found that the large-average and small-population questions gave similar results within both the discussion (D1-D3) and online samples (O1-O3). On the other hand, responses were less egalitarian in the small-average question compared with the large-average question. However, this difference was not statistically significant in the online sample (O1-O2) and only just reached statistical significance in one of the three tests within the discussion group sample (D1-D2). Furthermore, the size of the difference was never large in any of the large

versus small gains comparisons – the largest difference was a 9.2 percentage point difference in the proportion expressing strong egalitarian views (D1-D2). Overall, therefore, there was no clear evidence of a substantial and systematic effect.

Our second hypothesis was that responses would be more egalitarian under population-level (Q2) rather than individual-level (Q3) descriptions of the small gains question. The pattern of responses was in this direction within the discussion group (D2-D3), but did not reach statistical significance in any of the tests. Furthermore, there was no such pattern of responses within the online sample (O2-O3). Again, therefore, there was no evidence of an effect.

Our third hypothesis was that responses might differ (in either direction) between concrete (D4) and abstract (D3) scenarios. In all three tests we found that discussion group sample responses were significantly more egalitarian under the abstract rather than concrete scenario, providing clear support for the third hypothesis.

Finally, our fourth hypothesis was that discussion group respondents (D) would be more egalitarian than online respondents (O). This was indeed the general pattern of responses, with a substantially larger proportion of the discussion group sample (between 11 and 21 percentage points) expressing strong egalitarian responses in all three questions. However, only the small-population question (D3-O3) reached statistical significance. So this provides some albeit weak support for our fourth hypothesis.

Figure 3 gives a visual representation of the rank-sum test, using the example of the large-average question comparing the discussion versus online samples (D1 vs O1). Along the horizontal axis are the 11 ranked points at which respondents can be indifferent between the two programmes. The vertical axis represents the cumulative proportion of respondents who have switched to the less egalitarian programme A by that point. The stronger the inequality aversion, the lower the cumulative curve. In Figure 3, the cumulative curves are similar up to 4 but then the online group rises more rapidly showing a smaller proportion of respondents giving the "strong egalitarian" responses of 3 ("maximin") and <3 ("strict egalitarian).

Figure 3: Cumulative distribution of trade-off points for the large-average question, by mode of administration (D1 vs O1) [about here]

Figure 4 shows a cumulative rank comparison within the discussion group sample, comparing abstract and concrete versions of the small-population presentation (D3 vs D4). This time the curves start to diverge early on, with a higher proportion of <3 ("pro-rich") and 3 ("health maximiser") responses under the concrete question frame.

Figure 4: Cumulative distribution of trade-off points for the small-population vs concrete question for the discussion group (D3 vs D4) [about here]

4. Discussion

A number of studies have attempted to quantify societal value judgements about equity, including value judgements about severity and burden of illness, end of life, and health inequality aversion (Rowen et al., 2016), (Linley and Hughes, 2013), (Shah et al., 2013, Dolan and Tsuchiya, 2011). While these studies elicit public views, most do not evaluate the effect of different scenario presentations and mode of administration that may influence the final results. This paper contributes towards filling this gap in the context of health inequality aversion, by performing experimental tests contrasting: (1) small instead of unrealistically large health inequality reductions; (2) population-level instead of individual-level descriptions of health inequality reductions; (3) concrete instead of abstract intervention scenarios; and (4) online instead of face to face mode of administration.

We find no clear evidence of systematic and substantial effects of small versus unrealistically large health inequality reduction scenarios (1) or population-level descriptions (2). However, we do find clear evidence of an inequality aversion-reducing concrete scenario effect (3), and weak evidence of an inequality aversion-reducing online mode of administration effect (4). Within our discussion group sample, the proportion of non-egalitarians rose substantially and significantly when using a concrete rather than abstract scenario (by 12 percentage points), and the proportion expressing extreme inequality aversion fell substantially and significantly (by 19 percentage points). Finally, respondents were substantially more likely to give strict egalitarian responses in our discussion group sample compared with our online sample (by between 11 and 21 percentage points), although this pattern of findings only reached statistical significance for one of the three questions. So we conclude cautiously that there is only weak evidence of an inequality aversion-reducing online mode of administration effect.

Despite these three effects, however, median responses always implied substantial health inequality aversion and the implied weight to health gains in the worst off group never fell below 2.57 in any of our experimental conditions or sub-groups.

One possible explanation for the concrete scenario effect is that the intervention in question (a reminder letter to promote uptake of bowel cancer screening) was an "agentic" intervention to promote individual health behaviour change, rather than a "structural" intervention to alter the social determinants of health. "Agentic" interventions may make concepts of individual responsibility for health behaviour and outcomes more salient in respondents' minds, thus reducing aversion to health inequality. If so, abstract scenarios may tend to produce higher estimates of public concern for reducing health inequality than concrete scenarios based on "agentic" interventions.

Finally, the mode of administration effect may suggest a "social desirability bias" whereby face-to-face administration tends to elicit pro-egalitarian "Sunday best" responses. On the other hand, the (slightly) less egalitarian social attitudes reported by the discussion group sample suggests that this may be because face-to-face discussion provides a better opportunity for careful deliberation. Either way, it is important that decision makers are aware of the nature and magnitude of potential biases, so that they can appropriately assess and interpret evidence about public views.

One of the considerations in inequality aversion surveys is the choice of terminology used to describe the socioeconomic groups being compared. Our survey describes these groups as the 'richest' and 'poorest' fifth. This is both technically correct and easy to understand for the participants. Other terms such as most/least deprived and most advantaged/disadvantaged have been used in the literature. However, while the choice of terminology may influence the point of indifference within a scenario description, it is unlikely that the effects found in our study between scenario descriptions and between modes of administration may be due to the choice of this terminology.

We note that a number of valuation tools exist to elicit equity-efficiency trade-offs (Gu et al 2015); these may or may not provide different estimates of inequality aversion. However, the cognitive effects identified in our study are also likely to be relevant to other valuation tools. A potential weakness of the questionnaire instrument used in this study is that the visual aids

used focus on health gains, and not the final distributions of health. In this respect, this study may be criticised for favouring gain egalitarianism over outcome egalitarianism (Tsuchiya and Dolan, 2009). However, since identical framing with a fixed ratio of gains has been maintained across all questions, we expect this potential effect to cancel out in the comparisons across pairs of questions that we carried out. Another potential criticism of the study may be that respondents may favour the first (or the left hand side) option over the second alternative in pair-wise comparisons (commonly known as 'response order effect'); similarly, the titration sequence in which questions are presented (compared to random order presentation) may influence choice behaviour. However, Abasolo and Tsuchiya (2013) specifically evaluated both effects and found no evidence of significant difference due to response order or titration sequence.

Another potential criticism is that the order of questions was not randomised which may influence value judgments due to a "learning effect". However, we did not find a consistent pattern of responses across questions to suggest such effect. Finally, we acknowledge that the sample size of this study is relatively modest, although large enough to detect at least two statistically significant effects. As a suggestion for future research in this area, we recommend that the biases considered in this study should be investigated in larger samples. Another consideration in this study is the generalisability of our findings from a small sample to the general population. We think that while the absolute level of inequality aversion may vary between population groups, the cognitive effects found in this study are likely to hold true in other settings. However, further research is needed to investigate these biases in larger and more diverse samples.

Overall, however, the basic finding of substantial health inequality aversion is surprisingly robust. There was no substantial or clearly significant effect of using small rather than unrealistically large health gains, or using population-level rather than individual-level presentations. And although a concrete scenario and online mode of administration reduced the proportion of respondents expressing infinite inequality aversion, median responses in all the variations explored still displayed a substantial degree of health inequality aversion.

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Figure 1: Iso-Welfare Curves Representing Response Categories

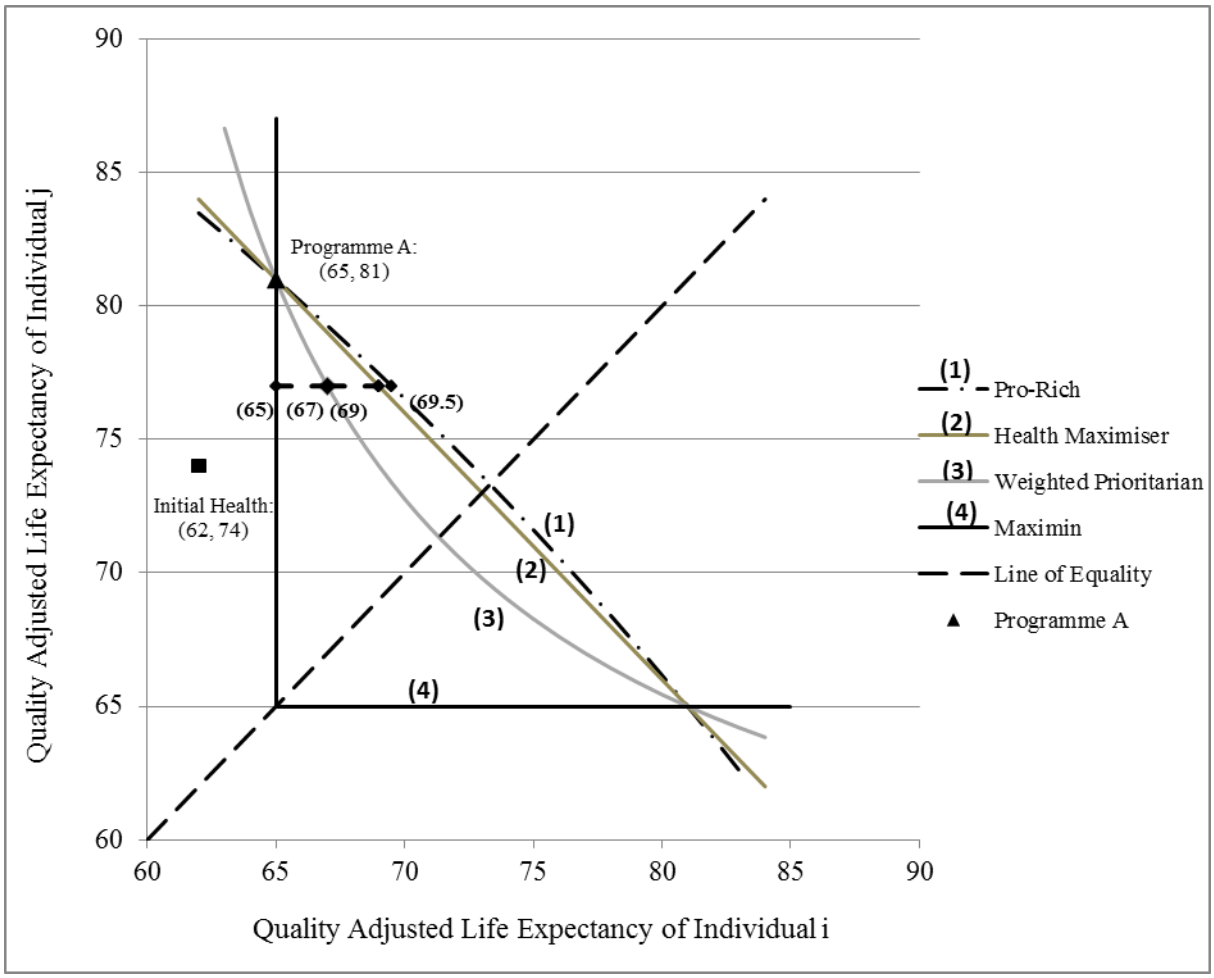
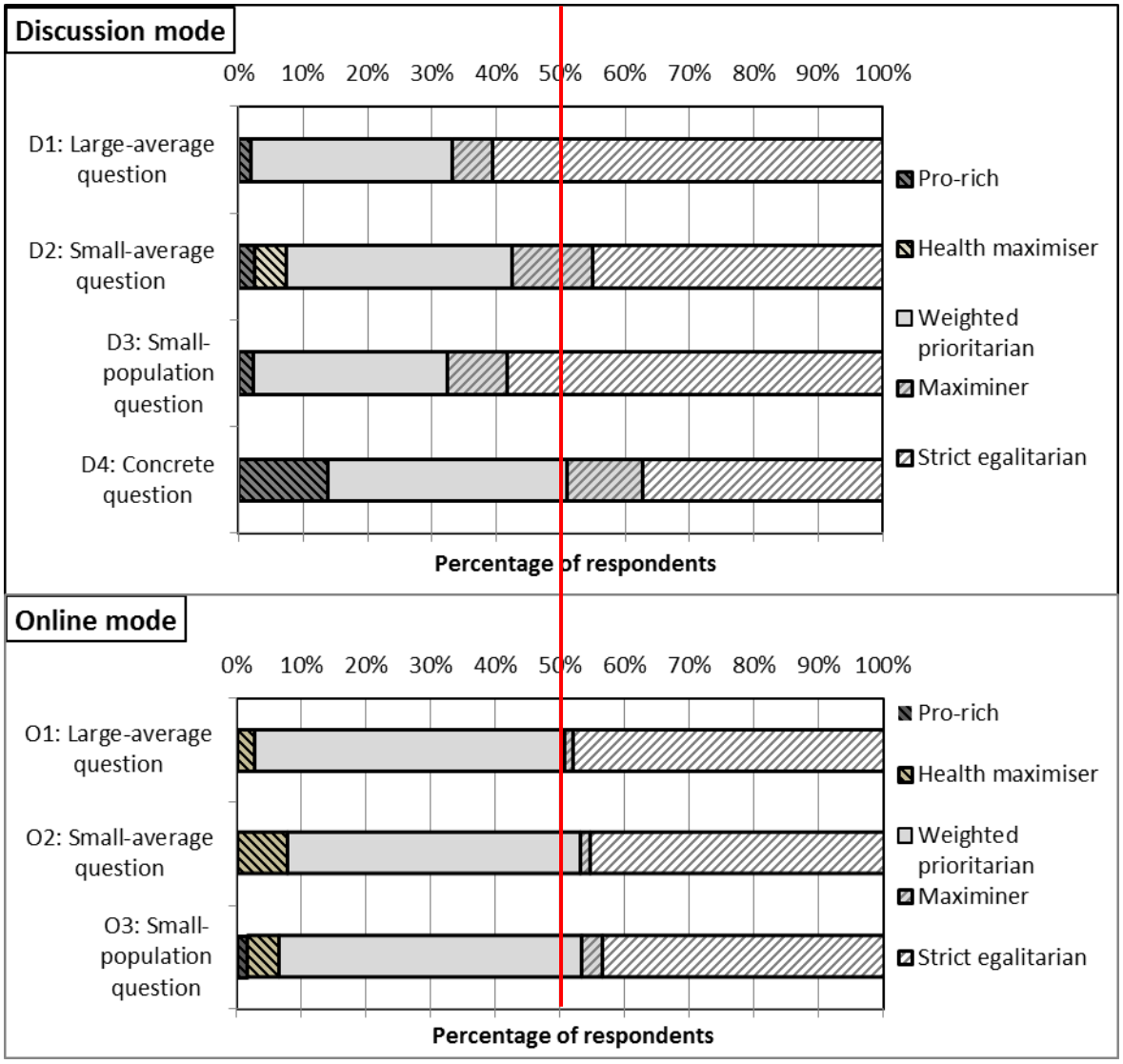
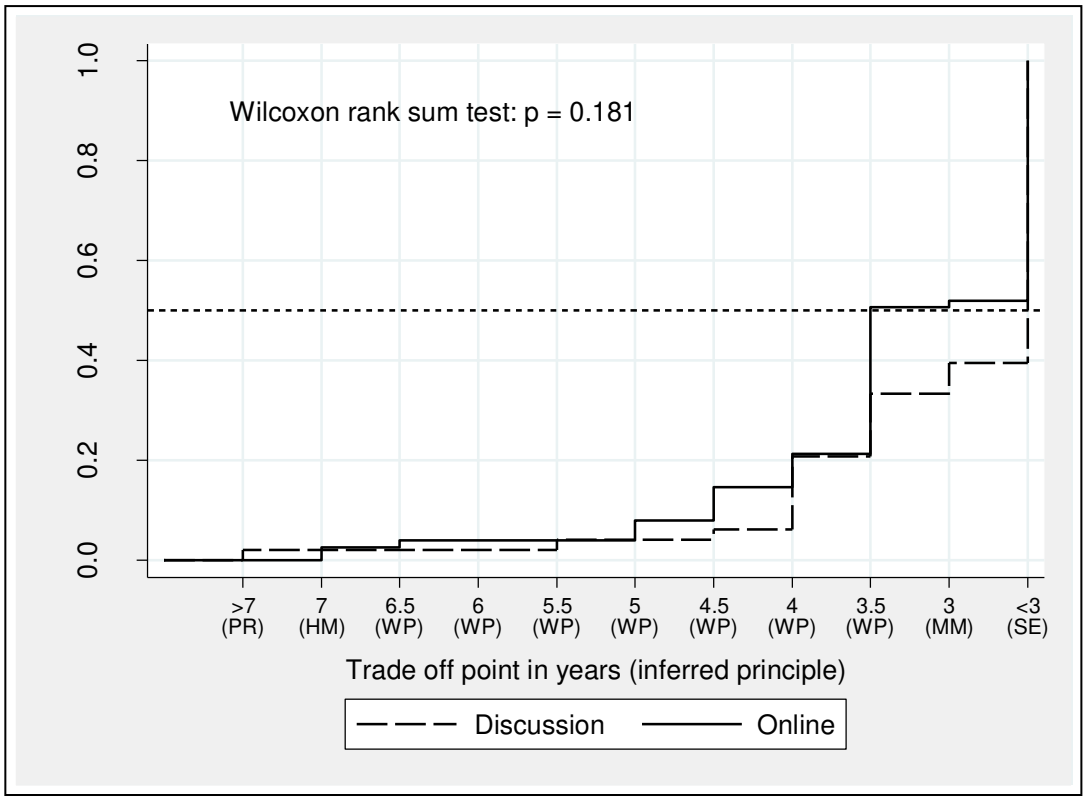


Figure 2: Inferred principles of health justice by question and sample design * **



* Pro-rich (AAAAA); health maximiser (=AAAA); weighted prioritarian (BXXXA); Maximiner (BBBB=); Strict egalitarian (BBBBB)
** The vertical line indicates the location of the median respondent

Figure 3: Cumulative distribution of trade-off points for the large-average question, by mode of administration (D1 vs O1)* **



* The trade off point represents the point at which the respondent would be indifferent between the less egalitarian programme A, in terms of the gain in years of life in full health to the poorest fifth in Programme B

** In terms of our five principles of health justice, < 3 is "strict egalitarian", 3 is "maximin", 3.5 through to 6.5 are "weighted prioritarian", 7 is "health maximisation" and 7+ is "pro-rich".

Figure 4: Cumulative distribution of trade-off points for the small-population vs concrete question for the discussion group (D3 vs D4)

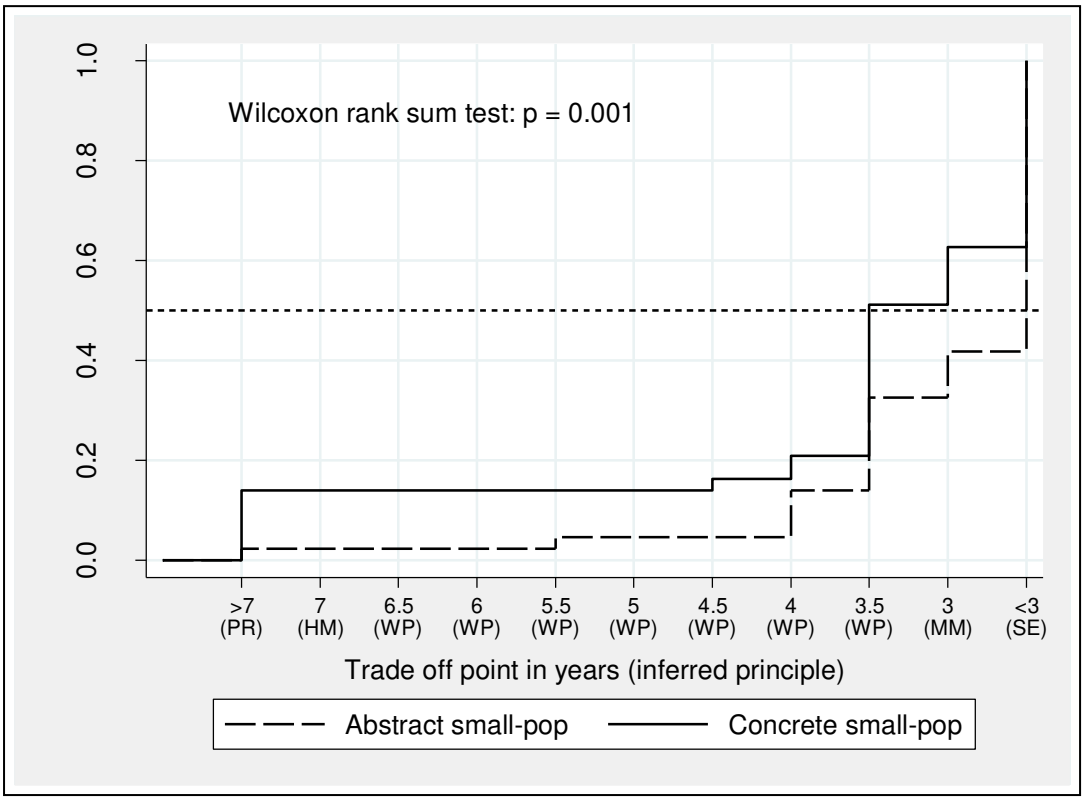


Table 1: Types of value judgement about health justice

Rank (from pro-rich to strict egalitarian)	Types of view about health justice	Trade-off point
1	Pro-rich (AAAAA)	>7
2	Health maximiser (=AAAA)	7.0
3	Weighted prioritarian (BAAAA)	6.5
4	Weighted prioritarian (B=AAA)	6.0
5	Weighted prioritarian (BBAAA)	5.5
6	Weighted prioritarian (BB=AA)	5.0
7	Weighted prioritarian (BBBAA)	4.5
8	Weighted prioritarian (BBB=A)	4.0
9	Weighted prioritarian (BBBBA)	3.5
10	Maximin (BBBB=)	3.0
11	Strict egalitarian (BBBBB)	<3

Table 2: Descriptive statistics of the discussion group and on-line survey respondents

	Discussion group (N = 52)		Online group (N = 83)	
Baseline	**Statistic**	**n**	**Statistic**	**n**
Male (%)	40.4%	21	32.5%	27
Age (%)				
Under 18	0.0%	0	0.0%	0
18-34	21.2%	11	18.1%	15
35-49	13.5%	7	15.7%	13
50-64	38.5%	20	42.2%	35
65+	26.9%	14	24.1%	20
Mean deprivation quintile (mean) (1 = most deprived; 5 = most affluent)	3.71	51	3.17	83
Social attitude statements* (mean) (1= strongly agree; 5= strongly disagree)				
The creation of the welfare state is one of Britain's proudest achievements.	1.42	52	1.36	82
Government should redistribute income from the better-off to those who are less well off.	2.86	51	2.05	82

*1 suggests most egalitarian and 5 suggests most non-egalitarian

Table 3: Median response in different groups, with 95% confidence interval in brackets

Question	**Discussion**		**Online**	
	Trade-off point	**Implied weight**	**Trade-off point**	**Implied weight**
Abstract-large-average	<3 (3 to <3)	Undefined	3.5 (4.5 to <3)	6.8 (2.6 to undefined)
Abstract-small-average	3 (3.5 to <3)	Undefined (6.8 to undefined)	3.5 (4.5 to <3)	6.8 (2.6 to undefined)
Abstract-small-population	<3 (3 to <3)	Undefined	3.5 (4 to 3)	6.8 (3.7 to undefined)
Concrete-small-population	3.5 (4 to 3)	6.8 (3.7 to undefined)	-	-

Table 4: Non-parametric statistical tests: all respondents

	Difference in % that are strong egalitarian*	Difference in % that are non-egalitarians*	Wilcoxon equality test ǂ
First hypothesis: large vs small health gains			
Large-average vs small-average question (D1 – D2)+	+9.2% (p = 0.377)	-5.4% (p = 0.225)	**z = 1.964; p = 0.0496**
Large-average vs small-population question (D1 – D3)	-0.8% (p = 0.937)	-0.2% (p = 0.937)	z = 0.458; p = 0.647
Large-average vs small-average question (O1 – O2)	+2.46% (p =0.772)	-5.1% (p =0.167)	z = 1.915; p = 0.056
Large-average vs small-population question (O1 – O3)	+2.6% (p =0.765)	-3.8% (p =0.281)	z = 0.979; p = 0.328
Second hypothesis: small-average vs small-population			
Small-average vs small-population question (D2 – D3)	-9.9% (p = 0.350)	+5.2% (p = 0.271)	z = -1.313; p = 0.189
Small-average vs small-population question (O2 – O3)	+0.1% (p =0.991)	+1.4% (p =0.767)	z = 0.311; p = 0.756
Third hypothesis: abstract vs concrete scenario			
Small-population vs concrete question (D3 – D4)	+18.6% (p = 0.080)	**-11.6% (p = 0.049)**	**z = 3.244; p = 0.001**
Fourth hypothesis: discussion group vs online			
Large-average question (D1 – O1)	+17.3% (p =0.059)	-0.6% (p = 0.838)	z =1.338; p = 0.181
Small-average question (D2 – O2)	+10.6% (p =0.292)	-0.3% (p = 0.954)	z = 0.987; p = 0.324
Small-population question (D3 – O3)	**+20.7% (p =0.036)**	-4.1% (p = 0.329)	**z = 2.022; p = 0.043**

* Strong egalitarians = maximiner or strict egalitarian; Non-egalitarians = pro-rich or health maximisers. p-values provided for test of equality of proportions.

* Negative sign indicates less egalitarian (or non-egalitarian in the third column) in the first group compared to the second group, and vice versa.

ǂ Wilcoxon rank-sum test was used for unmatched data and signed-rank test was used for matched data. Null hypothesis: two samples are from populations with the same distribution.

+D = discussion group; O = online group; 1 = large-average; 2 = small-average; 3 = small-population; 4 = concrete

APPENDICES

APPENDIX 1:

Estimating the inequality aversion parameter

To estimate health inequality aversion parameters, one can use a symmetric social welfare function with constant elasticity of substitution (CES):

$$W = [H_R{}^{-r} + H_P{}^{-r}]^{-\frac{1}{r}},$$

where W is the level of health related social welfare; H_i (≥ 0) is the level of years of life in full health for population group i, where $i = R$ for the richest fifth and $i = P$ for the poorest fifth; and r ($\geq -1, \neq 0$) is the inequality aversion parameter. When a respondent is indifferent between two programmes A and B, these two outcomes are on the same social welfare contour. At the mid-point of A and B, the gradient of the contour is:

$$\frac{dH_R}{dH_P} = -\left(\frac{H_R}{H_P}\right)^{1+r} = -\left[\frac{\left(H_R(A) + H_R(B)\right)/2}{\left(H_P(A) + H_P(B)\right)/2}\right]^{1+r},$$

which is also (approximately) equal to:

$$\frac{H_R(B) - H_R(A)}{H_P(B) - H_P(A)}.$$

From this relationship, a unique value of r can be obtained, either mathematically (Abasolo and Tsuchiya, 2004) or by using the solve tool in a spread sheet (Dolan and Tsuchiya, 2011). Once the value of r is obtained, the implied equity weight given to a marginal improvement in the health of the poorest fifth relative to the health of the richest fifth can be calculated from the marginal rate of substitution:

$$-\frac{dH_R}{dH_P} = \left[\frac{H_R}{H_P}\right]^{1+r}.$$

Appendix Table 1: Calculation table to estimate the inequality aversion parameter of a symmetric social welfare function with constant elasticity of substitution for the large-average question (source: Abasolo and Tsuchiya 2004)

	Types of preference (choice behaviour)	Trade-off point	QALE* of the rich (Prog A)	QALE of the rich (Prog B)	QALE of the poor (Prog A)	QALE of the poor (Prog B)	Inequality aversion parameter	Implied weight
1	Pro-rich (AAAAA)	>7	81	77	65	Undefined	[**]	[**]
2	Health maximiser (=AAAA)	7.0	81	77	65	69	-1.00	1.00
3	Weighted prioritarian (BAAAA)	6.5	81	77	65	68.5	-0.21	1.15
4	Weighted prioritarian (B=AAA)	6.0	81	77	65	68	0.67	1.34
5	Weighted prioritarian (BBAAA)	5.5	81	77	65	67.5	1.67	1.60
6	Weighted prioritarian (BB=AA)	5.0	81	77	65	67	2.86	1.98
7	Weighted prioritarian (BBBAA)	4.5	81	77	65	66.5	4.34	2.57
8	Weighted prioritarian (BBB=A)	4.0	81	77	65	66	6.40	3.70
9	Weighted prioritarian (BBBBA)	3.5	81	77	65	65.5	9.87	6.85
10	Maximin (BBBB=)	3.0	81	77	65	65	Undefined	Undefined
11	Strict egalitarian (BBBBB)	<3	81	77	65	Undefined	Undefined	Undefined

* QALE: Quality adjusted life expectancy

** Assuming symmetry, the implied preference is inequality seeking.