University of Sheffield

The UK-public's aversion to inequalities in health between socioeconomic groups

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A thesis submitted in partial fulfilment of the requirements
for the degree of Doctor of Philosophy

in the

School of Health and Related Research

April 11, 2021

Abstract

Public health policy has two primary aims: promoting population health and reducing health inequalities. When these aims conflict, policy-makers must determine the relative importance to place on each in decision-making. This thesis explores the UK-public's views on how government should act in these situations, and in particular, whether their "health inequality-aversion" differs depending on the groups between which a health inequality exists and the type of health an intervention provides. These issues are directly relevant to the conduct of "distributionally sensitive" forms of economic evaluation: methods that capture improvements in population health *and* reductions in inequalities in health. A systematic review, and three *de novo* person-trade-off choice experiments are reported. Over 1,600 members of the UK-public participated. I find evidence consistent with the idea that the UK-public are more averse to inequalities in lifetime health between socioeconomic groups than they are to inequalities in lifetime health between groups of unknown socioeconomic status. This motivates a normative debate about whether distributionally sensitive economic evaluations should apply estimates of the public's aversion between socioeconomic groups, or between neutrally labelled groups. In addition, I find evidence broadly consistent with the idea that UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health if an intervention improves life-expectancy than they are if it improves quality-of-life. Further research on this issue is warranted. If confirmed in future, this finding would would motivate the development of forms of distributionally sensitive economic evaluation that can reflect differences in the public's willingness to prioritise disadvantaged socioeconomic groups for different health-gain types.

Statement of Authorship

I am the sole author of Chapters 1, 3, and 7. Chapters 2, 5, and 6, each feature papers written with co-authors:

Chapter 2: McNamara, S., Holmes, J., Stevely, A. K., & Tsuchiya, A. (2020a), How averse are the UK general public to inequalities in health between socioeconomic groups? A systematic review. *European Journal of Health Economics*, 21(3), 275-285.

Chapter 5: McNamara S., Tsuchiya A., Holmes J. (2020b), Does the UK-public's aversion to inequalities in health differ by group-labelling and health-gain type? A choice-experiment. *Social Science and Medicine*, 269, 113573.

Chapter 6: McNamara S., Tsuchiya A., Holmes J. (2020c), Does the UK-public's willingness to prioritise disadvantaged socioeconomic groups differ by type of health-gain? A person-trade-off study. *Manuscript prepared for submission for publication.*

Chapter 4 contains sections loosely based on a working paper written with co-authors:

Chapter 4: McNamara S., Tsuchiya A., Holmes J. (2019), Is aversion to inequalities in health reference-dependent? A pilot study. *Health Economists' Study Group (HESG); York, UK.*

"CRediT" authorship statements (Elsevier, 2020) for these papers, and associated appendices, are provided in the relevant chapters. I am the sole author of any content not captured in the above.

Acknowledgments

I am eternally grateful to my supervisors, Aki Tsuchiya and John Holmes, for their support, and guidance, in developing this thesis. I have benefited greatly from, and enjoyed, working with both of you. In addition, I would like to thank the Wellcome Trust Doctoral Training Centre in Public Health Economics and Decision Science [108903/Z/19/Z], the University of Sheffield, and the EuroQol Research Foundation [2010840], for financially supporting this work. I would also like to thank the 1,602 participants who took part in the studies reported in this thesis, and all those who supported the studies logistically; in particular, the employees of “Accent” who recruited, and observed, participants in the study reported in Chapter 5 of this thesis.

I am also extremely grateful to those who have supported, and advised me, over recent years, and/or reviewed the chapters and papers in this thesis, including: Sarah Bates; Tom Bayley; John Brazier; Joanna Coast; Genevieve David; Daniel Gladwell; Susan Griffin; Nils Gutacker; Anthony Hatswell; Tessa Peasgood; Matthew Robson; Paul Schneider; Koonal Shah; Nicolas Silva; Robert Smith; Abigail Steveley; William Sullivan; Gustav Tinghög; and all the members, and directors of the Wellcome Trust Doctoral Training Centre in ScHARR. In addition, I am grateful to anonymous peer reviewers from the European Journal of Health Economics, and Social Science and Medicine for their comments of the papers provided in Chapters 2 and 5 of this thesis respectively.

I would also like to thank my mother, my sister, and my grandfather - Frank. I would not be where I am today without you. Finally, most of all, I would like to thank my wife - Liz. I could not have done this without you. Thank you for everything.

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Chapter 1: Introduction

In the United Kingdom, poorer people can expect to live shorter lives, on average, than richer people (Marmot, Allen, Boyce, Goldblatt, & Morrison, 2020). They can also expect to experience more health problems in their lifetime (Marmot et al., 2020), and to report lower health-related quality-of-life (Love-Koh, Asaria, Cookson, & Griffin, 2015). These "socioeconomic inequalities in health" are substantial. In Quality-Adjusted-Life-Year (QALY) terms, the quality-adjusted life-expectancy of a person who lives in the most deprived fifth of neighbourhoods in England is nearly 12 QALYs lower than that of a person who lives in the least deprived fifth of neighbourhoods (Love-Koh et al., 2015).

Policy-makers in the UK have explicitly stated that they aim to reduce health inequalities. For example, Public Health England state "We exist to protect and improve the nation's health and wellbeing, and reduce health inequalities" (Public Health England, 2020). Similarly, NICE state they "aim to reduce health inequalities" (NICE, 2020) and the NHS England "Long Term Plan" states their national programs will be "focused on health inequality reduction" (NHS England, 2019). These statements are mirrored by those of national decision-makers in Scotland (NHS Health Scotland, 2016), Wales (Public Health Wales, 2017), and Northern Ireland (NI Department of Health, 2014). Similarly, they are reflected in the stated priorities, and views, of local decision-makers (Frew & Breheny, 2019; Humphries & Galea, 2013).

In sharp contrast, health economic evaluations, typically, ignore inequality. Instead, they usually assume the sole objective of health-related resource allocation is health-maximisation (Weatherly et al., 2009). As a result, the distributional consequences of interventions are rarely modelled, or valued (Asaria, Griffin, & Cookson, 2016; Weatherly et al., 2009). Subsequently, policy-makers who apply the results of "distributionally naïve" economic evaluations risk implementing interventions they may not have, had the distributional consequences of those interventions been included in those economic evaluations.

Distributional Cost Effectiveness Analysis (DCEA)(Asaria, Griffin, Cookson, Whyte, & Tappenden, 2015) is a form of “distributionally sensitive” CEA. In contrast to conventional CEA, DCEA is capable of reflecting both policy-makers’ stated aim to improve population health, and to reduce inequalities in health.

A DCEA features two steps. First, the health consequences of an intervention are modelled distinctly for different social groups; for example, socioeconomic quintiles. Second, a “health-related social welfare function” (HR-SWF) is used to aggregate across the groups. A HR-SWF is a mathematical function that can be used to compare the social desirability of differing health-related states of the world. Whilst traditional CEA applies a simple additive HR-SWF[1], DCEA can apply alternative functions, including those that reflect an aversion to inequalities in health[2].

Two types of distributionally sensitive HR-SWF have been applied in DCEA to date (Asaria et al., 2016, 2015; Griffin, Walker, & Sculpher, 2020; Yang et al., 2020): one based on the Atkinson SWF (Atkinson, 1970) and one based on a Kolm SWF (Kolm, 1976). These functions can be parameterised so that incremental QALYs that reduce inequality are given a higher relative weight than those that increase it; thereby formally valuing the distributional consequences of an intervention. This is operationalised using an “inequality aversion parameter”: a number that defines the relative importance of population health, and equality in the distribution of that health in the HR-SWF. Generally speaking, the higher the inequality aversion parameter, the higher the relative weight given to QALYs that reduce inequality, and the lower the relative weight given to those that increase inequality.

This thesis is focused on the UK-public’s aversion to socioeconomic inequalities in health. My interest in this topic is motivated by the fact that decision makers in the UK have often sought out, and sometimes implemented, the views of the UK-public when considering the relative weight to grant to different consequences in health economic

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[1] State of the world A is preferred to state of the world B if the total sum of health in A is higher than in B.

[2] Even if the total sum of health in state of the world A is higher than state of the world B, B *may* be preferred to A if the lower overall level of health in B is distributed more favourably than in A.

evaluation. For example, health state utility values are, typically, defined based on a surveys of the general public (Dolan, 1997). Given this, I am interested in exploring the UK public's aversion to socioeconomic inequalities in health, because decision-makers may want to consider their views when defining the HR-SWF/s used in practice.

1.1. Existing evidence on the UK-public's aversion to socioeconomic inequalities in health

To date, eight stated preference studies have explored the UK-public's aversion to socioeconomic inequalities in lifetime health (Ali, Tsuchiya, Asaria, & Cookson, 2017; Anand & Wailoo, 2000; Cookson, Ali, Tsuchiya, & Asaria, 2018; Dolan & Tsuchiya, 2011; NICE, 2006; Robson, Asaria, Cookson, Tsuchiya, & Ali, 2016; Tsuchiya & Dolan, 2007, 2009). Of these eight, six provide evidence that the public are inequality averse (Ali et al., 2017; Cookson et al., 2018; Dolan & Tsuchiya, 2011; Robson et al., 2016; Tsuchiya & Dolan, 2007, 2009), one provides evidence of no aversion (Anand & Wailoo, 2000), and one provides mixed evidence (NICE, 2006)[3].

The six studies that provide evidence of aversion each used variants of a single method: a "benefit-trade-off" (BTO) design initially developed by Shaw et al. (2001). In these BTO studies, respondents are, typically, presented with an inequality in life-expectancy[4] between two socioeconomic groups. They are then asked to choose between interventions that vary the life-expectancy of each. Subsequently, participants' inequality aversion is estimated based on their willingness to prioritise between the two groups.

Studies that have applied variants of this method suggest the UK public's aversion to socioeconomic inequalities in health is relatively strong. For example, Dolan & Tsuchiya (2011) estimate that the UK-public place a relative weight of 6.8 to 9.9 on a marginal gain in life-expectancy provided to people from "social class V" ("unskilled occupation") and a life-expectancy at birth of 73 years, relative to people from "social class I" ("professional occupation") and a life-expectancy at birth of 78 years. Similarly, Robson et al. (2017)

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[3] Chapter 2 details a systematic review on this topic. Chapter 3 discusses the methods applied in these studies. Given this, in this section I give a brief overview of these studies, rather than providing substantial detail.

[4] Or variants thereupon. Three of these studies used "years in full health over the average person's life" (Ali et al., 2017; Cookson et al., 2018; Robson et al., 2017).

estimate the public place a weight of 6.2 to 7.0 on a marginal gain in the number of "years in full health (YFH) over the average person's life" provided to the poorest fifth of society who have a baseline YFH of 62, compared to the richest fifth of society who have a baseline YFH of 74. Furthermore, Ali et al. (2017) derive weights of 6.8 and upwards for the same group-types and levels of baseline YFH applied by Robson et al. (2017). More recently, Cookson et al. (2018) estimate weights of 2.6 to 7.0 for the same comparison[5].

In the one study that provides no evidence of aversion, Anand & Wailoo (2000) asked participants to imagine a disease which impacts two groups of people. One of the groups is made up of people from "poorer backgrounds" who have a life-expectancy of 70 years. The other consists of people from "richer backgrounds" who have a life-expectancy of 85 years. The authors asked which group should receive priority for healthcare treatment. In contrast to the BTO studies detailed above, 92% of participants stated the two groups should have equal priority, and 8% stated the poorer group should receive priority.

The one study that provides mixed evidence of aversion was a NICE Citizens' Council (NICE, 2006). In this study, a majority of participants (60%) agreed that it is "appropriate for NICE to issue guidance that concentrates resources on trying to improve the health of the most disadvantaged members of our society, thus narrowing the gap between the least and most disadvantaged, even if this has only a modest impact on the health of the population as a whole". Conversely, a minority (40%) agreed it is "appropriate for NICE to issue guidance that concentrates resources on improving the health of the whole population (which may mean improvement for all groups) even if there is a risk of widening the gap between the socio-economic groups". Whilst this provides evidence of inequality aversion, in the same study, participants also agreed with a conflicting statement: 83% agreed "NICE should issue guidance that concentrates resources on where it will have the greatest impact on the whole population".

In totality, these studies suggests the UK-public are averse to inequalities in health between socioeconomic groups, and, that the strength of that aversion *may* be relatively strong. This provides further motivation for the development of distributionally sensitive forms of economic evaluation.

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[5] In contrast to Ali et al. (2017) and Robson et al. (2017), some participants in Cookson et al. (2018) undertook "e-learning" exercises prior to completing the BTO tasks. More information on this study is provided in Chapter 2.

However, two important issues have yet to be addressed in the literature on distributionally sensitive economic evaluation, or the literature on the UK-public's aversion to inequalities in health. These issues form the basis of the two hypotheses explored in this thesis.

1.2. Two issues

Issue 1: Should the HR-SWFs applied in DCEA be parameterised using estimates of aversion to inequalities in health between socioeconomic groups, or between neutrally labelled groups?

DCEAs conducted to date have applied, or at minimum implied it would be appropriate to apply, estimates of the UK-public's aversion to inequalities in health between socioeconomic groups when parameterising a HR-SWF. For example, Asaria et al. (2016) conduct a DCEA on the NHS Bowel Cancer Screening Programme in which they apply a range of inequality aversion parameters, and note "recent work on eliciting these inequality aversion parameters from members of the general public in England estimates an Atkinson ε parameter[6] of about 10.95" - an estimate from a choice experiment in which respondents were asked to choose between helping the "poorest" or "richest" fifth of society (Robson et al., 2017). Similarly, Yang et al. (2020) conduct a DCEA on smoking cessation and apply the Robson Atkinson inequality aversion parameter, as do Griffin et al. (2020) in their DCEA of West Yorkshire low emission zone policies.

From a normative perspective, it is unclear whether DCEAs *should* use HR-SWFs parameterised using estimates of the public's aversion to inequalities in health between socioeconomic groups. This is for two reasons.

First, because estimates of the public's aversion to inequalities in health between socioeconomic groups *may* be influenced by non-health differences between those groups. For example, inequalities in income, education, and power; differences in economic productivity; or divergence in the wider societal costs associated with improving the health of different socioeconomic groups. To date, no choice-experiment that has elicited the

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[6] The Atkinson-based functional form associated with this parameter is provided in Appendix A1.1.

UK-public's aversion to inequalities in health between socioeconomic groups has reported information on the factors participants considered when responding. As a result, it is not clear whether or not participants in prior studies were influenced by non-health factors.

Second, because it is not normatively obvious whether non-health factors should be considered when defining a HR-SWF to be applied in DCEA. Whilst this issue has been debated in the context of defining the "evaluative space[7]" of health economic evaluation (Brock, 2003), it has not been debated in the context of the parameterising HR-SWFs for DCEA.

From a democratic perspective, it could be argued that non-health factors should not be considered, because a range of evidence suggests the UK-public do not think the government should consider a person's economic circumstance when making decisions about their health (Anand & Wailoo, 2000; Baker et al., 2010; Dolan, Cookson, & Ferguson, 1999). Equally, it could be argued that non-health factors should not be considered because this is inconsistent with the "anonymity principle" (Amiel & Cowell, 1999; Wagstaff, 1991): in this context, the idea that, for the purpose of comparison of health-related welfare, the desirability of a given distribution of health should not depend on the identity of the individuals in that distribution (e.g. their socioeconomic circumstance). Furthermore, it could be argued that it is simply unfair to value an improvement in someone's health differently depending on their socioeconomic circumstance *itself*[8] (Brock, 2003; Herlitz, 2017).

Given these positions, it *could* be argued that DCEA should apply HR-SWFs parameterised using estimates of the UK-public's aversion to inequalities in health between groups of unknown socioeconomic status ("neutrally labelled" groups), rather than between socioeconomic groups. This approach would allow the public's health-related preferences to be reflected in decision-making, whilst removing non-health factors from consideration.

From a practical perspective, this distinction is only of relevance if the UK-public's

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[7] The scope of the "objects of value" considered (Sen, 1993) (e.g. utility, health, capabilities etc).

[8] Note the italicisation here. It may be argued that (1) people who have lower lifetime health should be prioritised over those with higher lifetime health; (2) that people from disadvantaged socioeconomic groups have, on average, lower lifetime health than those from advantaged socioeconomic groups; and therefore, that (3) health gains to disadvantaged socioeconomic groups should be prioritised above those provided to advantaged socioeconomic groups. With this argument, it is important to note the socioeconomically disadvantaged are not prioritised *because* they are socioeconomically disadvantaged, but simply because they have, on average, lower lifetime health.

aversion to inequalities in health between socioeconomic groups differs from their aversion to inequalities in health between neutrally labelled groups. Given this, it would be valuable to know whether or not this is the case. To date, no UK study has explored this issue. This motivates the first hypothesis of this thesis.

Hypothesis A: the UK-public are more averse to inequalities in lifetime health between socioeconomic groups than they are to inequalities in lifetime health between neutrally labelled groups.

I anticipate this hypothesis holds, because: (1) as outlined above, I think that members of the public who are asked questions about prioritising the health of different socioeconomic groups will be influenced by non-health factors; (2) I expect these non-health factors are likely to motivate choices that favour socioeconomically disadvantaged groups; and (3) evidence from outside the UK is consistent with this hypothesis. Notably, Pinho & Botelho (2018) elicited Portuguese students' aversion to inequalities in health between socioeconomic groups, and between neutrally labelled groups, and found evidence aligned to Hypothesis A: participants were more averse to socioeconomic inequalities in health, than to inequalities in health between the neutrally labelled groups. Similarly, Hurley, Mentzakis, & Walli-Attaei (2020) elicited the Canadian public's aversion to inequalities in health between groups with differing levels of income, and between groups of unknown income, and found comparable results: respondents were more averse to the inequalities in health between the groups with differing levels of income, than to those between neutrally labelled groups.

If evidence were to suggest Hypothesis A holds in a UK population, this would motivate a normative debate about whether HR-SWFs applied in UK DCEAs should be parameterised using estimates of aversion between socioeconomic groups, or between neutrally labelled groups.

Issue 2: The focus on scenarios that improve life-expectancy[9]*, rather than quality-of-life, in studies that have explored the UK-public's aversion to socioeconomic inequalities in health.*

Whilst eight stated preference studies have explored the UK-public's aversion to socioeconomic inequalities in lifetime health, these studies have primarily[10] asked respondents to make choices about the life-expectancy, or variants thereupon, of different socioeconomic groups. Relatively little attention has been paid to interventions that would improve quality-of-life. In particular, no study has explored whether the UK-public are equally willing to prioritise people from disadvantaged socioeconomic groups with lower lifetime health above people from advantaged socioeconomic groups with higher lifetime health *for interventions that improve quality-of-life*, rather than improve life-expectancy.

This is, potentially, an important omission, because the QALY-based HR-SWFs applied in DCEAs to date treat all types of QALY gain equally. As a result, if the public's willingness to prioritise disadvantaged socioeconomic groups were found to differ by health-gain type, use of these QALY-based HR-SWFs may miss-represent the public's willingness to prioritise disadvantaged groups for a given health-gain type.

If decision-makers wish to reflect the views of the public in DCEA, it would be valuable to know whether this is the case. This leads to the second hypothesis explored in this thesis.

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[9] Or variants thereupon.

[10] Although not exclusively (Anand & Wailoo, 2000; NICE, 2006).

Hypothesis B: the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health if an intervention improves life-expectancy than they are if it improves quality-of-life.

I anticipate this hypothesis holds, because I think the UK-public will experience stronger instinctive negative emotional reactions to the idea of prioritising poorer people over richer people for interventions that relieve suffering than to those that extend life. Subsequently, I expect they will be more willing to prioritise poorer people over richer people for interventions that extend life, rather than for those that improve quality-of-life.

Whilst this issue has not been explored in the context of the public's aversion to socioeconomic inequalities in health, similar ideas have been investigated in other areas. For example, Ryen and Svensson (2015) conducted a systematic review of studies that explored peoples' individual willingness-to-pay for different types of QALY gain, and found that studies that asked questions about life-expectancy improving QALYs tended to generate higher monetary values than those that asked questions about quality-of-life, albeit few of the papers identified tested this within the same study. More recently, Shah, Tsuchiya, & Wailoo (2019) fielded a discrete choice experiment (DCE) in which they explored the UK-public's willingness to provide different types of QALY gains to others at the end-of-life. Shah et al. found evidence that participants preferred QALY gains attributable to improvements in quality-of-life, compared to those attributable to extensions of duration of life. Even more recently, Lancsar et al. (2020) fielded a DCE in Australia, and found evidence that participants preferred to provide others with QALY-gains that were the result of combinations of both extension of life and improvements in quality-of-life, rather than one or the other in isolation. However, this study found no statistically significant differences in participants' willingness to prioritise others for QALY-gains attributable to improvements in life-expectancy alone or gains in quality-of-life alone. Whilst the findings of these studies are mixed, in combination they suggest composition of a QALY may matter to the public, and so further motivate a test of Hypothesis B.

If the public's willingness to prioritise the socioeconomically disadvantaged were found to differ by health gain type, this would motivate the development of forms of distributionally sensitive economic evaluation, and/or HRSWFs, that can account for health-type specific preferences.

1.3. What follows in the remainder of this thesis

Chapter 2 reports a systematic review of existing evidence on the UK-public's aversion to inequalities in lifetime health between socioeconomic groups, and between neutrally labelled groups. Chapter 3 considers/explains how the two hypotheses could, should, and will be tested in this thesis. Chapter 4 reports a quantitative/qualitative pilot of a person-trade-off (PTO) study designed to test the two hypotheses. Chapter 5 reports a face-to-face fielding of a PTO study designed to test the two hypotheses. Chapter 6 details an online fielding of a PTO study designed to test Hypothesis B (health gain types). Chapter 7 discusses the thesis as a whole, and its implications.

1.4. Clarifying key terms

Inequalities in health

The term "inequalities in health" has been used in different ways by different authors (McCartney et al., 2019). For example, Kawachi et al. (2002) define inequalities in health as "differences, variations, and disparities in the health achievements of individuals and groups". In contrast, Graham et al. (2009) define health inequalities as "systematic differences" in the health of "more and less advantaged groups", whilst Williams, Buck & Babola (2020) define them as "avoidable, unfair and systematic differences in health between different groups of people". As a result of these varying definitions, it is possible that different readers may interpret the content of this thesis in different ways. Given this, it is important to clarify what I mean, and do not mean, when I use the term "inequalities in health".

In this thesis, I have opted to apply the definition of Kawachi et al. (2002) provided above: "differences, variations, and disparities in the health achievements of individuals and groups". The decision to use this definition, rather than the alternatives, does not mean that I think the inequalities discussed in this document are not avoidable, unfair or systematic. It simply means that when I use this term I do not require this to be the case. I have opted to use this definition because judgements of fairness are inherently subjective, and this thesis is not intended to be a treatise on distributional justice. Instead, my focus is on whether the UK-public would rather differences in the lifetime health of different individuals and groups were reduced, not on whether these differences *are* unfair; I leave this judgement to the public. In the interest of clarity, when I refer to issues of fairness in this thesis, I will instead use the terms "in/equity" or "un/fairness" directly rather than using "in/equality" as synonyms for these terms.

Socioeconomic groups

In this document, I apply the definition of socioeconomic status developed by Baker (2014): a measure "of one's combined economic and social status", commonly based on occupation, income, and education. As a result, when I refer to inequalities in health between socioeconomic groups, I am referring to differences in the health of individuals grouped by some combined measure of their economic and social status.

In practice, much of the recent literature that *purports* to be about the UK-public's aversion to socioeconomic inequalities in health has operationalised this concept using experimental labels that focus solely on the economic status of the impacted individuals. Notably, Ali, Tsuchiya, Asaria, & Cookson (2017), Cookson, Ali, Tsuchiya, & Asaria, (2018), and Robson, Asaria, Cookson, Tsuchiya, & Ali (2016) each conduct choice experiments in which they attempt to elicit the UK-public's aversion to socioeconomic inequalities in health, but do so using the labels "people from the richest fifth of society" and "people from the poorest fifth of society".

Whilst these labels do not fully convey the "socio" component of socioeconomic status, in this document I will carry-forward the convention set by these prior authors, and regard studies that apply economic status focused labels as capturing the public's aversion to socioeconomic inequalities in health. As social and economic status are correlated (albeit imperfectly), this is not an unreasonable substitution. I accept this is a limitation of this thesis.

In addition, it should be noted that existing literature sometimes applies area-level deprivation as an operational substitute for socioeconomic/economic status. For example, in each of the three choice experiments identified above (Ali, Tsuchiya, Asaria, & Cookson, 2017; Cookson, Ali, Tsuchiya, & Asaria, 2018; Robson, Asaria, Cookson, Tsuchiya, & Ali, 2016) the authors informed participants that people from the "richest" and "poorest" fifths of society had levels of lifetime health derived from a study that stratified the population using the index of multiple deprivation (IMD)(Love-Koh et al., 2015); an area based index with seven domains: income, employment, education/skills/training, health/disability, crime, barriers to housing/services, and living environment (MHCLG, 2020). As different geographic areas may contain people from different socioeconomic groups, this index is not a perfect substitute for socioeconomic or economic status[11]. In addition to these choice experiments, each of the DCEAs conducted to date have conducted analyses parameterised using data based on IMD, rather than socioeconomic status (Asaria et al., 2016; Griffin et al., 2020; Yang et al., 2020). This operational substitution is also present in the broader social-epidemiology literature. Notably, in the 2020 Marmot review the authors present data stratified by area level deprivation and state this demonstrates *"how the social gradient in health runs from the top of the socioeconomic spectrum to the bottom"*(p14; Marmot et al., 2020). Given this precedent, in this thesis, I will similarly regard inequalities in health between neighbourhoods of differing deprivation levels as being a reasonable, albeit imperfect, substitute for inequalities in health between socioeconomic groups.

1.5. How estimates of health inequality aversion might be used by policy-makers & the potential implications of these uses

In this section, I provide a brief overview of ways the estimates of health inequality aversion discussed in this thesis could be used by policy-makers, and some of the potential implications of these uses. The issues discussed are not a primary focus of this thesis,

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[11] Note each of the three studies highlighted above aim to elicit Atkinson health inequality aversion parameters under the assumption that these are locally stable (i.e. the inequality aversion parameter is assumed to be independent of the precise baseline inequality between groups). If this assumption holds, the use of approximately correct IMD-based health estimates, rather than socioeconomic status-based equivalents, would not impact the inequality aversion parameters estimated.

but are valuable background context against which to interpret my work. In Chapter 7 (Section 7.5) I provide my views on what policy-makers should do.

Use of estimates of health inequality aversion to inform distributionally sensitive economic evaluations which: (1) formally integrate across groups, or (2) take a non-integrative approach

Policy-makers could use estimates of health inequality aversion in at least two ways. First, as a way of informing integrative distributionally sensitive economic evaluation (i.e. DCEA). In an integrative approach, social strata are modelled separately[12], and then formally integrated into a single, distributionally-weighted, whole using a HR-SWF[13]. As a result of this integration, these analyses produce a unified conclusion of cost-effectiveness across all social strata, rather than individual conclusions for each stratum. As discussed earlier in this chapter, a HR-SWF may be directly parameterised using estimates of the inequality aversion of the public. Equally, this could be done based on the judgement of policy-makers taking into account the views of the public.

Alternatively, policy-makers could use estimates of health inequality aversion as a way of supplementing non-integrative forms of distributionally sensitive economic evaluation: approaches in which social strata are modelled separately[14] but not integrated into a unified distributionally-weighted whole. This approach effectively treats each social stratum as a subgroup, with individual economic evaluations conducted for each, rather than a weighted simultaneous evaluation across every stratum. If a policy-maker were to take a non-integrative approach, they could supplement these analyses with deliberation, or a more formal rule based procedure, informed by estimates of the public's inequality aversion. For example, a policy-maker *could* decide to formally introduce different

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[12] Potentially including stratum specific baseline risk information, treatment effects, costs, utility values etc. See Asaria et al. 2016 for an example of this form of analysis.

[13] Note that this is somewhat of a simplification. In practice, these analyses typically: (1) estimate the net health benefit/cost associated with an intervention in each strata (i.e. including consideration of the opportunity cost of displaced spending); (2) combine these net health benefit/costs with an estimate of the initial distribution of health across strata in order to derive an estimated post-intervention distribution; (3) apply the HR-SWFs to the pre & post intervention distributions in order to enable the two to be compared. See Asaria et al. 2016 for further detail.

[14] As above, this may include stratum specific baseline risks, treatment effects, costs, utility values etc.

cost-effectiveness thresholds[15] for different social groups based on the public's aversion to inequality. Equally, they could achieve the same outcome by fixing the threshold across strata, but applying different QALY weights to each.

Each of these approaches have their advantages and disadvantages. For example, if a policy-maker is open to the idea of restricting interventions to specific socioeconomic groups[16], a non-integrative approach may be preferable to a purely integrative approach. This is because this would provide discrete cost-effectiveness results for the intervention in each of the strata modelled. Subsequently, policy-makers could use these discrete results to make informed decisions about whether an intervention should be funded in each group. Alternatively, if the policy-maker is averse to the idea of considering the cost-effectiveness of an intervention separately in each socioeconomic group, they may prefer a purely integrative approach with no presentation of discrete cost-effectiveness results by social stratum.

In addition, use of an integrative approach, or a non-integrative rule-based approach, may enable policy-makers to be more transparent and in their consideration of inequality than a purely deliberation based approach (i.e. by publishing the HR-SWF or rule to be applied). Conversely, a purely deliberative approach may allow decision-makers to be more flexible, and consider the nuance of a given evaluation, rather than being held to specific rules or aggregation procedures. Alternatively, formal aggregation, or assessment against a pre-defined rule, could be supplemented with deliberation in order to achieve the benefits of both.

Throughout this thesis, I primarily discuss my findings in the context of integrative DCEA. I have chosen to do this, because my work is motivated by a number of recently published economic evaluations that have used this approach (e.g. Asaria et al., 2016; Griffin et al., 2020; Yang et al., 2020). Whilst I do not focus on the potential to supplement these integrative analyses with deliberation, in Chapter 7 (Section 7.5) I will argue policy-makers should do this, as this would allow them to gain the transparency and consistency benefits associated with explicit formal aggregation, but enable them to

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[15] When I use the term “threshold” here, I am referring to an applied decision threshold (i.e. λ), rather than using the term as a synonym for the efficiency of displaced spending (i.e. k) (Claxton et al., 2015).

[16] This issue will be explored further in the subsection immediately below this one.

consider the nuance of specific evaluations where required[17]. In addition, whilst this thesis does not explicitly consider use of estimates of health inequality aversion to develop non-integrative rule based procedures it should be noted the studies I report could reasonably be used for this purpose.

Use of estimates of health inequality aversion to inform economic evaluations of interventions: (1) restricted to specific social strata or (2) available to all

Estimates of the public's health inequality aversion could be used to inform DCEAs of interventions restricted to specific socioeconomic groups; for example, subsidising gym memberships to people on low incomes. Equally, they could be used to inform DCEAs of interventions available to all; for example, subsidising gym memberships for everyone[18].

In practice, policy-makers' willingness to restrict interventions to specific socioeconomic groups are likely to depend on the type of interventions under consideration. For example, they may conclude it would be unfair, or politically untenable, to restrict access to medicines or medical procedures in this way. Conversely, they may find it more acceptable to restrict access to preventative interventions to specific socioeconomic groups. Indeed, restricting public health interventions to specific socioeconomic groups is relatively common (Bull et al., 2014).

If a policy-maker were opposed to restricting access to a specific intervention (e.g. a medicine) to specific socioeconomic groups, DCEAs of that interventions could still be conducted: the policy-maker could simply limit the set of strategies considered to those in which the intervention is made available to all socioeconomic groups, or to none. If a decision-maker opted for this approach, this would systematically prioritise (deprioritise) those interventions that disproportionately benefit the disadvantaged (advantaged). In practice, this is likely to mean prioritising interventions for conditions that disproportionately impact the disadvantaged, but this is not necessarily the case[19]. Conversely, if

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[17] i.e. In a manner comparable to the way in which NICE deliberates on cost-effectiveness, rather than mechanically applying cost-effectiveness thresholds.

[18] Note that both intervention types could be assessed using integrative, or non-integrative, methods.

[19] For example, it may be that an intervention that disproportionately impacts the disadvantaged is more effective in advantaged groups. Subsequently, the net health benefit of the intervention may be higher in advantaged groups.

the policy-maker were to consider DCEAs of interventions restricted to specific socioeconomic groups, this would enable the prioritisation of people who are socioeconomically disadvantaged, irrespective of whether universal availability of the intervention would disproportionately benefit the socioeconomically advantaged (i.e. the policy-maker could evaluate, and consider funding, a strategy restricted to the disadvantaged, even if wholesale availability of the intervention would favour the advantaged).

Given the above, readers of this thesis should be aware that the estimates of health inequality aversion discussed could be used to inform DCEAs of both restricted and universal interventions. However, in practice, policy makers may wish to apply a universal approach to specific interventions, and a restricted approach to others.

Use of estimates of inequality aversion to inform economic evaluations of: (1) preventative & screening public health interventions, or (2) treatments for ill health

In theory, policy-makers and researchers could use estimate of health inequality aversion to inform DCEAs of any type of intervention. However, to date all published DCEAs have focused on interventions designed to prevent ill health or identify illness, rather than on evaluating different treatment strategies. For example, Griffin et al. (2020) model the introduction of a low-emissions traffic zone: a preventative intervention. Similarly, Yang et al. (2020) evaluate two preventative interventions and one screening intervention: smoking cessation therapy, a brief intervention designed to reduce alcohol consumption, and alcohol misuse screening. In addition, Asaria et al. (2016) evaluate bowel cancer screening: an intervention designed to identify illness. As far as I am aware, no study has explored use of DCEA to evaluate different "downstream" treatments.

In practice, I suspect this is because policy-makers are relatively uncomfortable with the idea that socioeconomic status should influence the way sick people are treated: particularly in the context of an NHS founded on treatment according to need, not socioeconomic circumstance. Conversely, they may be more comfortable with the idea that socioeconomic status is relevant to the evaluation of "upstream" interventions, as this is commonly accepted as being relevant in the context of public health decision making (Bull et al., 2014).

If policy-makers were to restrict DCEA to upstream interventions, this may lead to practical difficulties. For example, in the context of “whole disease models” (Tappenden et al., 2012) designed to simultaneously evaluate upstream and downstream interventions, it is not clear how alternatives could be compared if socioeconomic group-based QALY-weights are included for upstream interventions, but not downstream ones.

Given the above, readers of this thesis should be aware that estimates of health inequality aversion discussed could be used in DCEAs of upstream interventions and treatment strategies. However, in practice policy-makers may request DCEA be limited to upstream interventions, and this has potential to lead to both practical problems for those interested in comparing upstream and downstream interventions.

Use of estimates of: (1) aversion to inequalities in lifetime health of different groups, or (2) preferences regarding prioritisation of groups with higher burden of illness

When reading this thesis, it is important to note there is conceptual overlap between the idea of weighting QALYs based on the public’s aversion to inequalities in lifetime health between different groups, and weighting QALYs based on the public’s preferences regarding prioritising groups who have conditions associated with higher burden-of-illness, expressed in terms of absolute QALY-shortfall (Rowen et al., 2016)[20]. Both these concepts have a similar normative underpinning, albeit approached from different perspectives: the idea that we should prioritise gains provided to people who are more disadvantaged in some way over those who are less disadvantaged.

In fact, if we are willing to classify socioeconomic disadvantage as being a form of illness, then the QALY shortfall associated with it may be regarded as the burden of that “illness”. Subsequently, estimates of the public’s aversion to socioeconomic inequalities in health may be conceptualised as a specific form of burden of illness weighting. Equally, the idea of weighting QALYs based on the public’s preferences regarding QALY-shortfall may be thought of as implementing their aversion to inequality; albeit their aversion to

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[20] The number of QALYs people with a given health condition can expect to lose relative to an otherwise healthy person of the same age. For example, an individual who is 50 years old is about to die imminently of cancer, but would otherwise have lived to another 30 years in perfect health if they had been healthy, would have a 30 QALY burden of illness (in absolute QALY loss terms).

inequalities in the amount of *lost* expected lifetime health between different groups, rather than inequalities in expected lifetime health.

Given this overlap, it is important that policy-makers considering simultaneously introducing QALY-weighting based on both aversion to inequalities in health and burden of illness carefully evaluate the potential for double-counting a concern for the worse-off. For example, the socioeconomic gradient of health is itself a result of the cumulation of inequalities in multiple health conditions and risk factors associated with differing levels of absolute QALY shortfall. As a result, if a policy-maker were to simultaneously introduce QALY-weighting based on the public's aversion to socioeconomic inequalities in lifetime health and disease-level absolute QALY-shortfall they may count the public's concern for the worse off twice.

In the remainder of this thesis, I will primarily present my findings as representing the public's aversion to inequalities in lifetime health between different groups, rather than as representing their willingness to prioritise groups with a higher burden of illness; however, readers with an interest in weighting QALYs on the basis of burden of illness, may wish to consider my findings from this perspective.

1.6. Three notes on the way this thesis is presented

Formatting

This document is formatted using the University of Sheffield's "alternative" thesis format. This approach permits a doctoral candidate to present a hybrid between published work (Chapter 2), work prepared for submission to journals (Chapters 5 and 6), and a traditional monograph thesis format (Chapters 1, 3, 4, and 7).

Variation in the hypotheses/objectives/research questions explored across chapters

Whilst the over-arching aim of this thesis is to test the two hypotheses introduced above, the chapters presented *also* include additional hypotheses, objectives, and/or research questions, that are closely related to the two central hypotheses. Where this is the case, this is highlighted and explained. Table 1, below, summarises the hypotheses/research questions/objectives explored in Chapters 2, 4, 5, and 6[21].

Variation in the labelling of the two hypotheses

The papers presented in Chapters 2 (McNamara et al. 2020a), 5 (McNamara et al. 2020b) and 6 (McNamara et al. 2020c), are designed to be self-contained pieces of work in their own right. As a result, the hypotheses/research questions explored in them are labelled logically for each of those manuscripts, rather than using the terms “Hypothesis A” and “Hypothesis B” applied in this thesis. Table 1.1, below, shows the hypothesis/research question labelling applied in the papers.

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[21] Note that Chapter 3 is a methodological chapter

Table 1.1: *How the research questions/hypotheses/objectives explored in the chapters relate to the central hypotheses of this thesis.*

Chapter	**Research questions, hypotheses, or objectives explored in chapter**	**How these relate to the two central hypotheses of this thesis**
Chapter 2: Systematic review	The publication presented in this chapter (McNamara et al. 2020a) features three research questions: (1) How averse are the UK public towards inequalities in lifetime health between socioeconomic groups? (2) Does this aversion differ depending upon the type of health under consideration? (e.g. life extension, pain relief or mobility improvement). (3) Are the UK public as averse to inequalities in health between socioeconomic groups as they are to inequalities in health between neutrally framed groups?	- Question (1) provides the background against which to interpret the two hypotheses of this thesis. - Question (2) was designed to provide information relevant to Hypothesis B of this thesis: the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health if an intervention improves life-expectancy than they are if it improves quality-of-life. - Question (3) was designed to provide information relevant to Hypothesis A of this thesis: the UK-public are more averse to inequalities in health between socioeconomic groups than they are to inequalities in health between neutrally labelled groups.

Chapter 4: Pilot	The pilot had five objectives: (1) To test the mechanical operation of the PTO exercises. (2) To provide insight into the potential effect sizes likely to be observed in future fielding. (3) To evaluate participant understanding of the PTO tasks. (4) To identify the factors they considered when responding. (5) To highlight ways the study materials could be improved.	- Objectives (1), (3), (4) and (5) were designed to provide insight into whether the PTO exercises/materials were operating, and being interpreted, as intended; and, to identify potential modifications to the study design/materials prior to future fielding. This was a necessary step prior to using the PTO design to test the two hypotheses. - Objective (2) was designed to inform the sample sizes used in future fielding of the PTO study. - Objective (3) was designed to provide insight into whether participants who were asked questions about socioeconomic groups were influenced by non-health factors. This is of interest, because, as outlined above, this is the logic underlying Hypothesis A.

Chapter 5: Face-to-face fielding	The manuscript presented in this chapter (McNamara et al. 2020b) features tests of three hypotheses: (1) The UK-public are more averse to inequalities in health between socioeconomic groups than they are to inequalities in health between neutrally labelled groups. (2) This difference is, at least in part, driven by the role non-health information plays in determining aversion to inequalities in health between socioeconomic groups. (3) The UK-public are more willing to prioritise groups with lower lifetime health over groups with higher lifetime health if an intervention improves life-expectancy than if it improves quality-of-life.	- The first hypothesis of this chapter is Hypothesis A of this thesis. - The second concerns the logic underlying Hypothesis A of this thesis. - The third includes Hypothesis B of this thesis, but is more expansive: it is not limited to socioeconomic groups. This is because the design of the study allowed the socioeconomic group focused Hypothesis B of this thesis to be tested, and also an equivalent “neutrally labelled” version of the hypothesis to be tested. As this comparison may also be of interest to reader of Social Science and Medicine, both are reported in the manuscript.

Chapter 6: Online fielding	The manuscript presented in this chapter (McNamara et al. 2020c) tested one hypothesis: (1) The UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health if an intervention improves life-expectancy than if it improves quality-of-life.	- This is Hypothesis B of this thesis.

APPENDIX A1.1. The Atkinson HR-SWF functional form used by Asaria et al. (2016).

$$EDE_{Atkinson} = \bar{H}\ .\left[\sum_{i} .\left(\frac{H_i}{\bar{H}}\right)^{1-\varepsilon} f(x_i)\right]^{1/(1-\varepsilon)} \tag{1.1}$$

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Chapter 2: Systematic review

The review presented in this chapter grounds the two hypotheses of this thesis in existing literature; demonstrates they have not been tested previously; and, provides indirect evidence consistent with Hypothesis A: the UK-public are more averse to inequalities in lifetime health between socioeconomic groups than they are to inequalities in lifetime health between neutrally labelled groups.

The review was designed to answer three questions: (1) How averse are the UK public towards inequalities in lifetime health between socioeconomic groups? (2) Does this aversion differ depending upon the type of health under consideration[1]? (3) Are the UK public as averse to inequalities in health between socioeconomic groups as they are to inequalities in health between neutrally framed groups?

Question (1) provides the background against which to interpret the two hypotheses explored in this thesis. Question (2) is motivated by Hypothesis B: the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health if an intervention improves life-expectancy than they are if it improves quality-of-life. Question (3) provides information relevant to Hypothesis A: the UK-public are more averse to inequalities in lifetime health between socioeconomic groups than they are to inequalities in lifetime health between neutrally labelled groups.

The review was first conducted in October 2017. A working paper on the review was then discussed at the Summer 2018 meeting of the Health Economists' Study Group (HESG). Subsequently, the paper was revised, submitted, and accepted for publication in the European Journal of Health Economics (McNamara, Holmes, Stevely, & Tsuchiya, 2020a[2]).

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[1] e.g. Life extension, pain relief or mobility improvement.

[2] Note that this paper is reproduced in this thesis under the terms of the Creative Commons Attribution

In the following, I first present the McNamara et al. (2020a) paper. I then provide three appendices. The first appendix (A2.1) is the online appendix of the journal article. The second (A2.2) details an update of the review conducted in April 2020. The third (A2.3) clarifies the contribution this chapter makes to this thesis as a whole.

Authorship statement

The McNamara et al. (2020a) paper was written with three co-authors: John Holmes; Abigail Stevely; and Aki Tsuchiya. A "CRediT" author statement (Elsevier, 2020) for this paper is as follows:

Simon McNamara: Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing - Original draft, Project administration. **John Holmes**: Supervision, Writing - Reviewing and Editing. **Abigail Steveley**: Validation (second reviewer), Writing - Reviewing and Editing. **Aki Tsuchiya**: Supervision, Writing - Reviewing and Editing.

I conducted the update search alone, and am the sole author of the second and third appendices.

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2.1. McNamara et al. (2020a)

The European Journal of Health Economics (2020) 21:275–285
https://doi.org/10.1007/s10198-019-01126-2

ORIGINAL PAPER

How averse are the UK general public to inequalities in health between socioeconomic groups? A systematic review

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Received: 21 March 2019 / Accepted: 7 October 2019 / Published online: 24 October 2019

Abstract

There is growing interest in the use of "distributionally-sensitive" forms of economic evaluation that capture both the impact of an intervention upon average population health and the distribution of that health amongst the population. This review aims to inform the conduct of distributionally sensitive evaluations in the UK by answering three questions: (1) How averse are the UK public towards inequalities in lifetime health between socioeconomic groups? (2) Does this aversion differ depending upon the type of health under consideration? (3) Are the UK public as averse to inequalities in health between socioeconomic groups as they are to inequalities in health between neutrally framed groups? EMBASE, MEDLINE, EconLit, and SSCI were searched for stated preference studies relevant to these questions in October 2017. Of the 2155 potentially relevant papers identified, 15 met the predefined hierarchical eligibility criteria. Seven elicited aversion to inequalities in health between socioeconomic groups, and eight elicited aversion between neutrally labelled groups. We find general, although not universal, evidence for aversion to inequalities in lifetime health between socioeconomic groups, albeit with significant variation in the strength of that preference across studies. Second, limited evidence regarding the impact of the type of health upon aversion. Third, some evidence that the UK public are more averse to inequalities in lifetime health when those inequalities are presented in the context of socioeconomic inequality than when presented in isolation.

Keywords Health inequality aversion · Social preferences · Equity weighting · Fair innings · Systematic review

JEL classification I14 · D04

Introduction

The UK is an unequal society. If you are poor, you can expect to live a shorter life than if you were rich [1, 2], you can expect to live with lower average health-related quality of life [3], and you can expect to experience disability at a younger age [4]. This "health gap" is substantial [5]. In quality-adjusted life-year (QALY) terms, a person living in the most deprived quintile areas of English society can expect to experience 11.87 QALYs less in their lifetime than a person living in the least deprived areas [3].

Recent evidence suggests the UK public are averse to this inequality, and would be willing to sacrifice a significant amount of average population lifetime health to achieve a more even distribution of it between socioeconomic groups[1] [6–9]—they appear to be "distributionally sensitive". In contrast, economic evaluation in health is typically "distributionally naïve" [10], and operates under the assumption that "a QALY is a QALY is a QALY" [11], irrespective of who receives it. This apparent discordance has led some to question the democratic legitimacy of distributionally naïve approaches, and to call for distributionally sensitive forms of economic evaluation, such as "distributional cost-effectiveness analysis" [12–14].

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s10198-019-01126-2) contains supplementary material, which is available to authorized users.

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[1] A finding mirrored in Spain [45, 46], the United States [47] and Australia [25].

If the UK public's preferences towards inequalities in health are to be captured in distributionally sensitive economic evaluation, it would be valuable to understand the answers to three questions: (1) How averse are the UK public towards inequalities in lifetime health between socioeconomic groups? (2) Does the extent of that aversion differ depending upon the type of health (e.g. life extension, pain relief or mobility improvement) under consideration? (3) Are the UK public as averse to inequalities in health between socioeconomic groups as they are to inequalities in health between neutrally framed groups? This third question matters, as it is not immediately obvious whether or not it is normatively desirable for social health-related resource allocation decisions to be made based on socioeconomic status, or whether they should be based on health alone [15]. This systematic review focuses on these three questions.

Previous systematic reviews have focused on general public preferences regarding different broad criteria for prioritisation [16, 17], or preferences regarding differences in the future health of individuals [18–20]. This is the first systematic review to focus explicitly on the UK public's aversion to inequalities in lifetime health between socioeconomic groups, although an unsystematic review has recently been published [21]. The scope of this review is restricted to the preferences of the public in the UK, as the primary objective of the study is to inform distributionally sensitive economic evaluation in the UK.

Methods

Search strategy

Four databases were searched: Ovid MEDLINE (1946—27/10/2017), Ovid EMBASE (1974—26/10/2017), Ovid EconLit (1886—30/09/2017), and Web of Science's Social Sciences Citation Index (SSCI) (1956—27/10/2017). All searches were undertaken on 27/10/2017.

The search strategy was developed in an iterative fashion. First, six "pearls" [22] were identified as starting points, to provide the initial list of key words [6, 8, 23–26]. Second, the MeSH headings associated with these papers were recorded, and a word frequency analysis of the paper titles/abstracts was undertaken [27]. These were supplemented with additional terms based upon the search questions to generate an initial search strategy.[2] Following this, the reference lists of the pearls were reviewed, to identify additional papers. The sensitivity of the draft search strategy was then tested in MEDLINE, by assessing whether or not it could return the papers identified from those reference lists. If a paper was not identified, the search strategy was then updated with key terms from the unidentified paper. Further scoping searches were then conducted based upon this revised strategy, and the reference lists of potentially relevant papers scanned for other potentially relevant papers.

The search strategy was then tested again to assess whether it identified all papers identified in scoping searches, refined as needed, and the same process repeated until the reference list of all papers identified in scoping searches were picked up by the search strategy. The final MEDLINE search strategy is detailed in Online Appendix 1. Following the screening of the database search results, the selected papers were reviewed in detail, to identify potentially relevant journal publications, or grey literature, not captured within this search. These papers were then treated as new records, and screened accordingly.

Eligibility criteria

Papers were assessed for eligibility using six hierarchical inclusion criteria. First, papers published in English were included, and all others were excluded. Second, publications in peer-reviewed journals, reports published by NGOs/HTA bodies, and studies published in discussion papers by academic institutions, were included. All other publication types, including conference abstracts, were excluded. Third, experimental studies in which the stated preferences of participants were quantitatively elicited were included. Non-experimental revealed preference studies, non-quantitative studies, and reviews of prior studies, were excluded. Fourth, those studies featuring broadly representative samples of the UK adult general public were included.[3] Studies centred on selective samples of the UK population, such as students, policy makers and health care professionals were excluded. Studies featuring exclusively non-UK respondents, or for which it was not possible to isolate the preferences of UK respondents, were excluded. Fifth, studies were assessed for their ability to provide information on the extent of the public's aversion to inequalities in lifetime health between socioeconomic groups. Studies that explicitly asked, or

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[2] Note that this keyword supplementation means our search strategy captures both the keywords anticipated by the authors, and those used in the "pearls" [22]. Also, note that an iterative procedure was used to ensure that the search picked up all papers referenced in any of the identified papers. The combination of these two factors means that it is unlikely that the choice of pearls will have artificially narrowed the number of studies identified; although a non-pearl based, non-iterative procedure may have missed some of the studies we identified.

[3] This included samples recruited from limited geographical areas. These samples were included, as we were aware that practicality means that face-to-face research is commonly conducted in limited geographical areas. We did not want to bias our results in favour of online, geographically broad samples, and so opted to include these geographically limited studies.

could be implied as asking, respondents to make efficiency/equality trade-offs between individuals, or groups, with differing lifetime health in a range relevant to socioeconomic inequalities in health (life expectancy[4] or quality-adjusted life expectancy: >50 and <90 [1]) were included—irrespective of whether participants were told they were choosing between socioeconomic groups, or between neutrally framed groups in a comparable range of lifetime health. Two distinct strands of empirical literature were considered to be capable of providing this information—(1) stated preference studies focused on health inequality aversion[5] [28–30], and (2) stated preference studies focused on eliciting preferences regarding prioritising those individuals with a higher Burden of Illness, as defined by their absolute QALY shortfall in prospective health attributable to some illness[6] [31, 32].

Studies that did not apply a lifetime time-horizon, or that could not be utilised to infer aversion to lifetime health, were excluded. Stated preference studies that focused on severity, as defined by relatively poor quality of life [19], and preferences regarding treatment at the end of life [18] were excluded for this reason. Studies focused explicitly on inequality aversion in the context of gender, or differences in lifestyle, were also excluded. Finally, the choice perspective employed in each study was evaluated. Those studies that asked respondents to make choices in the context of public resource allocation decisions that did not affect them personally, for example how to allocate finite NHS resources between two groups they were not part of, were included. Those studies that asked respondents to make choices that would impact them, for example their willingness to trade-away their own wealth, were excluded.

Study selection

Study selection was conducted using a two-step process, with titles and abstracts screened first followed by screening of full papers. Eligibility criteria were applied sequentially in the order detailed above, with the first arising reason for exclusion recorded. The first two waves of screening were conducted by Simon McNamara. Abigail Steveley then independently reviewed a random sample of 20 full papers against the eligibility criteria. This independent review identified one discrepancy: the decision of whether or not to include a study by Petrou et al. [33]. The lead author of the study was contacted to clarify whether it used a general population sample, which resolved the discrepancy and the study was included. The audit identified no significant concerns regarding the screening undertaken.

Results

Search output

In total, 2155 unique records were screened after removing duplicates. Of these, 2059 were excluded based upon title and abstract alone, and 96 full-text articles were retrieved. Of these, 81 were excluded, leaving 15 final records (Fig. 1) [34]. The commonest reason for exclusion of full-text articles was the study population. Most of these excluded records were based on studies conducted in other countries, although a proportion were conducted in selective samples of the UK population, such as students or healthcare professionals. The conduct of the search, and rationale for exclusion of papers, is detailed in a PRISMA flow-chart, above [34].

Characteristics of included studies

Choice context

Of the 15 studies identified, 8 provided estimates of aversion to inequalities in health between neutrally labelled groups [23, 24, 31, 33, 35–38], whilst 7 provided estimates of aversion to inequalities in health between socioeconomic groups [6–9, 39–41].

Participants

Forty percent of identified studies recruited local samples, whilst 66.6%[7] recruited national samples. The identified studies ranged in size from only 26 participants [40], to 3669 participants [31]. On average, those studies that provided estimates of inequality aversion between neutrally labelled groups were substantially larger than those that provided evidence of aversion between socioeconomic groups (mean $n=1064$ vs. $n=154$).

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[4] For the avoidance of doubt, when we refer to “life expectancy” we refer to life expectancy from birth, and not remaining life-expectancy from a given point in time.

[5] This includes studies focused upon the “fair innings” argument, and its “extended” version that incorporates quality of life [30]—the idea that those individuals who are not expected to experience a ‘normal’ span of lifetime health should be prioritised over those who are. Note that lifetime health is expressed in terms of life expectancy from birth in the fair Innings argument, and in terms of quality adjusted life expectancy from birth in the extended fair Innings argument.

[6] Note that tests of BOI are founded upon shortfall in prospective health, rather than lifetime health. However, if we assume the impact of BOI on the preferences of the public is linear—as the literature on BOI does [31]—then estimates of preferences regarding BOI may be used to imply aversion to inequalities in lifetime health.

[7] Note that one study featured both a UK level, and local sample [7].

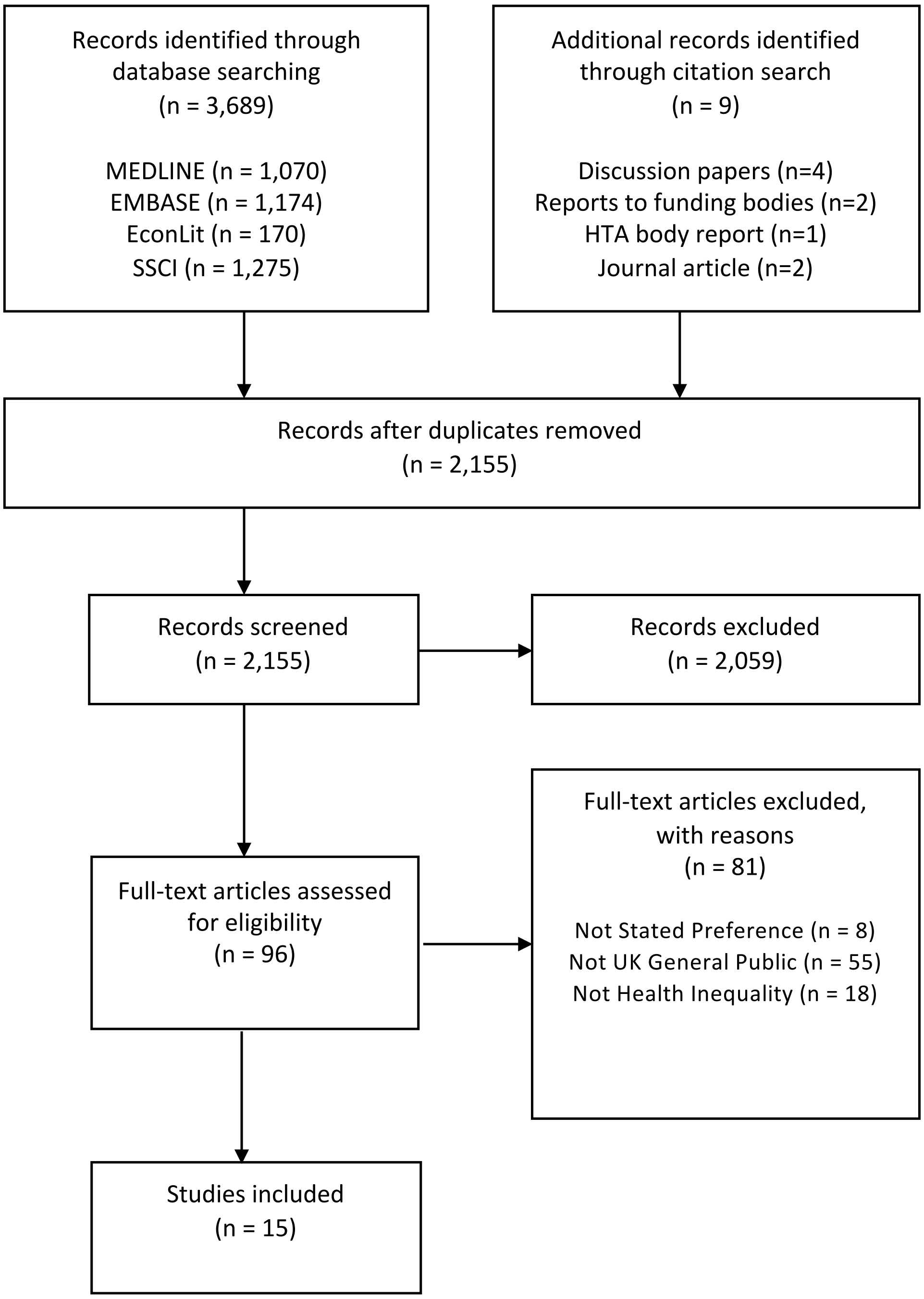

Fig. 1 PRISMA Flow Diagram

Mode of administration

The studies used a wide range of administration modes. These included individual interviews—both computer assisted [35, 36],[8] and paper-based [8, 24, 38]—postal questionnaires [9, 39], online studies [6, 7, 33, 37], and discussion groups featuring individual completion of choice exercises [7, 23, 40]. Of the discussion groups, one was a NICE Citizen's Council [40].

Methods

The 15 studies applied a variety of different methods. Four studies utilised a form of benefit trade-off (BTO), based upon a design first developed by Shaw et al. [6–9, 28]. Two studies applied discrete choice experiments (DCEs) [36, 37]

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[8] Note that Lancsar et al. [36] and Baker et al. [35] are both part of the social value of a QALY project, and that [35] is an overarching report that contains the results of the discrete choice experiment reported in [36], and other parts of the project, including a person trade off (PTO) study. Throughout this paper, when we refer to the Baker et al. [35] study we are referring to this PTO study.

Table 1 Identified studies—study characteristics

Authors (date)	Sample size	Sample population	Administration method	Method	Focus of relevant questions within study
Ali et al. (2017) [7]	135	York + UK	Group with individual response + online	BTO	Aversion to inequalities in YFH
Anand and Wailoo (2000) [39]	144	Leicester	Postal	Simple choice	Relevance of cause of inequality
Baker et al. (2010) [35]	587	England	CAPI	PTO	Social value of the QALY
Dolan and Tsuchiya (2005) [23]	100	Sheffield	Group with individual response	Ranking	Relevance of past/future health
Dolan and Tsuchiya (2011) [8]	130	York	Interview	BTO	Aversion to inequalities in LE
Edlin et al. (2012) [24]	559	England + Wales	Interview	Other choice	Relevance of cause of inequality
Lancsar et al. (2011) [36]	587	England	CAPI	DCE	Social value of the QALY
NICE (2006) [40]	26	England + Wales	Group with individual response + Citizens Council	Simple choice	Prioritising the socially disadvantaged
Petrou et al. (2013) [33]	2500	UK	Online	PTO + ranking	Fair innings
Rowen et al. (2016) [37]	371	UK	Interview + online	Other choice	BOI
Rowen et al. (2016) [31]	3669	UK	Online	DCE	BOI
Robson et al. (2017) [6]	244	England	Online	BTO	Aversion to inequalities in YFH
Tsuchiya et al. (2003) [38]	140	York	Interview	Ranking	Fair innings
Tsuchiya and Dolan (2007) [9]	271	UK	Postal	BTO	Aversion to inequalities in LE
Tsuchiya and Dolan (2009) [41]	128	Sheffield	Group with individual response	Ranking	Aversion to inequalities in LE

BTO benefit trade-off, *PTO* person trade-off, *DCE* discrete choice experiment, *CAPI* computer-assisted personal interview, *LE* life expectancy at birth, *YFH* years of life in full health over the average person's lifetime, *BOI* burden of illness

featuring multiple attributes, two featured a person trade-off (PTO) exercise [33, 35], and two featured simple choice questions[9] [39, 40]. Three studies used a form ranking exercise [33, 38, 41], whilst the remaining two studies featured other forms of choice exercise [24, 37].

Whilst a range of different methods were identified, these were not spread evenly across choice contexts. Both the DCEs [36, 37], and the two PTO [33, 35], studies elicited only aversion to inequalities in lifetime health between neutrally labelled groups, whilst all of the four Shaw et al. variant BTO studies [28] elicited aversion between socioeconomic groups.

The identified studies explored a range of different measures of lifetime health, including life-expectancy at birth [8, 9, 39, 41], age at death [33, 38], expected number of lifetime QALYs—presented as either decomposed profiles[10] [23, 35, 36], or composed values [24], BOI as expressed by the QALY [31, 37]—and the number of "years of life in full health over the average person's lifetime" [6, 7]. In those studies that elicited aversion to health inequality between socioeconomic groups, the labels given to the groups included: "the richest" and "the poorest" fifth of society [6, 7]; having a "wealthy background" or a "poor background" [39]; and social (occupational) "Class I" vs "Class V"[11] [8, 9, 41] (Tables 1, 2).

Findings of identified studies

Of the 15 identified studies, 8 provide evidence of health inequality aversion [6–9, 24, 33, 38], 2 provide evidence of no aversion [36, 39], and 5 provide mixed evidence [23, 31, 35, 37, 40]; see Table 3 above. Seven studies explored

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[9] When we refer to "simple choice questions" we mean questions did not present concrete outcome scenarios, and were more generally about prioritisation. In contrast, the "other forms" of exercise were more traditional choice experiments featuring outcomes, but that were not BTO/PTO studies.

[10] Decomposed = A health profile expressed in terms of length of life, and quality of life, not expressed as a QALY value. Composed = A health profile expressed in terms of QALYs.

[11] Class I = professional occupation, Class V = unskilled.

Table 2 Identified studies—context

Authors (date)	Tested inequality	Range of relevant inequality	Tested change
Ali et al. (2017) [7]	YFH	YFH: 62–74	YFH
Anand and Wailoo (2000) [39]	LE	LE: 70–84	Priority
Baker et al. (2010) [35]	LT QALYs (DC)	LT QALYs: <76	LT QALYs (DC)
Dolan and Tsuchiya (2005) [23]	LT QALYs (DC)	LT QALYs: <66	LT QALYs (DC)
Dolan and Tsuchiya (2011)[b] [8]	LE	LE: 73–78	LE
Edlin et al. (2012) [24]	LT QALYs (C + DC)	LT QALYs: 52–76	LT QALYs (C + DC)[a]
Lancsar et al. (2011) [36]	LT QALYs (DC)	LT QALYs: 60–80	LT QALYs (DC)
NICE (2006) [40]	General health	–	Priority
Petrou et al. (2013) [33]	Age at death	Age at death: 60–90	Extra years at full health
Rowen et al. (2016)[c] [37]	BOI QALYs (DC)	Absolute QALY burden framed	QALYs (DC)
Rowen et al. (2016)[c] [31]	BOI QALYs (DC)	Absolute QALY burden framed	QALYs (DC)
Robson et al. (2017) [6]	YFH	YFH: 62–74	YFH
Tsuchiya et al. (2003) [38]	Age at death	Age: 55–70	Age at death
Tsuchiya and Dolan (2007) [9]	LE	LE: 73 vs 78	LE
Tsuchiya and Dolan (2009) [41]	LE	LE: 73 vs 78	LE

BOI burden of illness, *LT* lifetime, *YFH* years of life in full health over the average person's lifetime, *DC* decomposed (QALY profile presented in terms of LE, and QoL, but not as a unified figure), *C* composed (QALY figure presented)

[a] [24] involves choices between different profiles, not changes in existing profiles, so this is technically not a "tested change"

[b] Note that [8] also tested aversion between the "healthiest" and "unhealthiest" quintiles of society, these labels are ambiguous and may be interpreted as reflecting the lifestyle of these groups, their lifestyle and their outcomes, or their outcomes alone. As a result, they were excluded

[c] Note that both Rowen et al. papers take a forward looking, rather than lifetime perspective—these studies are included under the assumption that BOI has a linear impact upon the preferences of the public (see "Eligibility criteria" for further detail)

Table 3 Identified studies—summary of results

Authors (date)	Choice context	Evidence of aversion to inequalities in lifetime health?	Atkinson (ε) parameter[a] [42]	Weight placed on a marginal gain to group with lower lifetime health[e]
Ali et al. (2017) [7]	Socioeconomic groups	Yes	10.87 or greater	6.8–∞
Anand and Wailoo (2000) [39]	Socioeconomic groups	No	1 (implied)	1
Baker et al. (2010) [35]	Neutrally framed groups	Mixed	–	–
Dolan and Tsuchiya (2005) [23]	Neutrally framed groups	Mixed	–	–
Dolan and Tsuchiya (2011) [8]	Socioeconomic groups	Yes	28.9	166.22
Edlin et al. (2012) [24]	Neutrally framed groups	Yes	5.76–7.63	2.77–3.86
Lancsar et al. (2011) [36]	Neutrally framed groups	No	1 (implied)	1
NICE (2006) [40]	Socioeconomic groups	Mixed	–	–
Petrou et al. (2013) [33]	Neutrally framed groups	Yes	> 1 (implied)	> 1
Rowen et al. (2016) [37]	Neutrally framed groups	Mixed	–	–
Rowen et al. (2016) [31]	Neutrally framed groups	Mixed	–	–
Robson et al. (2017) [6]	Socioeconomic groups	Yes	10.95	6.95
Tsuchiya et al. (2003) [38]	Neutrally framed groups	Yes	> 1 (implied)	> 1 (implied)
Tsuchiya and Dolan (2007) [9]	Socioeconomic groups	Yes	> 1 (implied)	> 1 (implied)
Tsuchiya and Dolan (2009) [41]	Socioeconomic groups	Yes	> 1 (implied)	> 1 (implied)

[a] Atkinson inequality aversion parameters are sometimes presented as "r" values, and sometimes presented as "ε" values. $\varepsilon = r + 1$

[b] Estimates derived based upon baseline inequality tested in [7] and [8]; 62 YFH vs 74 YFH. Atkinson inequality aversion parameters applied where possible—see [8]

aversion between socioeconomic groups, and eight explored aversion between neutrally framed groups.

Aversion to inequalities in health between socioeconomic groups

The seven studies that explored aversion between socioeconomic groups provide general, although not universal, evidence of aversion to inequalities in lifetime health across socioeconomic groups. Five provide support for inequality aversion [6–9, 41], one study provides mixed evidence [40], and one was opposed [39]. In those studies that provide evidence of aversion between socioeconomic groups, the strength of this preference was high. For example, Dolan and Tsuchiya [8] find that participants valued a marginal life-expectancy gain provided to an individual with a social class V (unskilled) occupation and a life-expectancy of 73, between 6.8 and 9.94 times that of a marginal gain provided to an individual with a social class I (professional) occupation with a life-expectancy at birth of 78. Ali et al. [7] estimate relative weights of 6.8 to ∞[12] on marginal gains, in response to questions asking respondents to allocate incremental gains in "years in full health over the average person's life" (YFH), to a poor individual with a YFH of 62 years, compared to a rich individual with a YFH of 74 years. For the same comparison, Robson et al. [6] find relative weights of 6.20–6.95.[13] In contrast, studies where aversion between socioeconomic groups was elicited using alternative methods found more mixed results. Anand and Wailoo [39] find only 8% of respondents felt that a poor individual, who has a life-expectancy of 70 years, should receive priority for the treatment of a disease over a rich individual, who has a life-expectancy of 85 years. The overwhelming majority (92%) believed the two should be treated equally.

One study—a NICE Citizens Council report—provided mixed evidence of aversion between socioeconomic groups [40]. In this study, a minority (40%) of respondents agreed that NICE should "issue guidance that concentrates resources on improving the health of the whole population … even if there is a risk of widening the gap between socioeconomic groups", whilst a majority (60%) were in favour of focusing resources on "the most disadvantaged members of our society" (p. 15). However, in the same study, 83% of participants agreed with the, seemingly contradictory, statement that "NICE should issue guidance that concentrates resources on where it will have the greatest impact on the whole population" (p. 23), and only 50% agreed with the statement "It is the responsibility of the NHS to attempt to narrow the gap between the least and most disadvantaged in our society in terms of public health" (p. 24).

Aversion to inequalities in health between neutrally labelled groups

Eight studies explored aversion to inequalities in lifetime health between neutrally labelled groups, in a range of lifetime health comparable to those tested in socioeconomic group framed studies (a quality-adjusted life expectancy or life expectancy > 50 and < 90 [1]) [23, 24, 31, 33, 35–38]. Three of the eight studies provided support for inequality aversion [24, 31, 33, 38], albeit at lower levels than identified in those studies focused on aversion between socioeconomic groups.

Edlin et al. [24] provide the highest estimate of aversion to inequalities in health between neutrally labelled groups. In this study, the authors tested aversion to two inequalities. In the first of these, "study state A" (68 QALYs vs 54 QALYs) the authors found respondents granted a weight of 3.1 to an incremental health gain to the worse off group. In the second, "study state B" (76 QALYs vs 52 QALYs) the authors found a weight of 3.5.[14] In contrast, Petrou et al. [33] estimate a weight of only 1.37,[15] on a 5-year life extension at perfect health, provided to someone who would otherwise die at age 60 years, compared to someone who would otherwise die at age 80 years. This finding is consistent with that of Tsuchiya et al. [38], who found the public were willing to prioritise granting a 5-year survival benefit to a 55-year old who will otherwise die immediately, over an equivalent gain to a 70-year old, albeit without estimating a precise weight on the strength of that preference.

Four of the eight studies provided mixed evidence of aversion to inequalities in health between neutrally labelled groups. Two of these [31, 37], were focused on quantifying public preferences towards granting priority to those individuals who have a higher burden of illness (BOI), as expressed by their QALY shortfall, over those with lower BOI. In the smallest of these two studies [37], the authors asked four questions relevant to this topic.[16] Three of these

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[12] In these cases, the median respondent violated monotonicity and preferred not to grant an incremental health benefit to the better off group, even when it came at no opportunity cost to the worse off group.

[13] Note that the weights presented for [6] and [7] are not directly comparable to those for [8], as [8] used a different baseline inequality than was tested in [6] and [7]. If the Atkinson inequality aversion parameter from [8] is applied to the inequality tested in [6] and [7], this produces an implied weight of 166.22 on a marginal gain to a poorer individual compared to a richer individual [(74/62)^(27.9 + 1)]—see [8] for details of how these weights are derived.

[14] If the Atkinson inequality aversion parameters (ε) estimated by Edlin are applied to the inequality tested in [6] and [7], this results in estimated weights on marginal gains to the group with lower health of 3.86 and 2.77 for A [(74/62)^(6.63 + 1)] and B, respectively, [(74/62)^(4.76 + 1)].

[15] See Table 5 in Petrou et al. [33]: 0.78/0.57 = 1.37.

[16] PQ2, Q1, Q2 and Q3.

questions provided no support for granting preference to those who had a higher BOI, whilst one provided modest evidence (59% support) of a preference towards prioritising the worse off. In the largest study [31], the same research team found evidence of a preference towards treating those with higher BOI, over those with lower BOI—implying an aversion to inequalities in lifetime health. However, when they then deconstructed the impact of BOI into that attributable to loss of life-expectancy, and loss of health-related quality of life, the authors found respondents preferred to prioritise those whose BOI was attributable to loss of length of life, and made the opposite choices about those who BOI was due to losses of health-related quality of life[17]—a finding consistent with the fair innings hypothesis, but not the extended fair innings hypothesis [30]. This finding is similar to that observed by Dolan and Tsuchiya [23], who found preferences consistent with aversion to differences in life-expectancy, but not quality-adjusted life-expectancy. In both of the questions that Dolan and Tsuchiya tested, participants ranked the opportunity to provide a health benefit to the individual with the lowest lifetime QALYs second to last out of the six options tested. This outcome appears to have primarily been driven by the fact that respondents were not as averse to differences in past-quality of life as would be suggested by the QALY model, and placed a much higher emphasis on length of life, than lifetime quality of life.

Baker et al. [35] also find mixed evidence on inequality aversion. In their PTO study, the authors evaluated respondents' preferences towards granting an incremental health gain to individuals who are expected to die at differing ages. This gain took the form of a 20% gain in health-related quality of life for their last 20 years of life (4 QALYs). In response to these questions, the authors found respondents preferred to give the incremental benefit to individuals who are due to die at age 60 years, rather than those who are due to die at age 80 years—with an estimated relative weight of 1.55[18] on the gain provided to those with lower lifetime health. However, in the same study, the authors conducted a series of "profile tests" in which the lifetime health of certain profiles was varied to test the extended fair-innings hypothesis (e.g. by changing past quality of life, or by granting the profiles additional length of life after the tested quality of life gain). In these profile tests, the authors find mixed results, with, if anything, "a tendency to favour those with higher lifetime health" (p. 45).

The sole study to provide evidence of no aversion to inequalities in health between neutrally labelled groups was that by Lancsar et al. [36]. In this DCE study, the authors find that the public place extremely low weights on the lifetime health of individuals in comparison to the magnitude of the health gain offered, and that these weights are marginally counter to the idea of aversion to inequalities in lifetime health. For example, the authors find the public place an incremental weight of 0.94 on an incremental health gain to someone with an age of death of 60, compared to someone with an age of death of 80.

Discussion

This review set out to do three things. First, to identify estimates of the strength of the UK public's aversion to inequalities in lifetime health between socioeconomic groups. Second, to explore whether the strength of this aversion differs depending upon the type of health under consideration. Third, to explore whether or not aversion differs depending upon whether participants were told that the inequality existed between socioeconomic groups, or neutrally framed groups. We identified 15 studies relevant to these aims.

The identified studies provide general, although not universal, support for the idea that the UK public are averse to inequalities in life expectancy (at birth) between socioeconomic groups. Similarly, the studies identified provide evidence that the public are averse to inequalities in life-expectancy (at birth) between neutrally framed groups in a comparable range of lifetime health. Eleven of the 15 studies identified provide evidence in support of aversion to inequalities in total life expectancy [6–9, 23, 24, 31, 33, 35, 38, 41], two provide evidence in opposition [36, 39], and two are inconclusive [37, 40]. However, the strength of aversion differed substantially between studies, with higher levels of aversion elicited for inequalities presented as being between socioeconomic groups than between neutrally framed groups. For example, Petrou et al. [33] and Baker et al. [35] estimate relative weights of only 1.37 and 1.55, respectively, on an incremental health gain provided to someone who will die at 60, compared to someone who will die at 80. In contrast, Dolan and Tsuchiya [8] estimate weights of 6.8–9.95 for a marginal health gain provided to an individual of lower socioeconomic status with a life-expectancy of 73 compared to an individual of higher socioeconomic status with a life-expectancy of 78. Similarly, it is notable that the Atkinson inequality aversion parameters estimated by Edlin et al. [24] in a neutral context are substantially lower than those estimated by Robson et al. [6], Ali et al. [7], and Dolan and Tsuchiya [8] in a socioeconomic context; see Table 3.

A small number of the identified studies suggest that the public may be more averse to an inequality of a given QALY magnitude if that inequality is due to differences in life-expectancy, rather than quality of life. Both Rowen et al.

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[17] Note that the questions themselves featured both form of BOI simultaneously, and that this effect is a product of the way these two were decomposed in the analysis undertaken.

[18] See Table 20 in [35]: 0.814/0.527 = 1.55.

[31] and Dolan and Tsuchiya [23] find that, whilst the public are averse to inequalities in quality-adjusted life expectancy (QALE) attributable to differences in life-expectancy, they are not averse [31], or as averse [23], to inequalities in QALE attributable to differences in quality of life. Similarly, in their profile tests, Baker et al. [35] find that the public prefer to prioritise those with better, rather than worse, past quality of life. This evidence suggests that public preferences regarding inequalities in health may be consistent with the "fair innings" argument based on duration of life, but may not be consistent with the "extended fair innings" argument that adjusts for quality of life [30]. None of the studies identified explored the possibility that health inequality aversion might depend upon the specific type of health gain under consideration (e.g., comparing aversion in the context of pain relief and life extension).

This review has three primary limitations. First, our inclusion of studies focused on BOI under the assumption that the impact of BOI on preferences is linear, which is an assumption that may or may not hold [31]. Sensitivity analysis indicates that the exclusion of the two BOI studies identified would not have an impact upon our conclusions regarding aversion to life-expectancy at birth. However, one of the three studies that suggests aversion to inequalities in lifetime health attributable to differences in quality of life may be lower than to those attributable to differences in length of life was a BOI-based study [31]. As a result, the strength of this conclusion would be weakened by excluding these studies. Second, our search was designed to inform distributionally sensitive economic evaluations conducted in the UK, and so was restricted to evidence on the views of people in the UK. As a consequence, the results themselves may be of limited generalisability to other countries. Third, the studies identified are methodologically heterogeneous, and report estimates of aversion in different ways. This makes it challenging to compare across studies and, with the exception of the four studies for which we calculated Atkinson inequality aversion parameters, it prevents any attempt at formal synthesis. The primary strength of this paper is the fact that it is the first systematic review of this kind; notably, we identified more studies than found in a recent unsystematic review of health inequality aversion [21].

Four key issues

Our findings raise four issues. First, if the public are averse to inequalities in health, does it make sense to continue to conduct, and use, distributionally naïve economic evaluations? [43]. Whilst this review demonstrates that it is challenging to quantify precisely how averse the public are to inequalities in health, the evidence available does suggest they are averse. The distribution of health gains appears to matter to the UK public, and ignoring this preference by continuing to conduct distributionally naïve economic evaluation is a choice that runs counter to this preference. Second, if we want to introduce consideration of inequalities into economic evaluation, what level, or levels, of aversion should be implemented in practice?[19] This is a critical question, because the prioritisation of equality has a human cost [30, 44]. If we choose to prioritise equality, we accept there will be more suffering, and loss of life, than might otherwise be present in our society. Conversely, if we choose not to prioritize equality, we choose to accept that the social burden of ill health will be disproportionately placed on the poor. The level of inequality aversion incorporated in an economic evaluation would quantify the acceptable human cost of a given improvement in equality, and so it is critical to define it in a considered way. This review found wide variation in estimates of public preferences regarding inequalities across studies, which highlights the challenge of selecting a single estimate of aversion to implement. Given this variation, those conducting economic evaluations would be wise to undertake sensitivity analyses surrounding the relative weight they give to the distribution of health gains and average population health gains. If distributionally sensitive economic evaluation is to become more widespread in the UK, it would be valuable for a body like NICE or Public Health England to define a reference level of health inequality aversion (perhaps using a Citizen's Council comparable to [40]), so that those conducting these analyses can present their work in a comparable and consistent manner. Again, note that if these bodies do not comment on this issue, this equates to an endorsement of a status quo in which the reduction of inequalities in health carries no weight in economic evaluation. Third, if aversion to socioeconomic inequalities in health is higher than aversion to neutrally framed inequalities of equivalent magnitude, which (if either) strength of aversion is the appropriate one to reflect in distributionally sensitive economic evaluation? Should estimates of aversion from neutrally framed studies be used because this removes the influence of non-health factors upon respondents' preferences? Or should estimates of aversion from socioeconomically framed studies be used because this reflects the fact that inequalities in health between socioeconomic groups are systematic, as opposed to being random variation within the population, and so may be considered inequitable? Fourth, is health inequality aversion consistent with the QALY model, or does the type of health matter to the public? If aversion does differ depending upon whether the public are asked about life-expectancy, pain relief, or any other form of health gain: how should this be accounted for in distributionally

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[19] Note that this point applies equally to the development of indices of population health that account for aversion to inequalities in health [48, 49].

sensitive economic evaluation? Can QALY-based distributional cost-effectiveness analysis represent the views of the public?

In conclusion, this review suggests that the UK public are averse to inequalities in life expectancy between socioeconomic groups, albeit with wide variation in the strength of this preference between studies. We find evidence of aversion between neutrally framed groups; however, the UK public appears to be more averse to inequalities in health between socioeconomic groups. We find limited evidence that the composition of an inequality may impact the strength of aversion, and in particular, that the public may be less averse to an inequality of a given QALY magnitude if that inequality is due to differences in quality of life, rather than life-expectancy.

Acknowledgements Simon McNamara is funded by the ScHARR Wellcome Trust Doctoral Training Centre in Public Health, Economics and Decision Science. The authors are grateful to Allan Wailoo, Donna Rowen, Joanna Coast and attendees at the Summer 2018 meeting of the Health Economists' Study Group, for providing comments on an earlier draft of this paper. We would also like to thank two anonymous reviewers for their comments on the paper.

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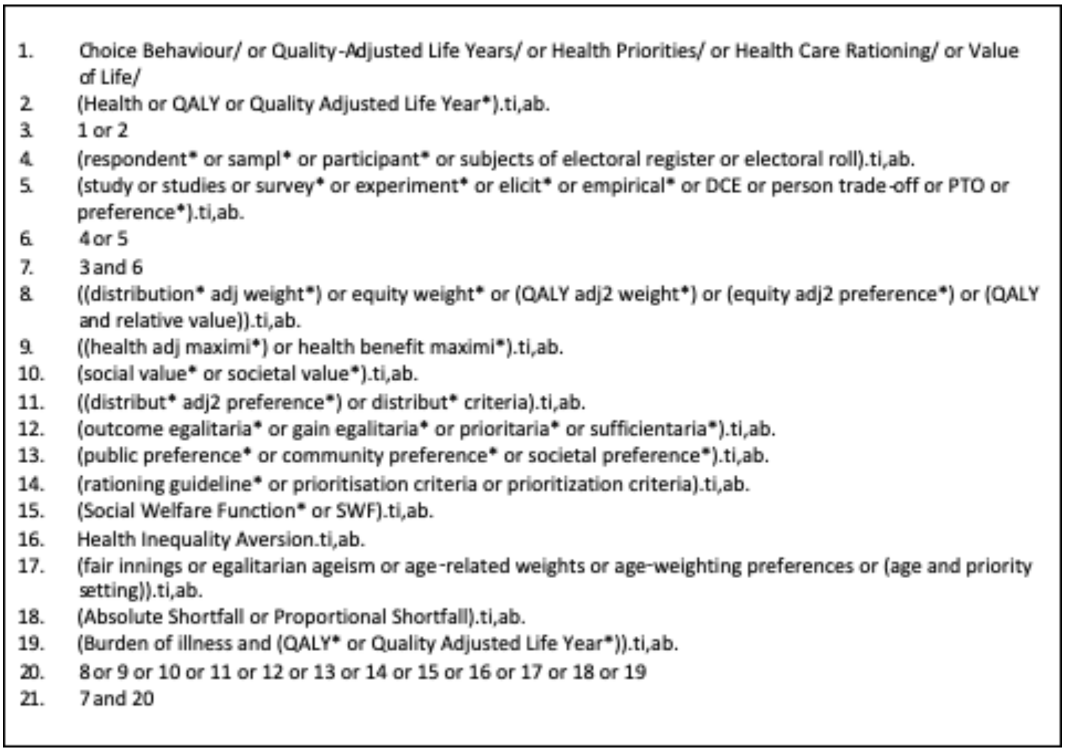
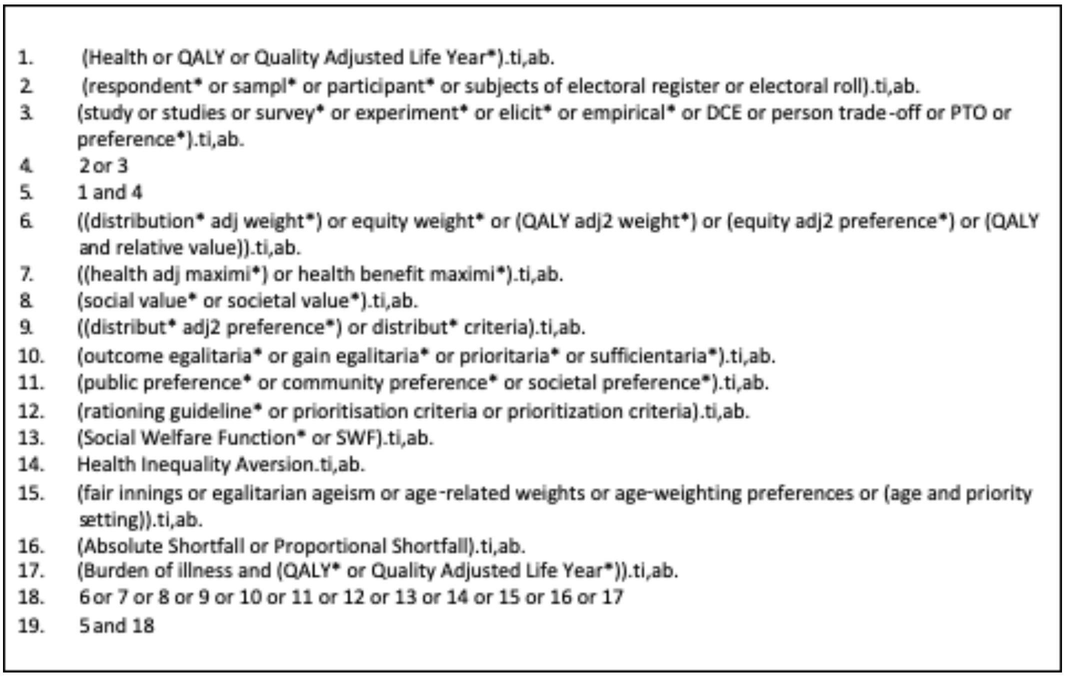
APPENDIX A2.1. McNamara et al. (2020a) online supplementary materials.

Figure 2.1: *MEDLINE Search Strategy*



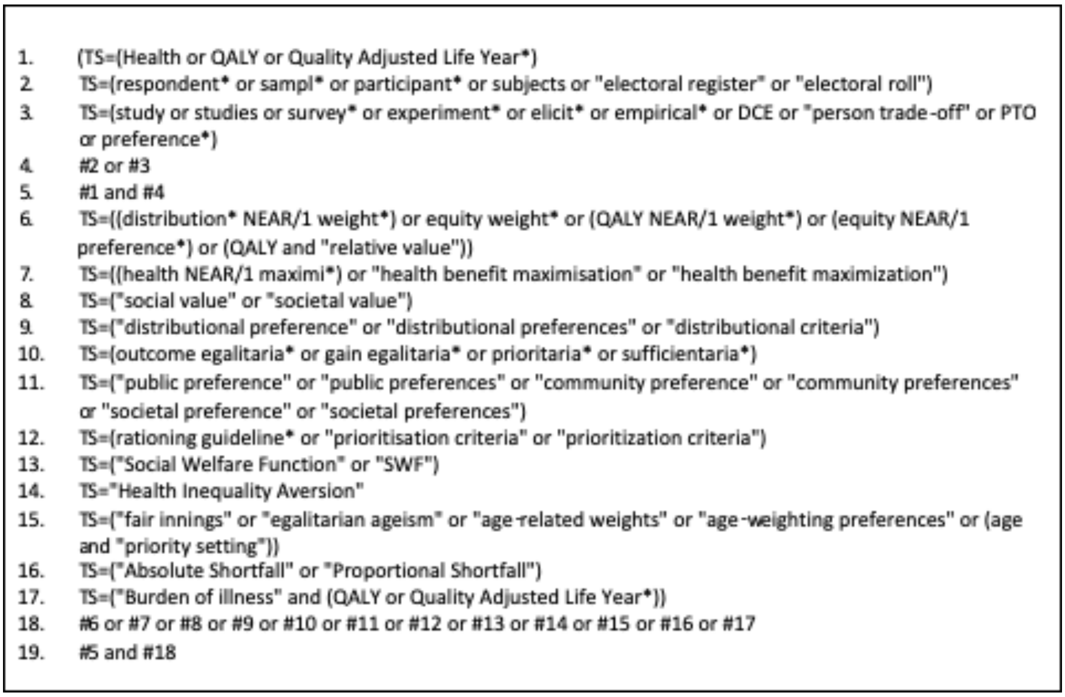
1. Choice Behaviour/ or Quality-Adjusted Life Years/ or Health Priorities/ or Health Care Rationing/ or Value of Life/
2. (Health or QALY or Quality Adjusted Life Year*).ti,ab.
3. 1 or 2
4. (respondent* or sampl* or participant* or subjects of electoral register or electoral roll).ti,ab.
5. (study or studies or survey* or experiment* or elicit* or empirical* or DCE or person trade-off or PTO or preference*).ti,ab.
6. 4 or 5
7. 3 and 6
8. ((distribution* adj weight*) or equity weight* or (QALY adj2 weight*) or (equity adj2 preference*) or (QALY and relative value)).ti,ab.
9. ((health adj maximi*) or health benefit maximi*).ti,ab.
10. (social value* or societal value*).ti,ab.
11. ((distribut* adj2 preference*) or distribut* criteria).ti,ab.
12. (outcome egalitaria* or gain egalitaria* or prioritaria* or sufficientaria*).ti,ab.
13. (public preference* or community preference* or societal preference*).ti,ab.
14. (rationing guideline* or prioritisation criteria or prioritization criteria).ti,ab.
15. (Social Welfare Function* or SWF).ti,ab.
16. Health Inequality Aversion.ti,ab.
17. (fair innings or egalitarian ageism or age-related weights or age-weighting preferences or (age and priority setting)).ti,ab.
18. (Absolute Shortfall or Proportional Shortfall).ti,ab.
19. (Burden of illness and (QALY* or Quality Adjusted Life Year*)).ti,ab.
20. 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19
21. 7 and 20

Figure 2.2: *EMBASE Search Strategy*



1. (Health or QALY or Quality Adjusted Life Year*).ti,ab.
2. (respondent* or sampl* or participant* or subjects of electoral register or electoral roll).ti,ab.
3. (study or studies or survey* or experiment* or elicit* or empirical* or DCE or person trade-off or PTO or preference*).ti,ab.
4. 2 or 3
5. 1 and 4
6. ((distribution* adj weight*) or equity weight* or (QALY adj2 weight*) or (equity adj2 preference*) or (QALY and relative value)).ti,ab.
7. ((health adj maximi*) or health benefit maximi*).ti,ab.
8. (social value* or societal value*).ti,ab.
9. ((distribut* adj2 preference*) or distribut* criteria).ti,ab.
10. (outcome egalitaria* or gain egalitaria* or prioritaria* or sufficientaria*).ti,ab.
11. (public preference* or community preference* or societal preference*).ti,ab.
12. (rationing guideline* or prioritisation criteria or prioritization criteria).ti,ab.
13. (Social Welfare Function* or SWF).ti,ab.
14. Health Inequality Aversion.ti,ab.
15. (fair innings or egalitarian ageism or age-related weights or age-weighting preferences or (age and priority setting)).ti,ab.
16. (Absolute Shortfall or Proportional Shortfall).ti,ab.
17. (Burden of illness and (QALY* or Quality Adjusted Life Year*)).ti,ab.
18. 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17
19. 5 and 18

Figure 2.3: *EconLit Search Strategy*



1. (TS=(Health or QALY or Quality Adjusted Life Year*)
2. TS=(respondent* or sampl* or participant* or subjects or "electoral register" or "electoral roll")
3. TS=(study or studies or survey* or experiment* or elicit* or empirical* or DCE or "person trade-off" or PTO or preference*)
4. #2 or #3
5. #1 and #4
6. TS=((distribution* NEAR/1 weight*) or equity weight* or (QALY NEAR/1 weight*) or (equity NEAR/1 preference*) or (QALY and "relative value"))
7. TS=((health NEAR/1 maximi*) or "health benefit maximisation" or "health benefit maximization")
8. TS=("social value" or "societal value")
9. TS=("distributional preference" or "distributional preferences" or "distributional criteria")
10. TS=(outcome egalitaria* or gain egalitaria* or prioritaria* or sufficientaria*)
11. TS=("public preference" or "public preferences" or "community preference" or "community preferences" or "societal preference" or "societal preferences")
12. TS=(rationing guideline* or "prioritisation criteria" or "prioritization criteria")
13. TS=("Social Welfare Function" or "SWF")
14. TS="Health Inequality Aversion"
15. TS=("fair innings" or "egalitarian ageism" or "age-related weights" or "age-weighting preferences" or (age and "priority setting"))
16. TS=("Absolute Shortfall" or "Proportional Shortfall")
17. TS=("Burden of illness" and (QALY or Quality Adjusted Life Year*))
18. #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17
19. #5 and #18

APPENDIX A2.2. Search update

A2.2.1. Methods

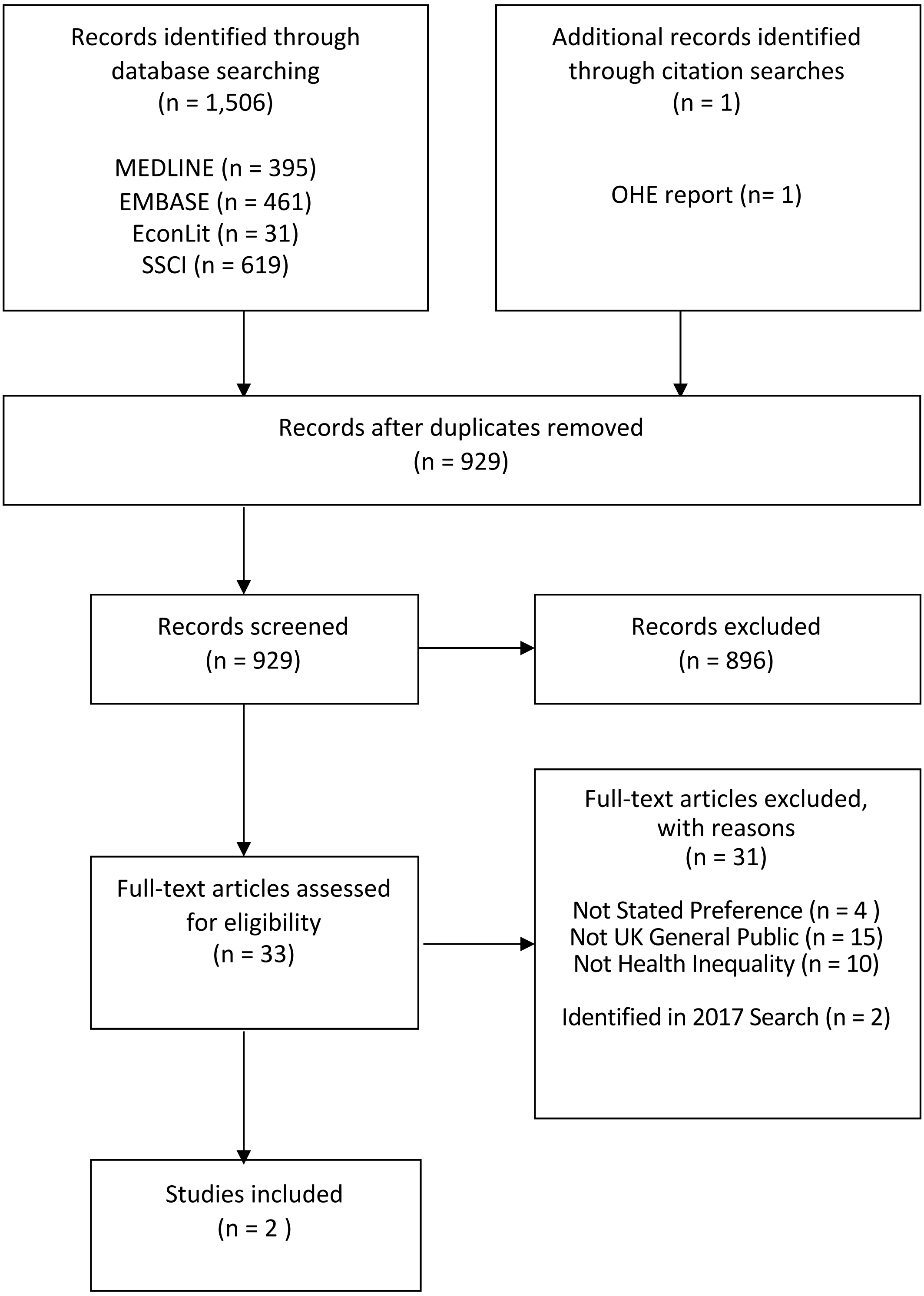
The search was updated on 21/04/2020. The search strategies, databases, and inclusion/exclusion criteria employed were identical to those in the initial search (previously conducted on 27/10/17). Database searches were supplemented with hand-reviews of the citation lists of identified records, and use of Google Scholar to identify papers that had cited the 15 papers identified in the initial review. Papers published before 2017 were excluded without screening. Records published in 2017 were reviewed in order to ensure relevant papers published between the initial search date and the end of 2017 were identified. All studies identified in the initial search were excluded. As in the initial review, a two-step process was used to screen potentially relevant records. First, titles/abstracts were screened against the hierarchical inclusion/exclusion criteria. Second, full-text versions of potentially relevant records were retrieved and evaluated. I (SM) undertook both phases of the screening alone. In contrast to the initial review, my inclusions/exclusions in the second sift were not validated by a second reviewer. This is a limitation of the updated review.

A2.2.2. Results

Search output

In total, 930 unique records were screened. Of these, 896 were excluded based on the review of titles and abstracts; and 33 full text articles were retrieved; of which 31 full text articles did not meet the inclusion/exclusion criteria and were excluded. Two studies were identified: a paper by Cookson et al. (2018) and a report from the Office of Health Economics (Hampson et al., 2019). Cookson et al. (2018) was identified through database screening. Hampson et al. (2019) was identified via the Google Scholar citation checking: the authors cited Rowen et al. (2016b). Figure 2.4, below, shows the conduct of the search and screening.

Figure 2.4: *Search PRISMA flow diagram*



Identified studies

Characteristics of identified studies

Cookson et al. (2018) explored (1) aversion to inequalities in health between socioeconomic groups, and (2) how estimates of aversion may vary depending on the methods used to elicit it[3]. The authors employed the same “benefit-trade-off” (BTO) exercise applied by Robson et al. (2017) and Ali et al. (2017): a variant of the design first developed by Shaw et al. (2001). In this exercise, participants are told that people in the poorest fifth of society experience 62 “years in full health [YFH] over the average person’s life”, and that people in the richest fifth of society experience 74 YFH. Respondents are then asked to make choices between scenarios that would change the YFH experienced by these two groups. Participant responses are then analysed to provide insight into their relative willingness to provide incremental YFH to each. The authors fielded the study in a sample of 60 residents of York: a city in the north of England. Participants were randomised to either a paper-based, or an interactive “e-learning” spreadsheet-based, variant of the exercise. Each respondent took part in a discussion group about socioeconomic inequalities in health, and then completed their allocated exercise twice: once before watching an “e-learning” video that outlined different normative positions that could be applied in the choice exercise, and once after. This resulted in a 2x2 design: pre-video paper completion; pre-video spreadsheet completion; post-video paper completion; post-video spreadsheet completion. The authors primary interest was exploring the impact of the two e-learning exercises on participant responses to the BTO tasks. Table 2.1, below, summarises the characteristics of the Cookson et al. (2018) study. In this table, “CAPI” denotes “Computer assisted person interview”; “BTO” represents “Benefit-trade-off”; and “YFH” is shorthand for “years of life in full health over the average person’s lifetime”.

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[3] Specifically, the impact of introducing “e-learning” exercises on participants apparent aversion to socioeconomic inequalities in health. Further information on these “e-learning” exercises is provided below.

Table 2.1: *Characteristics of study by Cookson et al. (2018)*

Choice context	Socioeconomic groups
Sample size	60 (59 in analysis set)
Sample population	York
Administration method	Group with individual response, CAPI/Paper
Method	BTO
Focus of relevant questions	Aversion to inequalities in YFH
Tested inequality	YFH
Range of relevant inequality	YFH: 62–74
Tested change	YFH

Hampson et al. (2019) fielded an online multi-attribute discrete choice experiment (DCE). The study was designed to elicit the UK-public's (n=1,000) willingness to prioritise curative therapies over non-curative therapies. The authors defined a cure as a treatment that restored "individuals to normal life expectancy and full quality of life". The authors included five attributes in their DCE, of which two defined the burden-of-illness (BOI) attributable to the condition: the gap between the impacted individual's current health and the health they could achieve if cured. The first of these attributes was the loss in life-expectancy. The second was loss in quality-of-life. These attributes define differing levels of lifetime health. As a result, under the assumptions outlined in the initial review (page 277 of McNamara et al. 2020a), this study is capable of providing insight into the UK-public's willingness to prioritise neutrally labelled individuals with lower lifetime health over neutrally labelled individuals with higher lifetime health. This is analogous to the two BOI-focused studies identified in the initial search (Rowen et al., 2016b, 2016a). Table 2.2, below, summarises the Hampson et al. (2019) study characteristics. In this table, "DCE" is shorthand for "Discrete Choice Experiment"; "BOI" is "Burden of illness"; and "DC" is "decomposed" (a QALY profile presented in terms of LE, and QoL, but not as a unified figure).

Table 2.2: *Characteristics of study by Hampson et al. (2019)*

Choice context	Neutrally framed groups
Sample size	1000
Sample population	UK
Administration method	Online
Method	DCE
Focus of relevant questions	BOI
Tested inequality	BOI QALYs (DC)
Range of relevant inequality	Absolute BOI
Tested change	QALYs (DC)

Results of identified studies

Cookson et al. (2018) provide evidence the UK-public are averse to inequalities in health between socioeconomic groups. In all four study conditions (paper/spreadsheet; pre/post-video), the median respondents were willing to prioritise YFH-gains provided to people from the poorest fifth of society above those provided to people from the richest fifth of society. In both spreadsheet conditions, the median respondents made choices consistent with placing a 2.6:1 weight on a marginal health gain provided to someone with a YFH of 62 from the poorest fifth of society compared to someone with a YFH of 74 from the richest fifth of society (Atkinson inequality aversion parameter[4] ε=5.4). In the pre-video paper condition, the median respondent expressed preferences that violated monotonicity: they chose scenarios in which the YFH of people from the richest fifth of society would be lower than would otherwise be achievable at no opportunity cost to people from the poorest fifth of society. In the post-video paper condition, inequality aversion was lower than in the pre-video paper condition. The median respondent in this condition made choices consistent with placing a 7.0:1 weight on a marginal health gain provided to people from the poorest fifth of society compared to people in the richest fifth of society (Atkinson inequality aversion parameter ε=10.9).

Hampson et al. (2019) provide evidence that the UK-public are not averse to inequalities in lifetime heath between neutrally framed groups. Interestingly, the authors find that, if anything, the UK-public prefer to prioritise health gains provided to people with higher lifetime health over those provided to people with lower lifetime health. The au-

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[4] Note that higher ε values indicate higher levels inequality aversion.

thors note that the coefficients associated with the lifetime health variables were relatively small compared to the ones for improvements in health. Subsequently, they state that it appears that lifetime health was not a major driver of respondent choices.

A2.2.3. Discussion

Aim 1: identify estimates of the strength of the UK public's aversion to inequalities in lifetime health between socioeconomic groups

I identified one new study relevant to this aim (Cookson et al., 2018). This study provides further evidence the UK-public are willing to prioritise health gains provided to disadvantaged socioeconomic groups over those provided to advantaged socioeconomic groups. This is consistent with the findings of the initial review.

In the pre-video paper condition, the strength of inequality aversion estimated (Atkinson inequality aversion parameter[5] ε=10.9) was close to those estimated by Robson et al. (2017)(Atkinson ε= 10.95) and Ali et al. (2017)(Atkinson ε=10.87). The Atkinson ε parameter estimated for the pre-video e-learning spreadsheet condition (ε=5.4) was lower than that estimated for the pre-video paper condition (ε=10.9). Similarly, the inequality aversion of the median respondent in the post-video paper condition was substantially lower than in the pre-video paper condition. These results suggest that the UK-public's apparent aversion to socioeconomic inequalities is conditional upon the way that aversion is elicited, and specifically: that exercises designed to prompt respondents to think more carefully about their choices are likely to prompt them to become more efficiency focused/less inequality averse.

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[5] See Appendix A1.1 for the functional form associated with this parameter.

Aim 2: explore whether the strength of this aversion [to socioeconomic inequalities in health] differs depending upon the type of health under consideration.

I identified no new evidence directly relevant to this aim. Cookson et al. (2018) used the YFH metric previously employed by Robson et al. (2017) and Ali et al. (2017), and did not explore whether aversion differs by health type.

Aim 3: explore whether or not aversion differs depending upon whether participants were told that the inequality existed between socioeconomic groups, or neutrally framed groups.

I identified no direct test of the influence of group-type upon inequality aversion. However, the fact that Cookson et al. (2018) provide evidence of aversion to inequalities in health between socioeconomic groups, and Hampson et al. (2019) provide no evidence of aversion between neutrally-labelled groups, is consistent with one of the findings of the initial review: that the UK-public appear to be more averse to inequalities in health between socioeconomic groups than neutrally framed groups. As per the initial review, it should be noted that no study has tested this directly, and that this conclusions is based on naïve comparisons across studies that applied different methodologies.

The results of Hampson et al. (2019) provide further evidence of inconsistency in the UK-public's apparent aversion to inequalities in health between neutrally labelled groups. Of the nine neutrally framed studies identified, two provide evidence of no aversion (Hampson et al., 2019; Lancsar et al., 2011), three provide evidence of aversion (Edlin et al., 2012; Petrou et al., 2013; Tsuchiya et al., 2003), and four provide mixed evidence of aversion (Baker et al., 2010; Dolan and Tsuchiya, 2005; Rowen et al., 2016b, 2016a). This mixed evidence means it is unclear whether or not the UK-public are averse to inequalities in health between neutrally labelled groups.

In conclusion, this update provides further evidence that the UK-public are averse to inequalities in lifetime health between socioeconomic groups. I find no evidence on the influence of health type on the strength of this aversion. I find no studies that explore the impact of group-type on inequality aversion; however, the results of the two newly identified studies are consistent with the hypothesis that the UK-public are more averse to inequalities in health between socioeconomic groups than between neutrally labelled groups.

APPENDIX A2.3. How this chapter contributes to this thesis as a whole

In totality, this chapter: (1) grounds the empirical work that follows Chapter 4, 5 and 6, in existing literature; (2) demonstrates the novelty of the two central hypotheses of this thesis; and (3) provides indirect evidence in support of Hypothesis A (the UK-public are more averse to inequalities in lifetime health between socioeconomic groups than they are to inequalities in lifetime health between neutrally labelled groups). In combination with the rationales outlined in Chapter 1, these findings motivate future direct tests of the two hypotheses.

When considering this chapter, it should be noted the review is limited to solely studies that explored the preferences of the UK-public. Similarly, it did not set out to explore in general whether the composition of an incremental QALY gain impacts the social value the public place on that QALY gain: a factor that could explain any differences in the public's willingness to prioritise disadvantaged groups over advantaged groups for different types of QALY gain. As a result, this chapter does not consider all studies that may provide information relevant to the two hypotheses of this thesis. Other studies relevant to the two hypotheses, but outside the scope of this review[6], are discussed in Chapter 1 when introducing the two hypotheses themselves.

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[6] e.g. Hurley et al., 2020; Lancsar et al., 2020; Pinho & Botelho, 2018; Ryen & Svensson, 2015; Shah et al., 2019.

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Chapter 3: How could, and will, the hypotheses be tested?

Chapter 1 introduced two hypotheses. Chapter 2 reviewed existing stated preference evidence relevant to these hypotheses. This review identified no direct tests of either hypothesis. In combination, these prior chapters motivate the empirical work that follows in this thesis.

This chapter is designed to act as a methodological bridge between the two prior chapters and the *de novo* studies that follow. It does this by first outlining the methods that could be used to test the two hypotheses, and explaining the decision to use one of these methods: person-trade-off (PTO). Subsequently, the chapter details the various ways PTO could, and will, be practically implemented. Finally, it provides a brief overview of the three *de novo* studies reported in subsequent chapters.

3.1. Methods that could, and will, be used

This section features three sub-sections: the first details the information required to test the two hypotheses; the second outlines the methods that could provide this information; the third explains which of these methods will be used, and why.

3.1.1. Which information is required to test the two hypotheses?

Two pieces of information are required to test Hypothesis A (the UK-public are more averse to inequalities in lifetime health between socioeconomic groups than they are to inequalities in lifetime health between neutrally labelled groups): first, an estimate of the extent of the UK-public's aversion to inequalities in lifetime health between socioeconomic groups; second, an estimate of the extent of their aversion to inequalities in lifetime health between neutrally labelled groups. These two estimates may then be compared in order to evaluate whether Hypothesis A holds.

Similarly, two pieces of information are required to test Hypothesis B (the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health if an intervention improves life-expectancy than they are if it improves quality-of-life): first, an estimate of the extent of the UK-public's willingness to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health for an intervention that improves life-expectancy; second, an equivalent estimate for an intervention that improves quality-of-life. These may then be compared in order to assess whether Hypothesis B holds.

Note both hypotheses include the word "more" (Hypothesis A: "more averse"; Hypothesis B: "more willing"). Given this, quantitative estimates of the *extent* of the UK-public's preferences are required to test the each of the hypotheses. This point is important, because, as outlined in Chapter 2, some methods provide evidence of whether or not the public *are* averse to inequality, but are incapable of providing quantitative estimates of the *extent* of that aversion (e.g. those used by Anand & Wailoo (2000) and NICE (2006)). Given this, these methods cannot be used to test the two hypotheses of this thesis.

3.1.2. Which methods could provide this information?

This sub-section first outlines the methods that have previously been used to elicit the extent of the public's aversion to socioeconomic inequalities in lifetime health. It then details methods that have yet to be to used for this purpose, but which could be.

3.1.2.1. Methods previously used to elicit aversion to socioeconomic inequalities in lifetime health[1]

The studies/methods detailed here were identified using the review reported in Chapter 2. This was done in two ways. First, using the final results of the review itself. Second, using the screening records from that review to identify studies fielded outside the UK, and/or in non-public samples. This was achieved by retrieving, and screening, the 821 records[2] previously excluded on grounds of participant-type. Abstracts that provided sufficient information to indicate the study did not elicit aversion to socioeconomic inequalities in lifetime health were excluded. The remaining studies were retrieved and evaluated[3]. This identified a further eight studies fielded outside the UK (Abásolo & Tsuchiya, 2004, 2013; Bleichrodt, Rohde, & Van Ourti, 2012; Hurley, Mentzakis, & Walli-Attaei, 2020; Lal et al., 2019; Lal, Siahpush, Moodie, Peeters, & Carter, 2018; Norman, 2013; Pinho & Botelho, 2018). The methods used in these studies, and those identified in Chapter 2, are detailed below.

Three types of method are discussed: benefit-trade-off designs based on Shaw et al. (2001); benefit-trade-off designs based on Bleichrodt et al. (2012); and the Norman et al. (2013) multi-attribute discrete choice experiment.

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[1] Note that there is also a literature on aversion to socioeconomic inequalities in mortality due to specific conditions (Lindholm, Rosén, & Emmelin, 1998), prevalence of illness (Blacksher et al., 2010; Shaw et al., 2001), and waiting times for interventions (Gibbs, Powell, & Tsuchiya, 2019). As these studies are not concerned with aversion to *inequalities in lifetime health*, they are not included here. Instead, the methods/approaches used in these studies inform the discussion regarding alternatives methods provided later in this section.

[2] In the initial search 586 papers were excluded on this ground in the first sift, and 34 were excluded on this ground in the second. In the updated search the equivalent figures were 186 and 15.

[3] This process was not intended to be a comprehensive systematic review of the kind detailed in Chapter 2. As a result, reasons for exclusion were not recorded, and no hand searches were conducted. Due to these issues, this review should be regarded as being of lower quality than that discussed in Chapter 2. Given this, it is possible potentially relevant studies may have been omitted. Nevertheless, this process is sufficient for my aim here: to give an overview of the kinds of methods that have been applied in prior studies, without claiming to have comprehensively detailed every method applied.

3.1.2.1.1. Benefit-trade-off (BTO) designs based on Shaw et al. (2001)

Eleven studies use BTO[4] designs based on Shaw et al. (2001) to elicit aversion to socioeconomic inequalities in lifetime health: two Spanish studies (Abásolo & Tsuchiya, 2004, 2013); six from the UK (Ali, Tsuchiya, Asaria, & Cookson, 2017; Cookson, Ali, Tsuchiya, & Asaria, 2018; Dolan & Tsuchiya, 2011; Robson, Asaria, Cookson, Tsuchiya, & Ali, 2017; Tsuchiya & Dolan, 2007, 2009), one in Portugal (Pinho & Botelho, 2018), and two in Australia (Lal et al., 2019, 2018).

In a Shaw-style BTO study, participants are, typically, asked to choose between pairs of hypothetical scenarios that offer differing levels of life-expectancy, or variants thereupon[5], to two socioeconomic groups. Respondent choices are then used to infer the extent of their inequality aversion.

An example

Figure 3.1, below, provides an illustrative example of a Shaw-style question. In this case, participants are presented with two interventions ("Programs") that would benefit the poorest fifth of society and the richest fifth of society. The poorer group have a pre-intervention life-expectancy of 77 years, and the richer group of society have a pre-intervention life-expectancy of 84 years. If Program A is selected, the life-expectancy of both groups would increase by four years (to 81 and 88 respectively). If Program B is chosen, the life-expectancy of the poorer group would increase by six years, and that of the richer group would increase by two years (to 83 and 86 respectively). Participants are, typically, told that the additional years of life-expectancy provided by the interventions will be experienced in perfect health. The respondents are then asked "which Program should the government choose?" (A, B, or indifferent).

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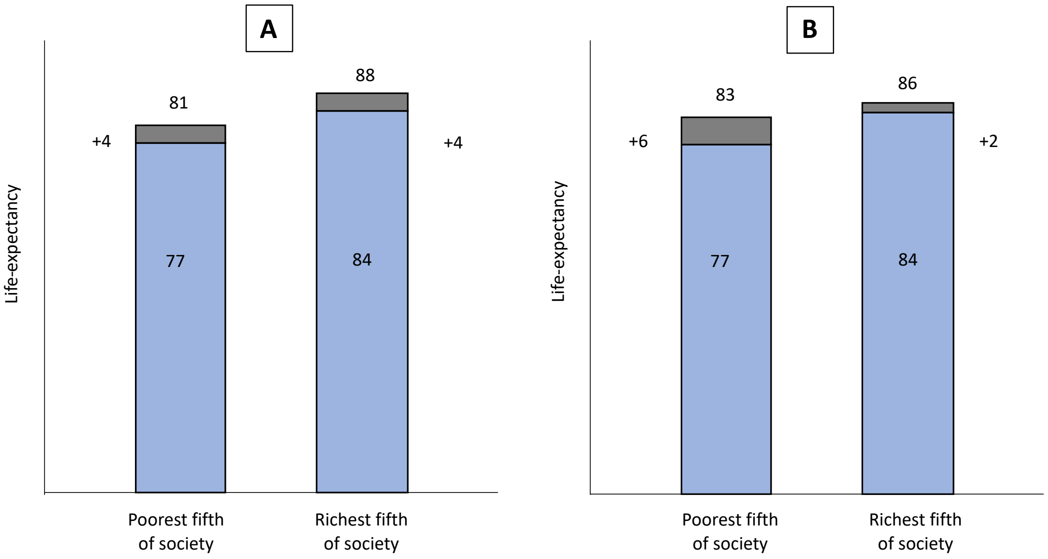
[4] BTO has also been referred to as "gain trade off" (GTO) (Mæstad & Norheim, 2009).

[5] For example, "years in full health over the average person's life" (Ali et al., 2017; Cookson et al., 2018; Robson et al., 2017).

Figure 3.1: *An example Shaw-style question: which program should the government choose?*



In this choice-set, both alternatives are equally efficient: each provides an average gain of four years per beneficiary. However, they differ in their impact on inequality. B reduces it from seven years to three years. A maintains it. As a result, participant choices between these Programs provide information about their concern for inequality. If a participant selects A (equal gains to both), we can interpret that they are not averse to inequalities in life-expectancy. This is because B would have reduced the inequality between the two groups at no cost to efficiency. As a result, we can interpret that a respondent who answers in this way is not averse to the inequality in life-expectancy between the two groups, and may favour it[6]. Alternatively, if they pick B, we can infer that they are averse to inequalities in life-expectancy between the two groups.

Figure 3.2, below, provides an example of a Shaw-based BTO question that might be presented to a participant who chose B (pro-poor) in Figure 3.1, above. The two options now differ in their efficiency, and their effect on inequality. Program A remains as it was (81 for the poorer group, and 88 for the richer group). Program B still offers a six year increase in life-expectancy to the poorest fifth of society; however, it now provides only a one (rather than two) year increase to the richest fifth of society (83 vs 85). A gives an

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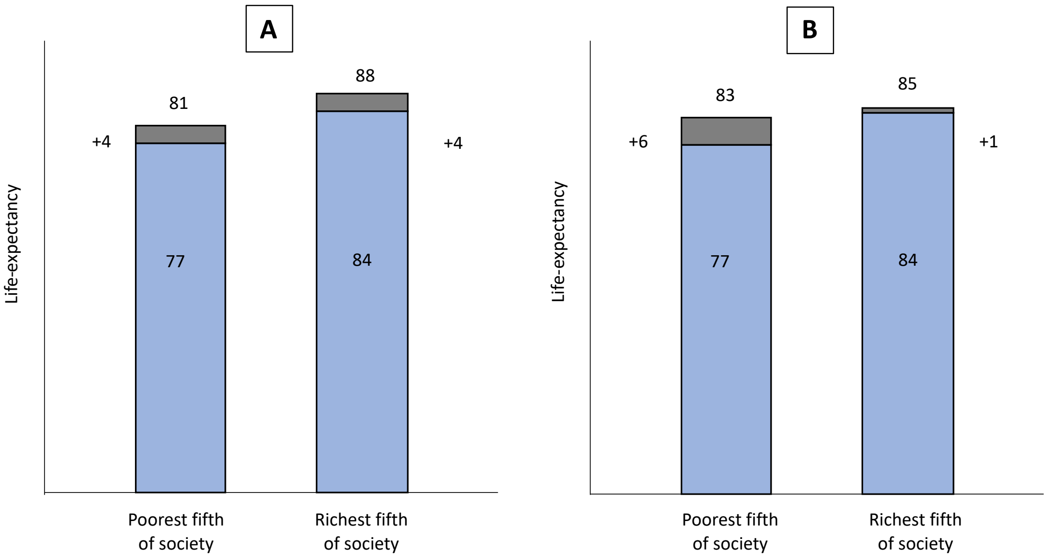
[6] Note that, whilst A does not increase inequality, of the two options available it does result in the higher level of inequality between the two groups.

average increase of four years and B provides an average gain of 3.5 years. This equates to a 0.5 year loss per recipient for B compared to A. As in the first question, A has no impact on the absolute inequality in life-expectancy between the two groups. Conversely, B now lowers the gap from seven years to two years (rather than three in the first question).

Figure 3.2: *A second Shaw-style BTO question: which program should the government choose?*



Whilst the initial question (Figure 3.1) allowed participants to reduce inequality without any cost to efficiency, this choice-set forces a trade-off between the two. Subsequently, if a respondent who chose B (pro-poor) in the first question switches to A (equal gains to both), we can infer they are inequality averse, but this aversion is not so strong that they are willing to forgo an average life-expectancy gain of 0.5 years in return for reducing the inequality between the groups from seven to two years. Conversely, if they chose B we can infer their aversion is sufficiently high that they are willing to forgo this level of efficiency in return for this reduction in inequality, and that they may be willing to sacrifice even more efficiency in return for that reduction of inequality. Equally, if a participant expresses indifference between the two options, we can infer that their level of inequality aversion is represented by the trade-off presented.

Usually, Shaw-style BTO studies present participants with a range of questions similar to those in Figures 3.1 and 3.2. Subsequently, participant indifference points are used to generate quantitative estimates of their inequality aversion. This is, typically, done by: (1) assuming a specific health-related social welfare function (HR-SWF) holds; and (2) estimating an "inequality aversion parameter" for that function, such that the health-related social welfare associated with the interventions a participant has expressed indifference between is equalised (Dolan & Tsuchiya, 2009).

Hypothesis A of this thesis (group types) could be tested by conducting a Shaw-based BTO using socioeconomic group labels, and neutral labels, and then comparing estimates of aversion across each group-type. Hypothesis B of this thesis (health gain types) could be tested by presenting participants with an inequality in lifetime health between two socioeconomic groups, and then asking them to take part in two Shaw-based BTO exercises: one about allocation of life-expectancy gains, and one about quality-of-life gains. Participant responses across the two exercises could then be compared in order to provide insight into whether Hypothesis B holds[7].

3.1.2.1.2. BTO designs based on Bleichrodt, Rohde, & Van Ourti (2012)

Two studies have used an alternative BTO approach to elicit aversion to inequalities between income groups: Bleichrodt et al. (2012) in a study of students in the Netherlands, and Hurley, Mentzakis, & Walli-Attaei (2020) in a sample of the Canadian public[8].

Whilst the Shaw et al. (2001) BTO design features only two groups that, typically, account for only a minority of a society[9], the Bleichrodt et al. BTO design features five income quintiles, which in combination cover all of a population. In addition, whereas Shaw-based BTO studies have not, historically, explicitly stated the income of the impacted groups, Bleichrodt-based designs have.

Table 3.1, below, provides an illustration of a Bleichrodt et al. style BTO question[10]. In this example, respondents are asked to choose between Program A and Program B. A

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[7] Note that both these comparisons could conceivably be done using within-persons, or between-persons designs

[8] As the Hurley design is very similar to the Bleichrodt design, I refer to this study as being "Bleichrodt-based", even though Hurley et al. (2020) do not cite Bleichrodt et al. (2012)

[9] e.g. The poorest and richest fifth of society (Robson et al. 2017).

[10] This is an illustration only. This choice-set is closer to that used by Hurley et al. (2020) than Bleichrodt et al. (2012), but was not included in either.

will result in a higher average life expectancy than Program B: 84 years compared to 83.5 years. Conversely, Program B will result in a lower level of inequality in life expectancy than A. The group-level life-expectancy (LE) and income[11] figures associated with each program are provided in Table 3.1, below.

Table 3.1: *A Bleichrodt-style BTO question: Program A or Program B?*

	Income Quintile 1	*Income Quintile 2*	*Income Quintile 3*	*Income Quintile 4*	*Income Quintile 5*	*Average LE*
Income	£15k	£17k	£19k	£30k	£40k	–
LE Program A	81.0	82.0	83.0	86.0	88.0	84.0
LE Program B	83.0	83.0	83.2	83.3	85.0	83.5

As in the case of the Shaw-style studies discussed previously, participant responses to multiple BTO questions of this kind can be used to infer, and quantify, the extent of their health inequality aversion.

Hypothesis A (group types) could be tested by conducting two Bleichrodt-based BTO exercises: one with, and one without information on the income/socioeconomic status of the groups. Participants responses across the two could then be compared to provide insight into whether this hypothesis holds. Hypothesis B (health gain types) could be tested by presenting participants with an initial distribution of life expectancy between the five income/socioeconomic quintiles, and an initial distribution of quality-of-life across the groups. Participants could then be presented with choices between pairs of alternative distributions of life expectancy/quality-of-life, in order to explore their willingness to prioritise the disadvantaged socioeconomic groups for different health-gain types.

3.1.2.1.3. The Norman et al. (2013) multi-attribute discrete choice experiment (DCE)

Norman, Hall, Street, & Viney (2013) fielded a DCE in which members of the Australian public were asked to make choices between pairs of hypothetical interventions. The options were described using seven attributes: (1) the income of the intervention beneficiaries; (2) their age of death without intervention; (3) their gender; (4) smoking status; (5) diet and exercise; (6) carer status; and (7) the life-expectancy gain the intervention provided.

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[11] Yearly income for individuals in the country, after taking into account all taxes and government programs. Note that the two programs impact only health, not income.

The income attribute featured two levels: below average and above average. Total life-expectancy without the intervention had four levels: 30 years; 45 years; 60 years; and 75 years. The levels of the seven attributes are provided in Table 3.2, below.

Table 3.2: *The Norman et al. (2013) DCE attributes and levels*

Attribute	**Levels**
Income	Above average; Below average
Total life-expectancy without intervention (years)	30; 45; 60; 75
Gender	Male; Female
Smoking status	Non-smoker; smoker
Lifestyle (diet and exercise)	Healthy; Unhealthy
Full time carers?	Yes; No
Life-expectancy gain (years)	1; 3; 6; 10

Each participant completed 16 choice-sets. The authors fitted random effects probit models to participant choices, and estimated parameters for different utility functions. Whilst the manuscript reports coefficients on the attributes for income and total life-expectancy for two utility functions, it does not report a function in which the two are interacted.

This design is distinct from the BTO designs discussed above in at least two ways. First, it includes a higher number of attributes that vary from choice task to choice tasks: seven compared to, typically, one (e.g. the size of the benefit offered). Second, it provides respondents with information about factors other than the lifetime health and socioeconomic status, or income, of the impacted groups. Notably, the authors include two behavioural attributes: smoking status and diet/exercise[12].

Hypothesis A (group types) and Hypothesis B of this thesis (health gain types) could be explored by conducting a DCE similar to Norman et al. (2013), in which the attributes in the choice-sets include: lifetime health pre-intervention; group type (e.g. from the poorest fifth of society, from the richest fifth of society, or unknown socioeconomic status[13]); and health gain type (e.g. life-expectancy gain, quality-of-life gain). Utility functions

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[12] As members of disadvantaged socioeconomic groups are more likely to smoke; and less likely to eat/exercise according to government recommendations (Buck & Frosini, 2012); and these factors influence health (Petrovic et al., 2018), it could reasonably be argued that public should be told about these behavioural differences when eliciting their aversion to socioeconomic inequalities in health. This is because this is factual information, and something respondents may consider as being relevant to their decision making. This issue is discussed further in Section 3.2, below.

[13] A form of neutral label.

could then be fitted to participant choices in order to explore the relative contribution the attributes, and interactions between the attributes, had on participant choices, and subsequently whether or not the two hypotheses hold.

3.1.2.2. Methods that have not previously been used to elicit aversion to socioeconomic inequalities in lifetime health, but could be

This sub-section details two methods that have yet to be used to elicit aversion to socioeconomic inequalities in lifetime health, but could be: (1) budget/pie splitting designs; and (2) person-trade-off. Whilst these methods have not been used in this context previously, both have been used to elicit preferences regarding other prioritisation criteria in health (Gu, Lancsar, Ghijben, Butler, & Donaldson, 2015).

3.1.2.2.1. Budget/pie-splitting designs

Budget/pie splitting designs[14], typically, ask respondents to allocate some finite public resource (e.g. a budget, or set number of points) between competing interventions/recipient types. The relative amount of that resource a respondent allocates across intervention or recipient types is then used to quantify their preferences.

Budget/pie splitting exercises have been used in a wide range of health economic preference elicitation studies (Blacksher, Rigby, & Espey, 2010; Costa-Font, Forns, & Sato, 2015; Johri, Damschroder, Zikmund-Fisher, & Ubel, 2005; Ratcliffe, 2000; Richardson, Iezzi, & Maxwell, 2017; Richardson, McKie, Iezzi, & Maxwell, 2017; Schwappach & Strasmann, 2006). For example, Ratcliffe (2000) asked members of the UK public to allocate 100 “donor liver grafts” between two groups of 100 people who were in urgent need of a transplant (referred to by the authors as a “social conjoint analysis” design). The characteristics of the two groups were varied (e.g. age, time already spent on the waiting list) in order to explore which factors influenced respondents’ choices, and by how much. More recently, Richardson, McKie, Iezzi, & Maxwell (2017) used a budget splitting

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[14] Also known as “constant-sum” comparisons (Skedgel, & Regier, 2015), as “willingness to allocate” studies (Costa-Font et al., 2015), and as “relative social willingness-to-pay” studies (Richardson, McKie, et al., 2017).

design (referred to as "relative social willingness-to-pay" study) in order to explore the Australian public's support for prioritising the health of younger people over old people.

How could the UK-public's aversion to socioeconomic inequalities in health be elicited using a budget/pie splitting design?

Table 3.3, below, provides an illustrative example of a pie-splitting question. In this case, respondents are informed that people from the poorest fifth of society have a life-expectancy of 77 years, and that people from the richest fifth have a life-expectancy of 84 years. They are then presented with two programs: A and B. Program A will provide people from the poorest fifth of society with a four year improvement in life-expectancy. Program B will provide the same life-expectancy benefit to people from the richest fifth of society. Participants are told that the additional life-expectancy would be experienced in perfect quality-of-life. They are then informed they have 100 points they can allocate to the two programs and are told they should allocate the points according to how much focus they think the government should put on each. For example, if they choose to allocate 100 points to Program B, the government should focus entirely on that program, and not pursue on Program A[15].

Table 3.3: *An illustrative point allocation question: how much focus should the government put on Program A and B?*

Program	**Type of people helped**	**LE before intervention**	**LE after intervention**	**Points allocated**
A	The **poorest** fifth of society	77	81	?
B	The **richest** fifth of society	84	88	?

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[15] Note that this example is an "open ended" question in which participants are asked to freely allocate points between the two options. This form of design could be equally operationalised using a "closed" design, in which they are asked to make choices between pairs of pre-defined potential allocations of the 100 points. The distinction between a closed and open ended designed is discussed further in Section 3.3.

If a respondent is indifferent to inequality, they would be expected to allocate the 100 points evenly between the two options. Alternatively, if they are inequality averse, they would be expected to allocate a higher proportion of points to the Aim A (pro-poor), and if they are pro-inequality, more to Aim B (pro-rich). Given this, the ratio of participant allocations of points across the aims can be used to infer their relative support for prioritising the disadvantaged group and the advantaged group for a four year gain in life-expectancy. For example, if they choose to allocate 80 points to Aim A and 20 points to Aim B, it can be inferred they place a 4:1 weight on helping the poorer group.

Hypothesis A of this thesis (group types) could be tested by comparing participant budget/pie-splitting responses across two exercises: one in which respondents are asked to allocate a finite resource between socioeconomic groups with differing levels of lifetime health, and another in which they are asked to do the same between otherwise equivalent neutrally labelled groups. Hypothesis B (health gain types) could be explored by presenting participants with an inequality in lifetime health between two socioeconomic groups, and then asking them to take part in two budget/pie-splitting exercises: one about an intervention that would extend life-expectancy, and another that would improve quality-of-life[16]. Participant allocations across the two exercises could then be compared to test Hypothesis B.

3.1.2.2.2. Person-trade-off (PTO)

PTO studies[17] (Nord, 1995) quantify preferences using the number of people who would receive a stated benefit. For example, respondents may be asked to make choices between pairs of interventions that offer a defined benefit to different numbers of people with differing characteristics/from different groups. Subsequently, the number of people in each group who would benefit from each of the interventions can be varied in order to explore participants' relative willingness to prioritise each.

PTO has been used to explore the public's willingness to prioritise health gains provided to a range of different beneficiaries (Gu et al., 2015). For example, Baker et al. (2010)

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[16] Note this could equally be done using a between persons design.

[17] Sometimes known as "matching" studies (Baker et al., 2010).

and Petrou, Kandala, Robinson, & Baker (2013) used PTO to elicit the UK-public's willingness to prioritise health gains provided to people with unstated socioeconomic status and lower expected age of death over those provided to otherwise equivalent people with higher expected age of death. Similarly, McHugh, Pinto-Prades, Baker, Mason, & Donaldson (2020) used PTO to test the UK-public's willingness to prioritise gains provided to people at the end-of-life above those not at the end-of-life.

How could the UK-public's aversion to socioeconomic inequalities in health be elicited using a PTO exercise?

Table 3.4, below, provides an illustrative example of a potential closed pairwise PTO question. In this case, participants are faced with two options: A and B. As in Table 3, above, these two alternatives provide a four year increase in life-expectancy to people from either the poorest or richest fifth of society. In contrast to the point-splitting example, in this case, respondents are told that Option A will provide 100 people from the poorest fifth of society, whilst Option B will provide the life-expectancy benefit to 100 people from the richest fifth of society[18]. As in the prior question, participants are told that the additional life-expectancy would be experienced in perfect quality-of-life. They are then asked to choose between the two options.

Table 3.4: *An illustrative pairwise closed PTO question: which option should the government choose?*

Option	**Type of people helped**	**LE before intervention**	**LE after intervention**	**Number helped**
A	The **poorest** fifth of society	77	81	100
B	The **richest** fifth of society	84	88	100

If a respondent is averse to socioeconomic inequalities in health, they would be expected to choose A in this choice, as this reduces inequality at no cost to efficiency. Conversely if they are inequality seeking, they would be expected to choose B for the reverse reason.

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[18] Note that participants are asked to choose between pre-defined numbers of people in each group. This makes this question a "closed" PTO design. This question could also have been presented in an open-ended format, by fixing the number of people in poorer group at 100, and then asking participants to state the number of people who would have to be helped in the richer group in order to make them indifferent between the two options.

Alternatively, if they are a health maximiser, we would anticipate that they would express indifference between A and B, because both have the same impact on population health. Subsequently, if we vary the number of people in each of the groups who would benefit from the two options, and ask respondents to choose between them, we can infer the extent of their aversion to socioeconomic inequalities in health based on their responses.

Hypothesis A of this thesis (group types) could be explored by conducting two PTO exercises: one in which respondents are told the people they are choosing between are from different socioeconomic groups, and one in which they are not. Participant responses across the two exercises could then be compared to test the Hypothesis A. Equally, Hypothesis B (health gain types) could be tested by comparing participant PTO responses across two PTO exercises: one from an intervention that improves life-expectancy, and another that improves quality-of-life.

3.1.3. Which method will be used to test the two hypotheses?

Section 3.1.1 detailed the information required to test the two hypotheses[19]. Section 3.1.2 then introduced five types of method that could provide this information, and so enable the hypotheses to be tested: two variants of BTO; DCE; budget pie-splitting; and PTO. This section considers the relative merits of these methods, and outlines my rationale for choosing to use one of these in the *de novo* work that follows: PTO.

Why not BTO?

As detailed above, the literature on health inequality aversion is dominated by BTO. No less than 13 studies have used BTO for this purpose: 11 using variants of the Shaw et al. (2001) design, and two using variations of the Bleidhrodt et al. (2012) design. When considering use of BTO in the context of this thesis, this domination has both positive and negative implications.

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[19] Hypothesis A: the UK-public are more averse to inequalities in lifetime health between socioeconomic groups than they are to inequalities in lifetime health between neutrally labelled groups. Hypothesis B: the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health if an intervention improves life-expectancy than they are if it improves quality-of-life.

On a positive front, it demonstrates that BTO designs have been used successfully in prior studies. Similarly, the number of publications arising from these studies provide evidence that BTO designs have been received favourably following scrutiny by journal editors and peer reviewers. This prior use, and the associated publications, give confidence that BTO is an established way of exploring the public's aversion to inequalities in health. Conversely, in the context of a PhD, the use of an established method is associated with an opportunity cost: the loss of the opportunity to develop and apply an alternative, relatively unestablished, method. This is potentially of particular importance in this case, because as noted in Chapter 2, it is currently unclear whether the relatively high estimates of the UK-public's aversion to socioeconomic inequalities in health found in prior studies are, at least in part, a function of the use of BTO. Given this, use of BTO in this thesis would also mean losing the opportunity to cross-validate the findings of these prior studies using an alternative method.

In contrast, DCE, budget/pie-splitting and PTO designs have not been widely used to explore the public's aversion to inequalities in health. As a consequence, use of these alternatives is associated with a higher level of risk. However, in return for this risk, the benefits outlined above are gained: the opportunity to develop an alternative approach to eliciting health inequality aversion, and to cross-validate the findings of BTO studies. Whilst these methods have not been widely used for this purpose, as detailed above, each has a wide heritage of use in health economic preference elicitation studies. This gives a reasonable degree of confidence that they could be successfully used in this context.

As a result of this balance of advantages and disadvantages, I opted not to use BTO, and to instead choose one of DCE, budget/pie-splitting or PTO.

Why not DCE?

The defining characteristic of a DCE is the simultaneous variation of multiple choice-attributes[20]. In contrast, the alternative designs under consideration typically vary only one attribute. For example, in PTO the number of people the interventions benefit is

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[20] At least as the term "DCE" is defined in this thesis. It may be argued that BTO and PTO are specific single-attribute forms of DCE; however, for the purpose of this document I use the term "DCE" as a synonym for a multi attribute, rather than single attribute, discrete choice experiment.

usually varied across choice sets, whilst other attributes are fixed. Similarly, in BTO the size of the benefit an intervention provides to each individual is varied across choice sets, whilst all remaining attributes are held constant.

The ability to simultaneously vary multiple attributes in DCE has advantages and disadvantages. On one hand, this is attractive, as it allows the simultaneous evaluation of inequality aversion in different ways. For example, a DCE could simultaneously vary the benefit an intervention provides to each recipient (mirroring a BTO), the number of people the intervention helps (mirroring a PTO), and the budget required to achieve those benefits (mirroring budget/pie-splitting). Equally, alternative, non-inequality based, potential QALY-modifiers could be included as attributes: for example, whether or not potential beneficiaries are at the end of life. This would allow the relative importance of inequality aversion and other attributes to be explored: a factor of potential interest to policy-makers who face the challenge of weighting multiple potential prioritisation criteria.

Whilst in theory, adding attributes enables the simultaneous exploration of more issues, doing so comes at the potential cost of overwhelming participants with information (Kahneman, 2011). In turn, this risks respondents basing their choices on simplifying heuristics, rather than considered thinking about each of the attributes (Heidenreich, 2016). In addition, varying multiple attributes simultaneously risks distracting participants with issues that are not the primary focus of the study; for example, the relative importance of the benefit provided to each individual compared to the number of people helped. As a result, participants presented with multiple simultaneously varying attributes may not make fully considered choices regarding the attributes of primary interest (Heidenreich, 2016). Conversely, use of a single varying attribute design simplifies the decision, and allows the respondent to focus on the key issue at hand: in this case, whether they are willing to prioritise the disadvantaged over the advantaged, and how that may vary by group and health gain type. In the context of aiming to support decision-makers faced with multiple competing QALY-modifiers (e.g. disease rarity, end-of-life etc) this focus on one issue may be a bad thing, as it could lead to the focusing effect: a phenomenon whereby people overstate the importance of an attribute they are focusing on[21] (Kahneman, 2011). As a result of this effect, it is possible that attributes that appear important when pre-

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[21] i.e. The importance of inequalities in health in the case of this thesis.

sented in isolation in single-attribute choice experiments, do not appear important when included in a multi-attribute design. Given this, policy-makers should be cautious in comparing estimates of the pubilc's preferences regarding different prioritisation criteria based on multiple single-attribute choice experiments.

As the primary focus of this thesis is testing two hypotheses, rather than comparing across multiple prioritisation criteria, I opted not to use a multi-attribute DCE in the *de novo* studies reported here. Instead, I decided to apply one of the available single attribute designs. I would be interested to explore use of a DCE in a future study.

Why not budget/pie-splitting, and why PTO?

The above logic leads to a choice between two alternatives: budget/pie-splitting and PTO. Each of these methods has their advantages and disadvantages. For example, use of a budget-splitting design may prompt participants to consider the absolute efficiency of the interventions, rather than simply the relative priority they place on helping two alternative groups. Whilst this could potentially be avoided by switching from budget allocation to allocation of a non-financial pie (e.g. points), this alternative is associated with its own issues. For instance, if participants are asked to allocate "points", they may not be clear about precisely what the points are designed to represent. Subsequently, this could influence their responses. Conversely, PTO can be be designed to avoid the issue of the absolute efficiency of interventions by not mentioning the specific budget required to fund them. Similarly, PTO overcomes the potential issue of confusion regarding the meaning of units (e.g. points) in a non-financial pie-splitting exercise. However, PTO is not without it's own issues. Notably, Robinson (2010) found that the test-retest reliability of PTO is "less clear" than for time-trade-off, albeit concluding it is still "moderate to strong".

Given the balance of these issues, I felt PTO would be a better way of testing the two hypotheses of this thesis than budget/pie-splitting. Therefore, I opted to use PTO in my *de novo* studies. If I had had more time, and a larger budget, I would have simultaneously explored the two hypotheses using the alternative methods, and would be keen to do so in future work. If alternative methods were used, it is possible that participants would respond in different ways, and subsequently, different conclusions reached. As a consequence, the findings of the *de novo* studies reported should be regarded as being conditional on the use of PTO.

3.2. How PTO could, and will, be practically implemented

This section explains and considers a sample of ways PTO could be practically implemented. The appendix to this chapter supplements this section with further detail on less substantive aspects of potential study designs (e.g. use of an interviewer vs observer vs self-completion with no observation).

3.2.1. Veil-of-ignorance?

In previous literature, authors have attempted to elicit health inequality aversion free from self-interest by using a form of "veil of ignorance" approach[22] (Andersson & Lyttkens, 1999; Costa-Font & Cowell, 2019; Rawls, 1971). For example, Bleichrodt et al. (2012) and Hurley et al. (2020) inform participants they are making choices about a hypothetical society, rather than their own country in the present day. Whilst these veil of ignorance designs attempt to limit the impact of self-interest on respondents choices, they do so at the cost of removing those choices from reality and the present.

Conversely, other studies have clearly informed respondents that the questions they are being asked are about their own country in the present, and may be used to shape policy-making. For example, NICE's Citizens' Council on inequalities in health (NICE, 2006) featured a briefing in which participants were explicitly told that their views may impact NICE's methods.

Both these alternatives could conceivably be used in a PTO study designed to test the two hypotheses of this theses. However, from a democratic perspective, there is a tension between use of veil of ignorance based preferences in resource allocation, and the tradition of unveiled democracy that underpins much of the modern world. For example, when we vote in elections, we are not asked to imagine that we voting for a hypothetical country. Instead, we are explicitly told our vote applies to our country and in the present. Given

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[22] Note the decision to use Rawls' terminology here is that of Andersson & Lyttkens (1999), and subsequent authors, not my own.

this, and my ultimate aim of informing resource allocation decisions in the UK (a country with a strong tradition of transparent democracy) in the *do novo* studies reported in this thesis I take an unveiled approach.

3.2.2. Impacted groups

In prior inequality aversion elicitation choice experiments, respondents have either been presented with a task about solely a subset of the population, or with a decision that will impact the whole population. For example, Shaw-based BTO designs typically operate based on sub-sets (e.g. just the poorest and richest fifth of a society, and not the middle 60%). Conversley, Bleichrodt et al. (2012) based BTO designs usually include all of a society in choice-sets.

Both these approaches could conceivably, and reasonably, be used in a PTO study designed to test the two hypotheses of this thesis. However, the use of a subset based approach is dominant in the existing socioeconomic health inequality aversion literature: eleven studies have used this approach (Abásolo & Tsuchiya, 2004, 2013; Ali, Tsuchiya, Asaria, & Cookson, 2017; Cookson, Ali, Tsuchiya, & Asaria, 2018; Dolan & Tsuchiya, 2011; Lal et al., 2019, 2018; Pinho & Botelho, 2018; Robson, Asaria, Cookson, Tsuchiya, & Ali, 2017; Tsuchiya & Dolan, 2007, 2009) compared to only two that have applied a full population exercise (Bleichrodt et al., 2012; Hurley et al., 2020). Given this dominance, in the *de novo* PTO studies reported in this thesis I have opted to use a social quintiles sub-set approach that mirrors that of the majority of prior authors. Whilst I have taken this approach, I accept I could have tested the two hypotheses of this thesis using a design that captures all of society, and would be interested in doing so in a future study.

In addition, prior studies have described impacted groups/individuals in multiple ways. For example, Ali et al. (2017), Cookson et al. (2018), and Robson et al. (2017) each told participants the impacted individuals were from the "poorest" fifth or "richest" fifth of society. Conversely, Shaw et al. (2001) used class labels, whilst Hurley et al. (2020) specified the income level of the impacted groups. These different group labels could potentially influence participants to respond in different ways. For example, use of the "poorest" and "richest" labels may prompt participants to imagine exaggerated caricatures of disadvantaged and advantaged people. As a consequence, this may result in participants appearing to be more inequality averse than they might be the case had the actual incomes of these groups been used. Whilst this is the case, these labels have been used in the three most recent studies on this topic (Ali et al., 2017; Cookson et al., 2018; Robson et al., 2017). Given this, I opted to use these terms again in the *de novo* PTO studies reported in this thesis. As discussed in Chapter 1, I note these labels do not perfectly convey socioeconomic status in its entirety. In future work, it would be interesting to develop, and apply, alternative terms that are better able to do this.

Similarly, a range of different labels could be used to represent socioeconomically-neutral groups. For example, participants could be told the groups of people have "Disease A" and "Disease B", or are simply from "Group A" or "Group B". As in the case of the socioeconomic group labels, the choice between these labels may influence the way participants respond. For example, it is possible that using "Disease A" and "Disease B" could result in participants imagining specific disease when responding. Equally, it is possible that telling respondents they are choosing between "Group A" and "Group B" could result in participants inferring the choices are in fact about specific groups of people; for example, different socioeconomic groups, ethnic groups or genders. As a result, both these forms of "neutral" labels are potentially informative, and could confound an intended test of Hypothesis A (group types). Given this, it is challenging to identify a perfect "neutral" group label.

In the empirical work that follows in this thesis, I chose to use the labels "Disease A" and "Disease B". I did this in order to reduce the likelihood of study participants presuming the questions they were being asked were actually about socioeconomic groups; a factor that could compromise a test of Hypothesis A. I accept the use of these labels mean that some participants may have imagined specific diseases when responding. In future work, I would be keen to explore the impact of alternative labels.

3.2.3. Quality-of-life health gain types

Hypothesis B of this thesis states "the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health if an intervention improves life-expectancy than they are if it improves quality-of-life". This hypothesis could be tested using a wide range of quality-of-life types.

For example, respondents could be asked to choose between groups of people who receive benefits in one or more of the dimensions of the EQ-5D (Brooks, 1996): mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Equally, the two composite dimensions of the EQ-5D could be split out into their constituent parts: pain, discomfort, anxiety and depression. Alternatively, quality-of-life types considered to be potential "bolt on" candidates to the EQ-5D descriptive system could be used: hearing, vision or tiredness (Yang et al., 2015). Equally, quality-of-life could be conceptualised in terms of the capabilities model. If this approach is taken, Hypothesis B could be tested using the five dimensions of the ICECAP-A instrument (Al-Janabi et al., 2012): feeling settled and secure; love, friendship and support; being independent; achievement and progress; enjoyment and pleasure. Furthermore, improvements in quality-of-life could simply be presented in generic terms, rather than as a specific dimension of health. For example, respondents could be told an intervention will improve peoples' utility scores, rather than stating explicitly which dimension of health that gain is attributable to.

In addition, the quality-of-life types could be presented in different ways. For example, participants could simply be provided with the EQ-5D responses of individuals who could benefit from an intervention. Alternatively, they could be provided with vignettes that provide further detail surrounding the issues the impacted individuals are experiencing, and the impact intervention would have on their life. Equally, respondents could be provided with videos that illustrate the impact that a health problem is having on the quality-of-life of people who would benefit from intervention, in a manner comparable to Lenert et al. (2004). Furthermore, participants could be told the specific condition the impacted individuals were experiencing, or simply provided information about their quality-of-life.

Each of these approaches could reasonably be used in a PTO design, yet each may impact the ways participants respond to prioritisation decisions between different groups, and subsequently my findings regarding the two hypotheses. For example, it may be the case that the public are averse towards prioritising disadvantaged socioeconomic groups for pain relief, but supportive of prioritising them for improvements in "enjoyment and pleasure"[23]. Subsequently, if the public are willing to prioritise disadvantaged socioeconomic groups for gains in life-expectancy, a design based around pain-relief may find evidence that Hypothesis B holds, whilst one based on "enjoyment and pleasure" would not. Equally, providing participants with vignettes about participants quality-of-life may prompt them to think differently about their decisions than if they were provided with EQ-5D dimension level responses, or simply an EQ-5D summary score. Whilst it is challenging to predict precisely what impact this could have, it appears plausible that they could have an effect. Subsequently, the choice between these different alternatives could impact the results observed.

In the *de novo* PTO studies reported in this thesis, I have opted to present quality-of-life using the dimensions of the EQ-5D instrument. This is for three reasons. First, because EQ-5D has become the dominant measure of health related quality-of-life in applied health economic evaluations in the UK. Subsequently, use of the EQ-5D dimensions aligns my work to a significant number of applied studies. Second, because this allows me to explore the two hypotheses using a range of health related quality-of-life types. Third, because my work is, at least in part, funded by the EuroQol Research Foundation. As a result, my third study (Chapter 6) must in some way, feature use of the EQ-5D and/or it's associated descriptive system.

In addition, I have opted to use health state utility scores in order to convey the magnitude of quality-of-life problems impacted individuals are experiencing, and the benefits provided by quality-of-life improving interventions. I did this in order to enable the QALY benefits of different interventions to be matched, for the purpose of comparing participant responses across health gain types. In the interest of simplicity, I have opted not to provide participants with vignettes or videos about the health states, or to provide further information about the specific health conditions the impacted individuals are experiencing. In future work, it would be interesting to explore whether providing this information changes participants' prioritisation responses.

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[23] An ICECAP-A dimension.

3.2.4. Choice framing: stated role and question

In a PTO study designed to test the two hypotheses, respondents could be asked to to take on a range of different roles when responding. For example, they could be asked to imagine they are a member of the government, or senior figure within the NHS, who is faced with a resource allocation decision. Alternatively, they could be prompted to imagine they are a clinician making a bedside rationing decisions. Furthermore, they could be asked for their individual opinion, without being prompted to imagine they hold a specific role.

These alternatives may impact participant responses in different ways. For example, asking respondents to imagine they are a social decision maker (e.g. in government or the NHS) may prompt them to consider how other people might respond to the question, and integrate that with their own preferences, prior to responding. Alternatively, asking participants to simply choose between two options (e.g. as an individual, which do you think is better: A or B?) may better elicit their individual views, rather than a compound of their perceptions of the preferences of others, and their own. Furthermore, asking respondents to take on the role of of a clinician may prompt them to be less willing to sacrifice the health of advantaged groups than might be the case if they were asked to imagine they a relatively-distant policy-maker. As a result, use of different stated roles may prompt participants to respond in different ways.

In addition, prioritisation questions could be phrased in at least six ways. First, participants could be asked what they *would do* in a given situation (e.g. if you were in the government, would you choose A or B?). Alternatively they could be asked what they/someone else *should do* in a given situation (e.g. should the government choose A or B?). Equally, respondents could be presented with two alternatives, and asked *which is better?* (e.g. if you were in the government, which option would you think was better: A or B?). Alternatively participants could be asked what they *prefer* (e.g. which option would you prefer the government introduce?) Or, they could be asked which option they think it would be fairer to implement. Furthermore, respondents could be told that the government had established a voting procedure to determine how they act, and then asked to vote for one of the proposed policies.

It is possible that each of these question may prompt participants to respond in different ways. For example, an individual may decide that they would do something that should not be done (e.g. the government should not favour A over B, because I believe most people think[24] A should not be favoured over B, but if I was in government I would pick A over B, because I think A should be favoured over B). Equally, a respondent may think the government should do something, even though they consider another option is better (e.g. we should pick A over B, because people who benefit from A have paid lots of taxes, even though B is better than A). Alternatively, a respondent may prefer A over B, but think B is fairer than A. Furthermore, telling participants that they are voting between policies, and that many other individuals will be voting, could prompt them to take a more extreme position of inequality aversion than might be the case if they were told they were the sole person deciding between policies[25]. Subsequently, the choice of these different questions may impact the way participants respond, and so the conclusions of this thesis.

From a practical perspective, this range of alternative stated roles and prioritisation questions is problematic, because it is not normatively obvious which, if any, should be used to inform health-related resource allocation decisions. To a degree, this depends on why we are aiming to elicit the preferences of the public. For example, if we conceive of use of public preferences in health-related decision-making as being an extension of voting-based democracy, we could argue that the methods applied to elicit the views of the public should be based on voting. If this is the case, it could argued that participants should be prompted to respond as a member of the electorate, and asked to simply vote for one a set of policy options. Equally, one could argue the public's health inequality aversion should be taken into account in health related decision making, because this forms part of some individuals' utility functions. Subsequently, measuring health inequality aversion, and considering this in decision making may increase utility. If this is the case, then it could be argued that respondents should be prompted to respond as individuals, and simply asked which alternative they prefer[26]. Conversely, it may be argued that a HR-SWF

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[24] i.e. The injunctive norm (Cialdini, Kallgren, & Reno, 1991).

[25] I owe this idea to Gustav Tinghög who expressed this view when I visited him at Linköping University. Gustav thinks that it is possible that people who are acting as part of a group may find it emotionally easier to sacrifice the health of others than if they are a sole decision maker.

[26] In the interest of simplicity, I ignore the distinction between a preference satisfaction and hedonic account of utility here. Equally, I ignore the distinction between ex-ante expectations of utility and ex-post reality. As a result, I assume utility can be estimated through a question such as this (note that in

should be parameterised using preferences elicited from a social perspective (Tsuchiya & Watson, 2017), and that as a result, respondents should be asked to take on the role of a social decision maker, rather than an individual. If this is the case, participants could be prompted to imagine they are a social decision maker when making choices.

In the *de novo* PTO studies reported in this thesis, I take this later approach. As a result, participants were asked to imagine they were a member of government faced with a decisions that would impact peoples' health. They were then presented with choices between pairs of alternatives, and asked "which option should the government choose?". My choice to use a "should" question was largely pragmatic, and I accept I could reasonably have used one the alternatives detailed above (e.g. if you were a member of government, which option would you choose?). It would be interesting to explore the impact of employing alternative stated roles and questions in future work.

3.2.5. Benefits vs harms vs harm mitigation vs outcome-based scenarios

The two hypotheses of this thesis could be tested in a PTO study in which respondents are asked to make decisions about interventions that would: (1) improve the health of different groups; (2) harm their health; or (3) mitigate against expected harms to their health[27]. If the preferences of the public are consistent with a HR-SWF, the choice of these alternatives should not matter: the only thing that determines the attractiveness of a state of the world in a HR-SWF is the health of the people in it, not how the health of different individuals has changed. However, in a choice experiment the use of these varying alternatives may influence participant responses. For example, respondents may be willing to prioritise disadvantaged groups over advantaged groups for gains in health, but not have symmetrical preferences when it comes to an intervention that may harm the health of the advantaged or the disadvantaged.

In practice, most distributionally sensitive economic evaluations are likely to be of interventions designed to improve health. As a result, a choice experiment based on interventions that improve health is likely to be of higher relevance to decision makers than

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practice I disagree with this assumption, but this is beyond the scope of this thesis).

[27] e.g. Two richer people and one poorer person are expected to go blind in the near future, you can stop either the two richer people or the one poorer person going blind. Which would you pick?

one based on harm, or harm mitigation. Subsequently, I took this approach in the *de novo* studies reported in this document. I would be interested to explore whether inequality aversion is symmetrical regarding harms and benefits in future work[28].

3.3. An overview of the three studies

Three *de novo* studies are reported in this thesis: Chapter 4 details a pilot of a PTO study designed to test the two hypotheses; Chapter 5 report a face-to-face PTO study designed to test both hypotheses; Chapter 6 details an online PTO study designed to test Hypothesis B (health gain types) alone. The PTO tasks were piloted in order to ensure participants understood the tasks, and they functioned as intended. A face-to-face design was used for the second study so that participants could be observed completing the tasks, in order to gain insight into whether or not the study could be fielded without an observer present. An online design was used for the third study in order to maximise participant numbers given a finite budget. The logic behind the focus on Hypothesis B (health gain types) in the third study is explained in Chapter 6.

A brief overview of each study is provided below. Additional information on the approach taken in each study, and the logic behind those approaches, is available in each of the respective chapters.

Chapter 4: pilot

Chapter 4 details a pilot of a PTO study designed to test the two hypotheses. The pilot had five objectives: (1) to test the mechanical operation of the PTO exercises; (2) to provide insight into the potential effect sizes likely to be observed in future fielding; (3) to evaluate participant understanding of the PTO tasks; (4) to identify the factors they considered when responding; and (5) to highlight ways the study materials could be improved. It was not designed to test the two hypotheses formally.

Respondents (n=20) completed the PTO task online on a laptop computer, whilst in the presence of an observer. They were then interviewed. Participants were 1:1 randomised

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[28] Note that further detail on less substantive implementation decisions is provided in an appendix to this chapter.

to questions about socioeconomic groups (people from the “poorest” or “richest” fifth of society), or neutrally labelled groups (people with “Disease A” or “Disease B”, to replace the poorest and richest respectively). Respondents were explicitly told that the research was designed to find out how the UK-public think government should act when making decisions about health.

Participants were informed that, in the UK, people from the poorest fifth of society (Disease A) have a life expectancy of 77 years, and that people from the richest fifth of society (Disease B) have a life expectancy of 84 years (Love-Koh et al., 2015). They were not briefed on inequalities in lifetime quality of life[29].

Participants were told to imagine they are a member of government, and that they had been asked to make decisions that would impact peoples’ health. They were then asked two sets of closed pairwise PTO questions about their randomised group-types. The first intervention improved life-expectancy, and the second relieved pain. Both interventions provided a 3 QALY gain. For each choice-set, participants were asked “which option should the government choose?”. All participants completed the exercises on their own[30], and there were no pre-choice tasks (e.g. deliberation or practice questions).

Respondent PTO choices across the two study arms were designed to be compared to test Hypothesis A (the UK-public are more averse to inequalities in lifetime health between socioeconomic groups than they are to inequalities in lifetime health between neutrally labelled groups). The PTO choices of participants in the socioeconomic arm were designed to be compared across health-gain types to test Hypothesis B (the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health if an intervention improves life-expectancy than they are if it improves quality-of-life).

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[29] The decision to focus simply on inequalities in life-expectancy, rather than include consideration of inequalities in quality of life, means the empirical work that follows is not perfectly consistent with the two hypotheses, both of which use the words “lifetime health” rather than “life-expectancy”. This issue is discussed further in Chapters 4, 5, 6 and 7.

[30] i.e. Not in groups,

Chapter 5: face-to-face fielding

Chapter 5 details a face-to-face fielding of a modified version of the piloted PTO study. The modifications made to the PTO tasks are explained in Chapter 5. Eighty members of the UK-public took part. Respondents were randomised to questions about socioeconomic groups (Richest/Poorest fifth) or neutrally-labelled groups (Disease A/B). Each participant answered PTO questions about three types of intervention: one that extended life-expectancy, one that relieved pain, and one that relieved mobility problems. Two quality-of-life types were used to provide two distinct tests of Hypothesis B (group types). Each of the interventions provided a 3 QALY gain. As per Study 1, respondents completed the PTO task online on a laptop computer, whilst in the presence of an observer. Participant PTO responses across arms were compared (a between persons comparison) to test Hypothesis A (group types). Hypothesis B was tested by comparing the PTO responses of participants in the socioeconomic arm across the three health gain types (a within-persons comparison).

Chapter 6: online fielding

Chapter 6 reports an online fielding of the PTO exercises in a larger sample of the UK-public (n=1,502). Recruitment was stratified by age, gender, and ethnicity, using quotas derived from the UK-census 2010. Respondents completed the study on a computer they had access to. In contrast to Chapter 5, this study was focused solely on socioeconomic groups (Richest/Poorest fifth). Participants were randomised to one of ten health gain types: life-expectancy, the five dimensions of the EQ-5D (mobility, self-care, usual activities, pain/discomfort, anxiety/depression), and the two composite dimensions of the EQ-5D separated out into their constituent parts (pain, discomfort, anxiety, depression). Each respondent completed PTO tasks about two interventions that provided their randomised health-gain type: one that provided a 3 QALY gain, and one that provided a 0.5 QALY gain. Hypothesis B was tested by comparing participant PTO responses across health-gain types (a between persons comparison). This was done separately for each QALY gain magnitude. The nine quality-of-life, and two QALY gain magnitude, types were designed to provide 18 distinct tests of Hypothesis B.

Table 3.5 below summarises the method/implementation approaches taken in the three studies.

Table 3.5: *The three studies: an overview*

	Study 1	**Study 2**	**Study 3**
Method	PTO	PTO	PTO
Fielding format	Face-to-face pilot	Face-to-face fielding	Online fielding
Participants	20	80	1,502
Thesis hypotheses tested	None	A (Group types); B (Health gain types)	B (Health gain types)
Impacted groups	Poorest/richest fifth; Disease A/B	Poorest/richest fifth; Disease A/B	Poorest/richest fifth
Health gain types	(1) Life expectancy; (2) Pain	(1) Life expectancy; (2) Pain; (3) Mobility	(1) Life expectancy; (2) Mobility; (3) Self-care; (4) Usual Activities; (5) Pain/Discomfort; (6) Anxiety/Depression; (7) Pain; (8) Discomfort; (9) Anxiety; (10) Depression.
QALY gain magnitudes	3 QALYs	3 QALYs	0.5 QALYs; 3 QALYs

3.4. How this chapter contributes to this thesis as a whole

This chapter outlines a range of methods that could be used to elicit the UK-public's aversion to socioeconomic inequalities in health: BTO, DCE, budget/pie-splitting, and PTO. It then explains my reasons for choosing to use PTO in the *de novo* work that follows. Subsequently, it considers different ways in which a PTO study could be practically implemented, and explains why specific implementation approaches were made. Finally, it provides a brief overview of the way the two hypotheses will be explored in the *de novo* studies that follow in Chapters 4, 5 and 6.

APPENDIX A3.1. Less substantive implementation issues

This appendix provides further detail on ways in which the a PTO design could be implemented. This text is provided as an appendix, rather than in the main body of the thesis, because it details factors of less importance to the overall design of the *de novo* studies.

Closed vs open ended questions

Participants could be presented with "closed" or "open ended' PTO questions. In a closed question, respondents are presented with specific pre-defined alternative, and then asked to choose between them. For example, "should the government choose Option A which helps 100 poorer people, or Option B which helps 100 richer people?". In contrast, in an open ended question, respondents are, typically, asked to "fill in the blank" in an incompletely defined scenario. For example, respondents could be asked to define "x" in the following statement: "the government should be indifferent between choosing Option A which helps 100 poorer people, or Option B which helps x richer people". In this thesis, I opted for a closed PTO design, but could have reasonably chosen an open one.

Information provided to and/or made salient to participants

A range of information relevant to inequalities in health could be provided to participants in pre-PTO briefings. For example, they could be told about the socioeconomic gradient of health-related behaviour (Buck & Frosini, 2012); the relationship between socioeconomic status and ethnicity[31] (ONS, 2018); or, inequalities in household income (ONS, 2020). Briefings could also make different types of health inequalities[32] and their human consequences, salient in different ways (e.g. statistics, graphics, videos, vignettes). In addition, elicitation exercises themselves could also provide/make salient different types of information. For example, health-related behaviour, ethnicity, and income, could be included as attributes in a choice-experiment. In the *de novo* studies reported in this thesis, I opted

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[31] People from disadvantaged socioeconomic groups are more likely to be from minority ethnic groups.

[32] For example, inequalities in life-expectancy, quality-of-life, quality-adjusted life-expectancy, or death due to specific causes.

to provide participants with information about solely inequalities in life-expectancy. It would be interesting to explore the impact of providing participants with different briefing materials in future studies.

Online vs postal vs face-to-face vs telephone vs hybrid fielding

PTO could hypothetically be fielded online (similarly to Robson et al., 2016), via post (e.g. Anand & Wailoo, 2000), face-to-face (e.g. Abásolo & Tsuchiya, 2004), over the telephone (Marcus & Crane, 1986), or using a hybrid approach (e.g. sending a participant an exercise in the post, and then calling them on the telephone for them to report their answers). As detailed in the main body of this chapter, I opted to field the initial two studies face-to-face, and the final study online. I decided to do this in order to first establish the functionality of the study tasks in the presence of observers, prior to moving to a lower cost per participant online design for the final study.

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Chapter 4: Pilot study

This chapter details a quantitative/qualitative pilot of a new PTO study designed to test the two hypotheses of this thesis. Hypothesis A: the UK-public are more averse to inequalities in lifetime health between socioeconomic groups than they are to inequalities in lifetime health between neutrally labelled groups. Hypothesis B: the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health if an intervention improves life-expectancy than they are if it improves quality-of-life. The pilot had five objectives: (1) to test the mechanical operation of the PTO exercises; (2) to provide insight into the potential effect sizes likely to be observed in future fielding; (3) to evaluate participant understanding of the PTO tasks; (4) to identify the factors they considered when responding; and (5) to highlight ways the study materials could be improved. The pilot was not designed to formally test the two hypotheses themselves.

Objectives (1), (3), (4) and (5) were designed to provide insight into whether the PTO exercises/materials were operating, and being interpreted, as intended; and, to identify potential modifications to the study design/materials prior to future fielding[1]. Objective (2) was designed to inform the sample sizes used in future fielding of the PTO study. Objective (3) was also designed to provide insight into whether participants asked questions about socioeconomic groups were influenced by non-health factors. This is of interest, because, as outlined in Chapter 1, this is the logic underlying Hypothesis A.

The chapter is divided into five sections. [4.1] provides an overview of the study design. [4.2] details the methods used. [4.3] reports results. [4.4] discusses the findings. Finally, [4.5] clarifies how this chapter contributes to the thesis as a whole. Three appendices are

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[1] Note that piloting is commonly considered to be a "crucial element" of good study design (Van Teijlingen Hundley, 2001).

provided: A4.1. provides a figure referenced in the main text; A4.2. is the interviewer guide used in the study; A4.3. presents the briefing materials participants were shown.

Authorship statement

Parts of 4.1-4.4 are based on a co-authored working paper discussed at the Winter 2019 meeting of the Health Economists' Study Group in York, UK (McNamara, Tsuchiya, & Holmes, 2019). This working paper was written with two co-authors: Aki Tsuchiya and John Holmes. A "CRediT" author statement (Elsevier, 2020) for this paper is as follows:

Simon McNamara: Conceptualization, Methodology, Software, Investigation, Formal analysis, Data curation, Writing - Original draft preparation, Project administration. **Aki Tsuchiya**: Supervision, Writing - Reviewing and Editing. **John Holmes**: Supervision, Writing - Reviewing and Editing.

I am the sole author of Section 4.5 and the appendices.

4.1. Design

Participants completed the PTO exercises on a laptop computer in the presence of an observer. They were then interviewed.

4.1.1. Overview of PTO tasks

Respondents were 1:1 randomised to one of two arms[2]: a "socioeconomic" group arm, and a "neutral" arm. In the socioeconomic arm, participants were asked questions about people from the poorest fifth of society and people from the richest fifth of society. These group-labels are the same as previously used by Ali, Tsuchiya, Asaria, & Cookson (2017); Cookson, Ali, Tsuchiya, & Asaria (2018); and Robson, Asaria, Cookson, Tsuchiya, & Ali, (2017). In the "neutral" arm, participants were asked questions about people with Disease A (to replace the poorest fifth of society) or Disease B (to replace the richest fifth of society). Respondents were not told they had been randomised to one group type, and were unaware of the alternative study arm. Participant PTO choices across the two arms were designed to be compared (a between persons comparison) to test Hypothesis A: the UK-public are more averse to inequalities in lifetime health between socioeconomic groups than they are to inequalities in lifetime health between neutrally labelled groups.

Each respondent completed two PTO tasks for their randomised group-type: first, one about an intervention that improved life-expectancy; second, one about an intervention that relieved severe pain. In the socioeconomic arm, participant PTO responses for the two health-gain types were designed to be compared (a within persons comparison) in order to test Hypothesis B: the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health if an intervention improves life-expectancy than they are if it improves quality-of-life. As Hypothesis B is limited to socioeconomic groups, a comparison of participant PTO responses across the two health-gain types in the neutral arm is beyond the scope of this thesis[3].

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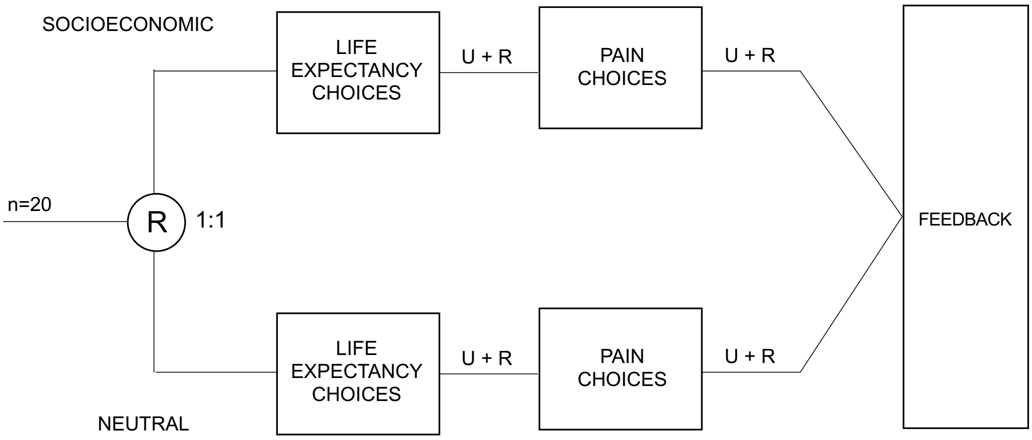
[2] This was done using an Excel-based random number generator.

[3] Note that in McNamara et al. (2020b) (the core paper in Chapter 5), this comparison is undertaken, because it was relatively easy to do so, and may be of interest to readers of the journal the paper was submitted to.

4.1.2. Interview, rating scales and feedback

Following each PTO exercise, respondents were interviewed. In these interviews, they were asked to explain the tasks, and the reasons for their choices. They were then asked to rate their understanding of the two exercises, and to provide feedback on ways the study materials could be improved. Figure 4.1, below, provides an overview of the design.

Figure 4.1: *Study schematic*



U + R = Understanding and rationale questions

4.1.3. How the study objectives were explored

Objective 1 (testing the mechanical operation of the PTO exercises) was achieved by having participants complete the exercises, and then analysing their responses for evidence of miss-coding of the PTO tasks (e.g. a respondent being asked questions about an arm they had not been randomised to). Objective 2 (providing insight into the potential effect sizes) was explored by analysing participant PTO responses across group, and health-gain, types. This is detailed further in Section 4.2, below. Objective 3 (evaluating participant understanding of the PTO tasks) was explored by: (1) reviewing participant explanations of the tasks, and the reasons for their choices, and comparing these to the study materials; (2) by reviewing participant ratings of their own understanding; and (3), by exploring participant feedback on the study for evidence of misunderstanding. Objective 4 (identifying the factors participants considered when responding) was achieved by thematically analysing participant explanations of their choices. Objective 5 (highlighting ways the study materials could be improved) was explored by reviewing participant feedback, and screening their interview responses to identify situations in which the study materials were interpreted in ways that would require modification for the PTO exercises to function as intended.

4.2. Methods

4.2.1. The PTO exercises

This section first explains the briefing participants in the socioeconomic arm received. It then details the PTO exercises they completed, and how the briefing/exercises differed in the neutral arm. The PTO exercises were programmed in, and hosted online, by Qualtrics. Study graphics were developed using Piktochart.

Socioeconomic arm initial briefing

Participants were informed that, in the UK, on average, poorer people live shorter lives than richer people. They were then told that people from the poorest fifth of society can expect to live until they are 77 years old, and that people from the richest fifth of society can expect to live until they are 84 years. It was clarified that this means there is a 7 year gap in life expectancy between the two groups (Love-Koh, Asaria, Cookson, & Griffin, 2015). This information was presented as shown in Figure 4.2, below.

When reviewing this graphic, and the ones that follow in this thesis, it should be noted that the icons, and terms, used to convey information to participants may have influenced their responses. Whilst I aimed to present information in an objective manner, it is possible that my choice of terms and images may have shaped the way participants thought about the questions, and subsequently the way they responded. For example, in the graphic below, I used the title “Inequalities in Health” rather than “Differences in Health”. Whilst, using my operational definition of inequalities in health set out in Chapter 1, these two phrases are interchangeable, it is possible that use of the term “inequality” may have prompted participants to consider the differences in health of poorer and richer people as being a matter of fairness, whilst the use of “differences” may not have. Subsequently, the choice to use this phrase may have prompted participants to respond in a more inequality averse way than might have been the case had “differences” been used. Equally, I used an image of a scale when attempting to convey information about inequality. As a scale is typically used to convey matters of justice (i.e. the scales of justice) it is possible that this may have prompted respondents to think of the inequalities presented as being unjust. As a result, this graphic may have prompted participants to make more pro-poor choices than might otherwise be the case had this icon not been used. In addition, it should be noted that I used smaller and larger house icons in order to represent poorer and richer groups. These graphics may have prompted participants to imagine exaggerated stereotypes of poorer and richer individuals. Subsequently, they may have responded in a more inequality averse fashion than they might have done had alternative, more objective, information been provided instead (i.e. stating the income of the individuals). Given this combination, it is possible that the results of this study, may overstate the public’s willingness to prioritise health gains provided to disadvantaged groups[4].

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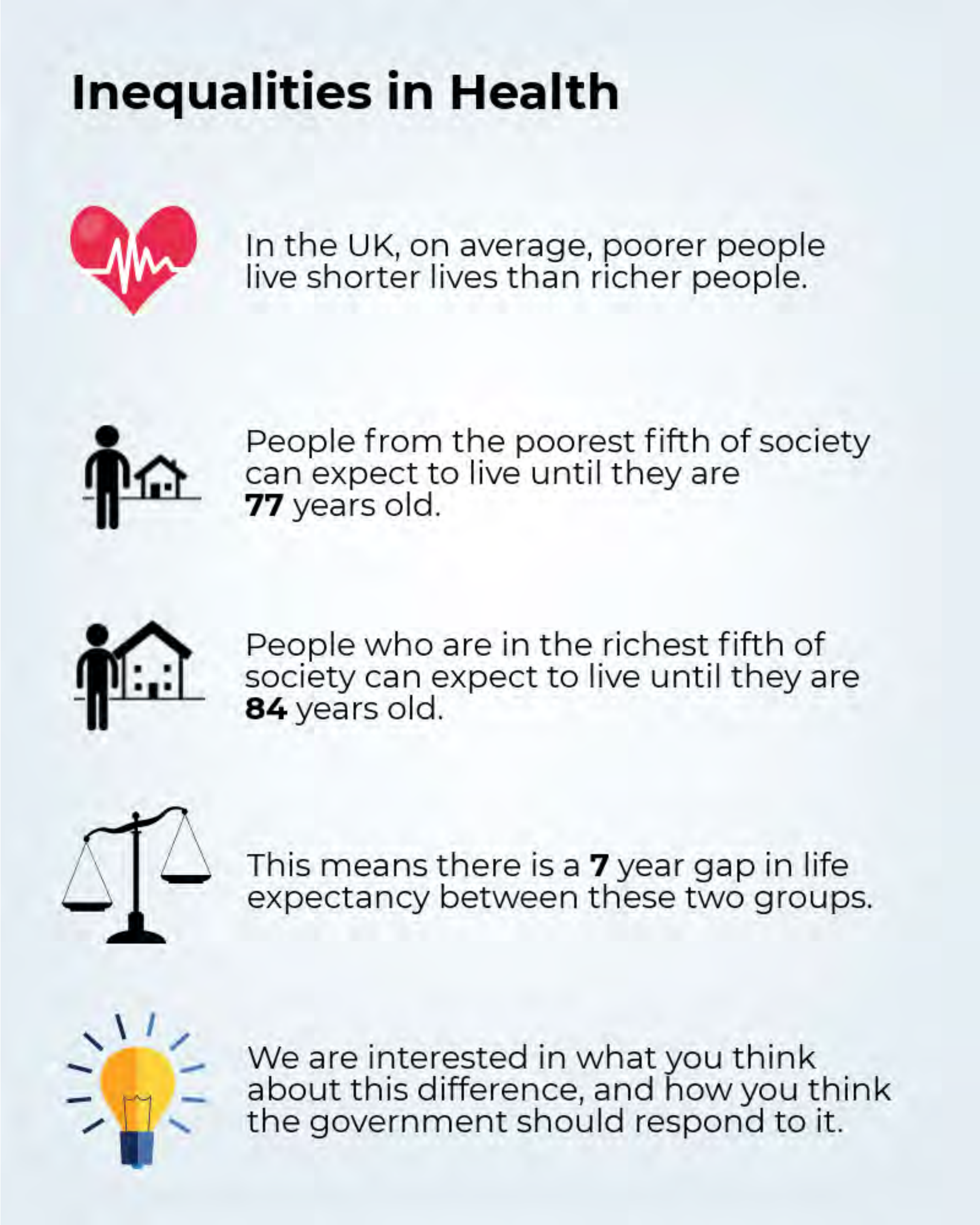
[4] Note this applies equally to the studies reported in Chapter 5 and 6

Figure 4.2: *Socioeconomic arm: briefing on inequalities in life-expectancy*



Inequalities in Health

In the UK, on average, poorer people live shorter lives than richer people.

People from the poorest fifth of society can expect to live until they are **77** years old.

People who are in the richest fifth of society can expect to live until they are **84** years old.

This means there is a **7** year gap in life expectancy between these two groups.

We are interested in what you think about this difference, and how you think the government should respond to it.

Participants were told to imagine they were a member of the government, and that they had been asked to make "some choices about health". They were informed the choices would have different impacts on the health of people from the poorest and richest fifths of society. This information was presented as shown in 4.3, below. Appendix A4.2 provides further detail on the briefing participants received.

Figure 4.3: *Socioeconomic arm briefing: "what we would like you to do"*

What we would like you to do

Imagine you are in the government.

Today, you have been asked to make some choices about health.

These choices will have different impacts on people from the richest fifth of society and the poorest fifth of society.

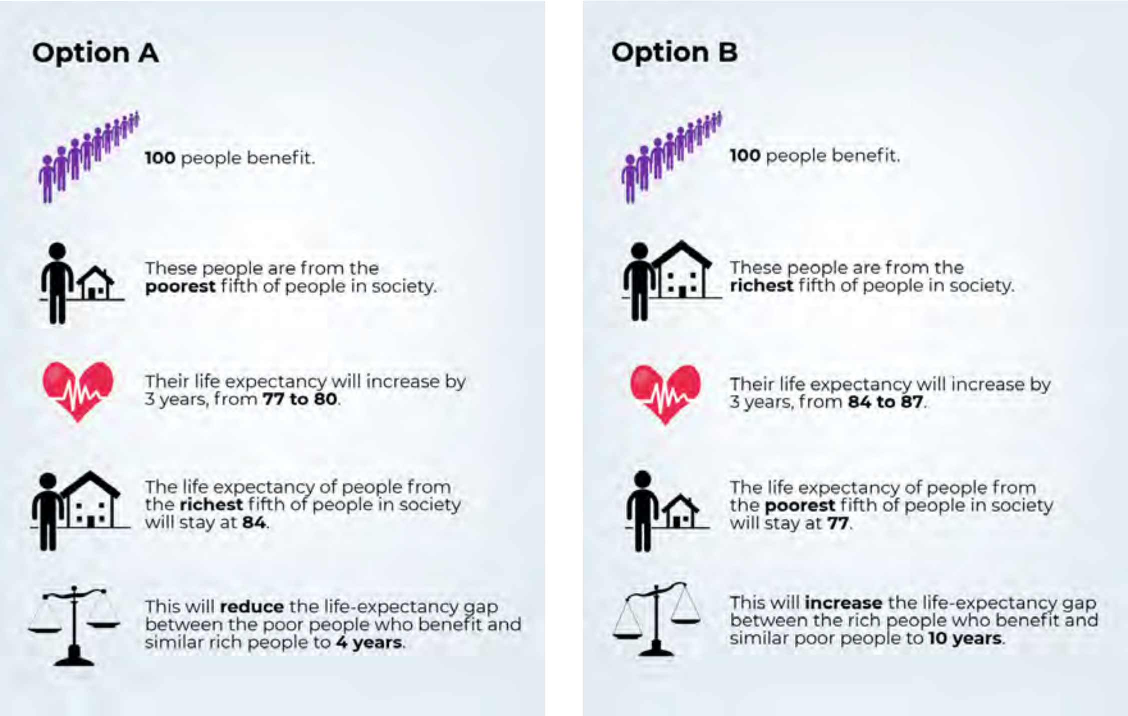
Think carefully about your choices - these are imaginary situations, but your responses could impact the way governments act in future.

4.2.2. Socioeconomic arm; life expectancy PTO

In the life expectancy exercise, the intervention increased the life-expectancy of each person who benefited from it by three years. These three years would be experienced in perfect health. This equates to a 3 QALY gain, although respondents were not told this.

In the first question, respondents were asked to choose between [Option A] an intervention that would provide the 3 year life-expectancy benefit to 100 people from the poorest fifth of society, who have a pre-intervention life-expectancy of 77 years; and [Option B] an intervention that would provide the 3 year life-expectancy benefit to 100 people from the richest fifth of society, who have a pre-intervention life-expectancy of 84 years. They were asked “which option should the government choose?”. Respondents were told they could express indifference between the two[5]. This initial question was presented as shown in Figure 4.4, below.

Figure 4.4: *Socioeconomic arm, life-expectancy PTO: the initial question*



Option A

100 people benefit.

These people are from the **poorest** fifth of people in society.

Their life expectancy will increase by 3 years, from **77 to 80**.

The life expectancy of people from the **richest** fifth of people in society will stay at **84**.

This will **reduce** the life-expectancy gap between the poor people who benefit and similar rich people to **4 years**.

Option B

100 people benefit.

These people are from the **richest** fifth of people in society.

Their life expectancy will increase by 3 years, from **84 to 87**.

The life expectancy of people from the **poorest** fifth of people in society will stay at **77**.

This will **increase** the life-expectancy gap between the rich people who benefit and similar poor people to **10 years**.

If the participant selected the poorer group, the number of individuals in the richer group was increased by 100 people (to 200 people). They were then asked to choose again. If they continued to choose the poorer group, the number of people in the richer group was increased by another 100 people, up to a maximum of 1,000 in the richer group. If the respondent chose the richer group at any point, the number of people in that group was reduced by 50 people, to a minimum of 50 people in the richer group. The number in the poorer group was fixed at 100 throughout.

If a participant expressed indifference between two of the options, the number of people in the richest fifth of society at that point (their “PTO indifference point”) was recorded and they moved on the next part of the study. If they chose to benefit 100

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[5] Note that, if an individual is indifferent to the inequality in life-expectancy between the two groups, they would be expected to express indifference between the two options in this initial question.

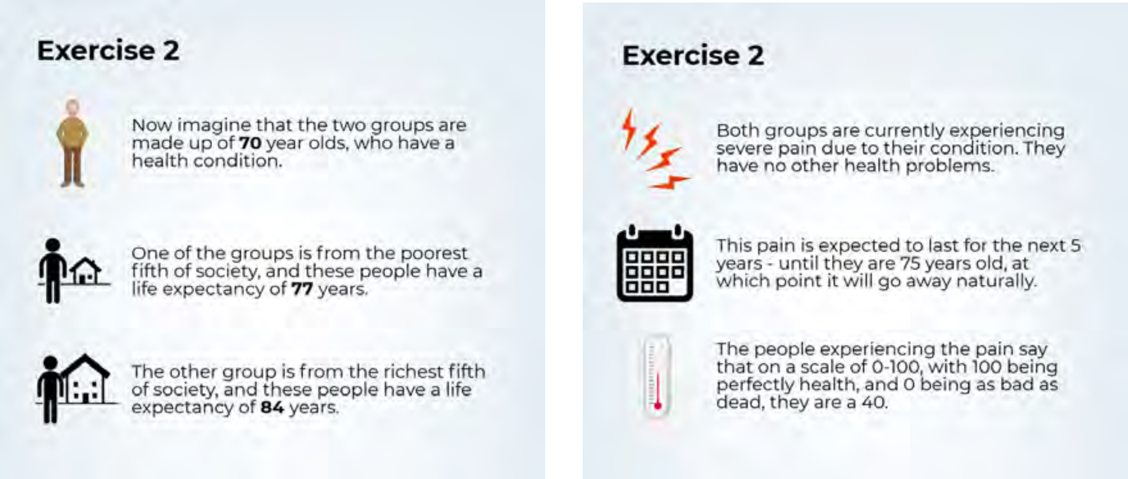
individuals from the poorer group rather than 1,000 individuals from the richer group their indifference point was recorded as >1,000 ("off-the-scale" pro-poor). Equally, if they chose to benefit 100 people from the poorer group rather than 50 from the richer on their indifference point was recorded as <50 (off-the-scale pro-rich). If a participant did not express indifference when presented with a choice 100 people in the poorer group and x50 (i.e. 150, 250, . . . , 950) people in the richer group, their indifference point was inferred to be halfway between two of their prior answers. For example, if they chose to help 100 poorer people over 150 richer people, but had previously chosen to help 200 richer people over 100 poorer people, they were assumed to be indifferent between helping 100 poorer people and 175 richer people.

4.2.3. Socioeconomic arm: the pain relief PTO task

The second PTO was comparable to the first, but about an intervention that relieved severe pain. As in the initial exercise, participants were told that the interventions would benefit people from the two socioeconomic groups. Similarly, they were told the two groups have differing levels of life-expectancy: the poorer group can expect to live until they were 77 years old and the richer group can expect to live until they were 84 years old.

In contrast to the initial exercise, participants were informed the people who would benefit from the intervention were currently 70-years old. These individuals have a health condition which is causing them to experience severe pain. The people experiencing the pain say that, on a scale of 0-100, with 100 being perfectly healthy and 0 being as bad as dead, they are 40. Without assistance, they will experience severe pain for the next five years, at which point it would go away naturally. This information was presented as shown in Figure 4.5, below.

Figure 4.5: *Socioeconomic arm: pain relief PTO exercise briefing*



Exercise 2

Now imagine that the two groups are made up of **70** year olds, who have a health condition.

One of the groups is from the poorest fifth of society, and these people have a life expectancy of **77** years.

The other group is from the richest fifth of society, and these people have a life expectancy of **84** years.

Exercise 2

Both groups are currently experiencing severe pain due to their condition. They have no other health problems.

This pain is expected to last for the next 5 years - until they are 75 years old, at which point it will go away naturally.

The people experiencing the pain say that on a scale of 0-100, with 100 being perfectly health, and 0 being as bad as dead, they are a 40.

The intervention would completely relieve the pain of each person who benefited from it for five years. In this period, their health related quality of life would improve to 100 (perfect health). Participants were informed the intervention would not change life-expectancy. As in the first exercise, this was designed to provide a 3 QALY gain[6]. Respondents were not told this. The pain-relief PTO followed the same protocol as outlined for the life-expectancy intervention. Figure 4.6, below, shows the initial question respondents were asked.

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[6] 1-0.4=0.6; 0.6*5=3.

Figure 4.6: *Socioeconomic arm, pain-relief PTO: the initial question*

Option A

100 people will benefit.

These people are from the **poorest** fifth of people in society

They will receive complete relief from their **severe pain** for **5 years**.

People in the **richest** fifth of society will get no relief from their severe pain.

The life-expectancy gap between the poorest fifth and richest fifth of society will stay at **7 years**.

Option B

100 people will benefit.

These people are from the **richest** fifth of people in society

They will receive complete relief from their **severe pain** for **5 years**.

People in the **poorest** fifth of society will get no relief from their severe pain.

The life-expectancy gap between the poorest fifth and richest fifth of society will stay at **7 years**.

4.2.4. How the neutral arm differed

The neutral arm briefing and exercises were identical to those for the socioeconomic arm, except participants were told the groups consisted of individuals with Disease A (to replace the poorest fifth of society) and Disease B (to replace the richest fifth of society). Figure 4.7, below, shows the life-expectancy inequality briefing participants in the neutral arm received. Figure 6.1, below, shows the first question respondents in the neutral arm were asked in the pain-relief PTO.

Figure 4.7: *Neutral arm: briefing on inequalities in life-expectancy*

Inequalities in Health

Please imagine there are two diseases, **A and B**.

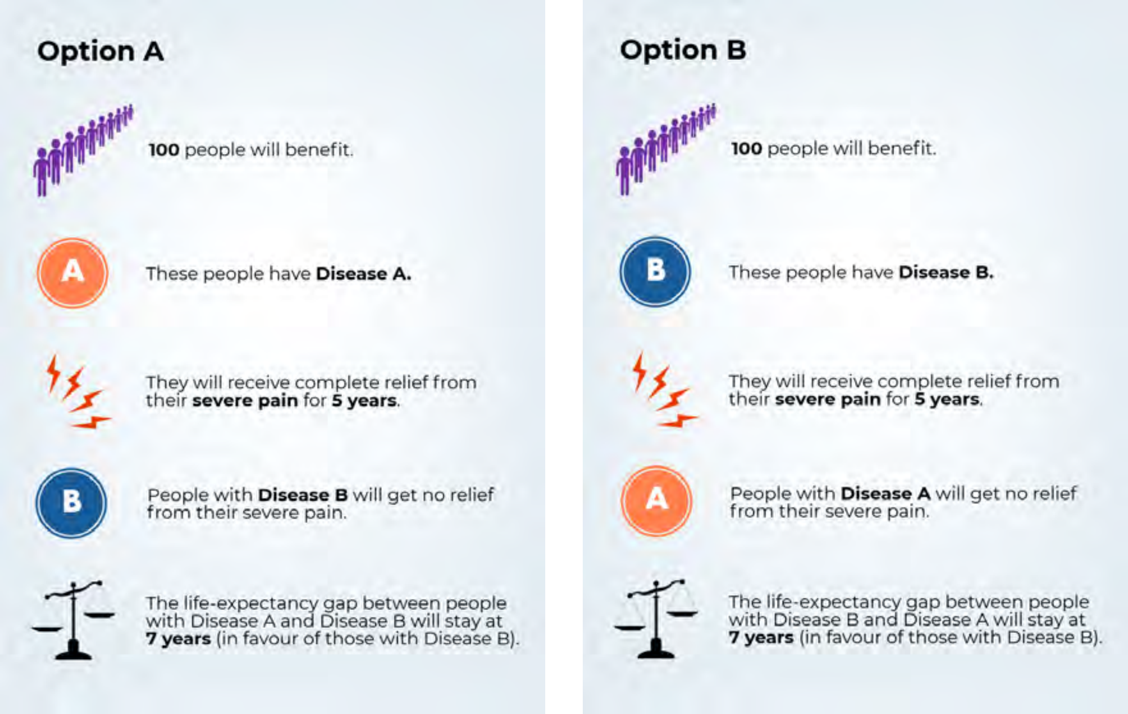
People with **Disease A** can expect to live until they are **77** years old.

People with **Disease B** can expect to live until they are **84** years old.

This means there is a **7** year gap in life expectancy between these two groups.

We are interested in what you think about this difference, and how you think the government should respond to it.

Figure 4.8: *Neutral arm, pain-relief PTO: the initial question*



Option A

100 people will benefit.

These people have **Disease A.**

They will receive complete relief from their **severe pain** for **5 years**.

People with **Disease B** will get no relief from their severe pain.

The life-expectancy gap between people with Disease A and Disease B will stay at **7 years** (in favour of those with Disease B).

Option B

100 people will benefit.

These people have **Disease B.**

They will receive complete relief from their **severe pain** for **5 years**.

People with **Disease A** will get no relief from their severe pain.

The life-expectancy gap between people with Disease B and Disease A will stay at **7 years** (in favour of those with Disease B).

4.2.5. The interviews

Following each PTO exercise, participants were asked semi-structured interview questions designed to explore their understanding of that task (e.g. “What was this question about?”), and the rationale for their choices (e.g. “So you chose option x here, why did you do that? What were you thinking?”). The interview protocol used is provided in Appendix A4.1. After completing the second of the PTO tasks, they were asked to rate their understanding of each[7]. Finally, respondents were asked for feedback on the study materials and procedure. I was the sole interviewer, and the audio of each interview was recorded for subsequent formal qualitative analysis.

4.2.6. Sample and data collection

Twenty non-academic, non-researcher, members of staff at the University of Sheffield completed the survey. Participation was restricted to those who did not hold a post-graduate qualification, and were not employed within the School of Health and Related Research (ScHARR). This was intended to provide a sample that better resembled the general-public in terms of their education level, and understanding of health-related resource allocation decision making.

Respondents were recruited by emailing a request for participants to a mailing list of staff who have expressed an interest in taking part in research studies, and by posting flyers in areas where members of staff congregate. Participants were offered a £15 gift voucher in return for 30 minutes of their time. The study was approved by the ScHARR Research Ethics Committee (ID: 022496). All interviews were undertaken in a meeting room in ScHARR in October 2018.

4.2.7. Analysis

Objective 1: testing the mechanical operation of the PTO exercises

Following study completion, I reviewed the Qualtrics record of each individual[8], and checked whether they were each asked the questions that they should have been (e.g. they were not asked questions about a group-type they were not randomised to; the person-numbers in the choice-sets were varied as intended etc.).

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[7] “On a scale of 0-10, with 0 being not all, and 10 being very well, how well do think you understood the questions about ... ”

[8] Qualtrics records the questions participants were asked, and the order these were presented in.

Objective 2: providing insight into potential effect sizes

Participants' inequality aversion in each exercise was quantified using their "PTO indifference points": the number of individuals in the group with higher life expectancy when a participant expressed (or was interpreted as) being indifferent between two options. As the number of people who would benefit from the intervention that helped the group with lower life-expectancy was fixed at 100 throughout, a participant's "PTO indifference point" provides an indication of the extent to which they preferred to help the group with higher life-expectancy. For example, a PTO indifference point of 100 indicates they were indifferent between helping the two groups types. In contrast, a PTO indifference point >100 suggests they are inequality averse, with higher numbers denoting higher levels of inequality aversion. As this was a pilot study, no formal statistical tests of the two hypotheses were conducted.

Hypothesis A: the UK-public are more averse to inequalities in lifetime health between socioeconomic groups than they are to inequalities in lifetime health between neutrally labelled groups.

Participant PTO indifference points across group-types were compared (a between persons comparison) in order to provide insight into the impact group-type may have on inequality aversion, and the likely size of that effect.

Hypothesis B: the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health if an intervention improves life-expectancy than they are if it improves quality-of-life.

The PTO indifference points of those in the socioeconomic arm were compared across the life-expectancy and pain relief exercises (a within persons comparison) in order to explore the potential impact health-gain type may have on participant responses, and the likely strength of that effect.

Objective 3: Evaluating participant understanding of the PTO tasks

The audio recordings of participant interviews were transcribed, and reviewed for evidence of misunderstanding. Respondent self-rated understanding scores[9] were explored for cases indicating they did not think they understood the tasks. Participant feedback on the study materials was reviewed for evidence of misunderstanding.

Objective 4: Identifying the factors participants considered when responding

Qualitative analysis was undertaken in four steps. First, participant interview transcripts were reviewed for statements in which they explained their choices. Where a rationale was identified, this was highlighted in the transcript, and a short summary of the respondent's rationale was recorded. Following completion of initial screening, extracted rationales were reviewed and grouped by rationale-type: for example, favouring the group with lower life-expectancy because they have lower life-expectancy. Subsequently, a spreadsheet was created to detail whether each participant cited each rationale-type in their response, and for which health-gain type they cited it. Finally, participant responses were compared across group type and health-gain types.

All qualitative analysis was undertaken by myself alone. My transcript reviews, rationale groupings, and spreadsheet analysis were not validated by a second reviewer. This is a clear limitation of my work; however, as the qualitative elements of this study were primarily designed to provide evidence to test the validity of the PTO approach, rather than form a substantive piece of research in their own right, this approach is sufficient for this purpose.

Objective 5: Highlighting ways the study materials could be improved

Potential modifications were identified in two ways. First, via a review of participant suggestions on ways the study materials could be improved. Second, by reviewing transcripts of the interviews for evidence of confusion, or interpretation of the study materials in unanticipated ways.

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[9] See Section 4.2.5 above, for further detail.

4.3. Results

Sample

Twenty people participated. Respondents were more educated than the general population: 55% were educated to degree level, compared to 40% of the public (ONS, 2017). Compared to the general-public, a lower proportion of the sample lived in more deprived areas, and a higher proportion lived in less deprived areas. For example, only 5% lived in areas that are classed as being in the most deprived 20% of areas in the country. Older people were under-represented. The oldest participant was 57 year old. This was expected given the nature of the sample. Table 4.1, below, summarises the demographics of participants.

Table 4.1: *Participant demographics*

		Sample
Age:		39.3
Sex:	Male	50%
	Female	50%
Ethnicity:	White	95%
	Asian	5%
Highest level of educational attainment:	High School/GCSEs/O-levels	20%
	College/A-levels	35%
	Undergraduate degree	55%
	Postgraduate degree	0%
Time resident in UK:	>3 years, but <10 years	5%
	>10 years	95%
Deprivation quintile (IMD based on LSOA:	Most deprived 20% of society	5%
	20% - 40%	20%
	40% - 60%	20%
	60% - 80%	30%
	Least deprived 20% of society	25%

4.3.1. Objective 1: testing the mechanical operation of the PTO exercises

The PTO exercises mechanically functioned as intended. All twenty participants were presented with briefing materials and choice-sets consistent with the study design.

4.3.2. Objective 2: providing insight into potential effect sizes

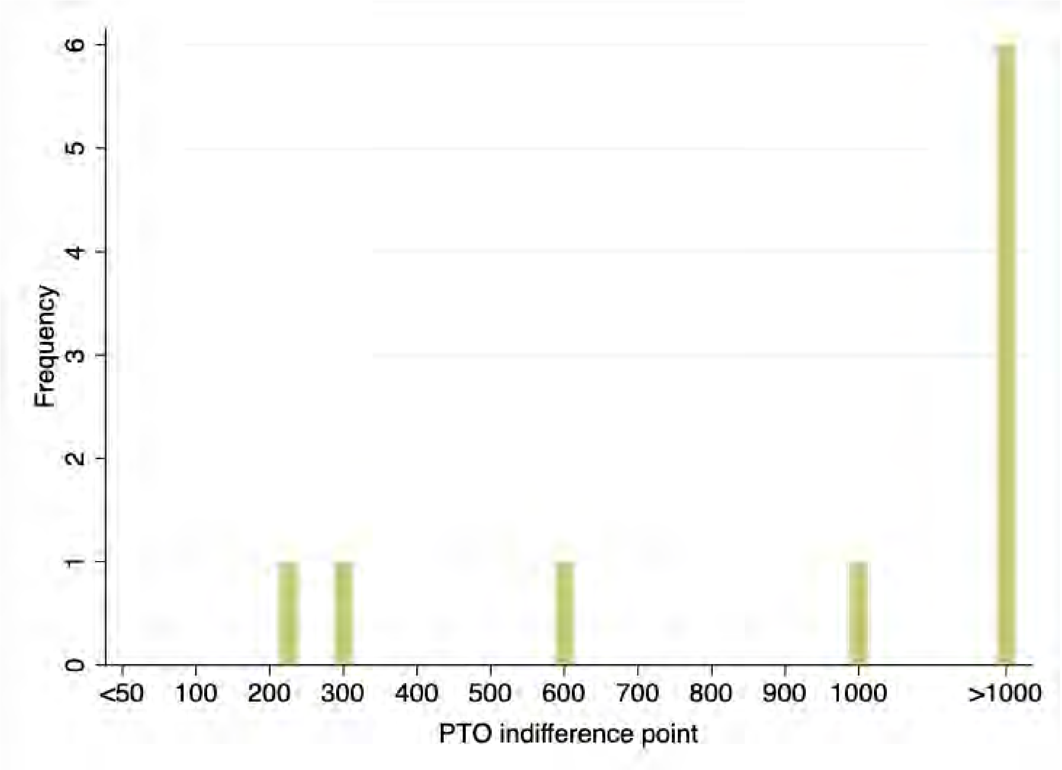
4.3.2.1 Hypothesis A: the UK-public are more averse to inequalities in lifetime health between socioeconomic groups than they are to inequalities in lifetime health between neutrally labelled groups.

4.3.2.1.1. Life Expectancy

Socioeconomic arm life expectancy PTO responses (n=10)

Six participants gave “off-the scale” pro-poor responses: they chose to help 100 people from the poorer group rather than 1,000 people in the richer group. This implies they place a >10:1 weight on providing a 3 QALY life-expectancy gain to a person from the poorest fifth of society who has a life expectancy of 77 years, compared to a person from the richest fifth of society who has a life expectancy of 84 years. The remaining four respondents gave pro-poor responses, albeit to a lower degree. Their indifference points ranged between 225 and 1000 (i.e. these participants were indifferent between helping 100 people from the poorest society and between 225 and 1000 people from the richest fifth of society, implying they value a gain to a poorer individual at between 2.25 and 10 times that to a richer individual). Figure 4.9, below, shows the distribution of PTO indifference points for this exercise.

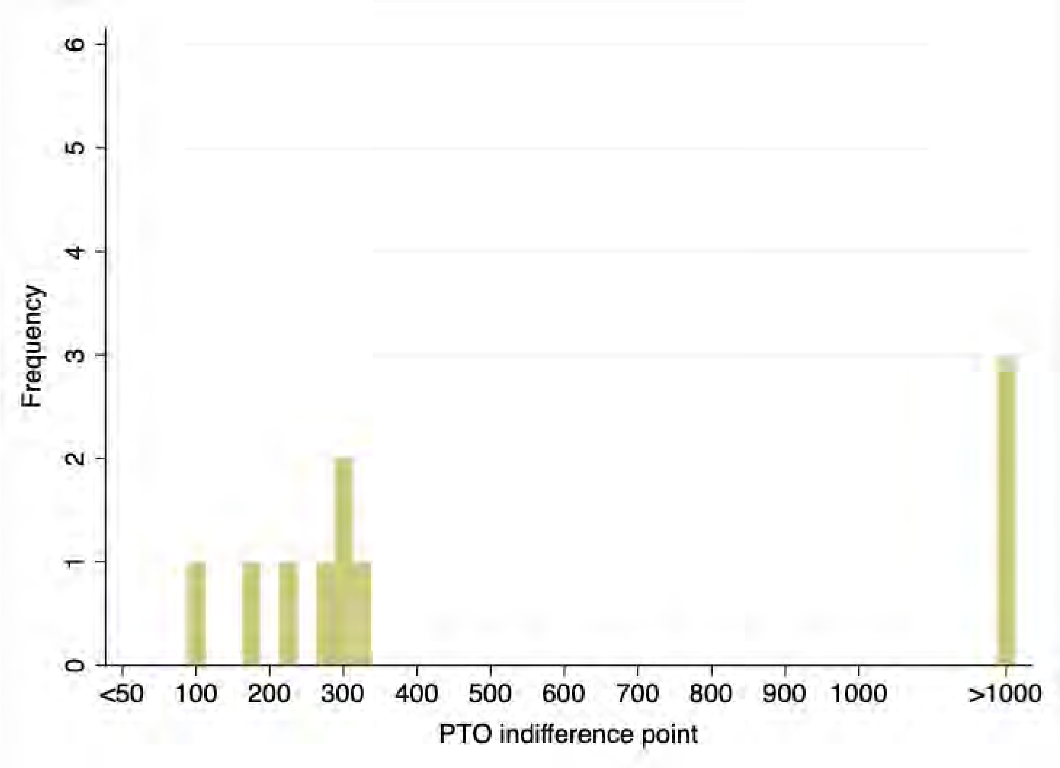
Figure 4.9: *Socioeconomic arm, life expectancy PTO indifference points (n=10)*



Neutral arm life expectancy PTO responses (n=10)

Of the ten participants in the neutral arm, three gave “off-the-scale” pro-Disease A (lower life expectancy) responses. Six participants favoured the group with lower life-expectancy to a lower degree, with indifference points ranging from 175 to 325. One participant expressed indifference between helping 100 people with Disease A or 100 people with Disease B. Figure 4.10, below, demonstrates the distribution of PTO indifference points for this exercise.

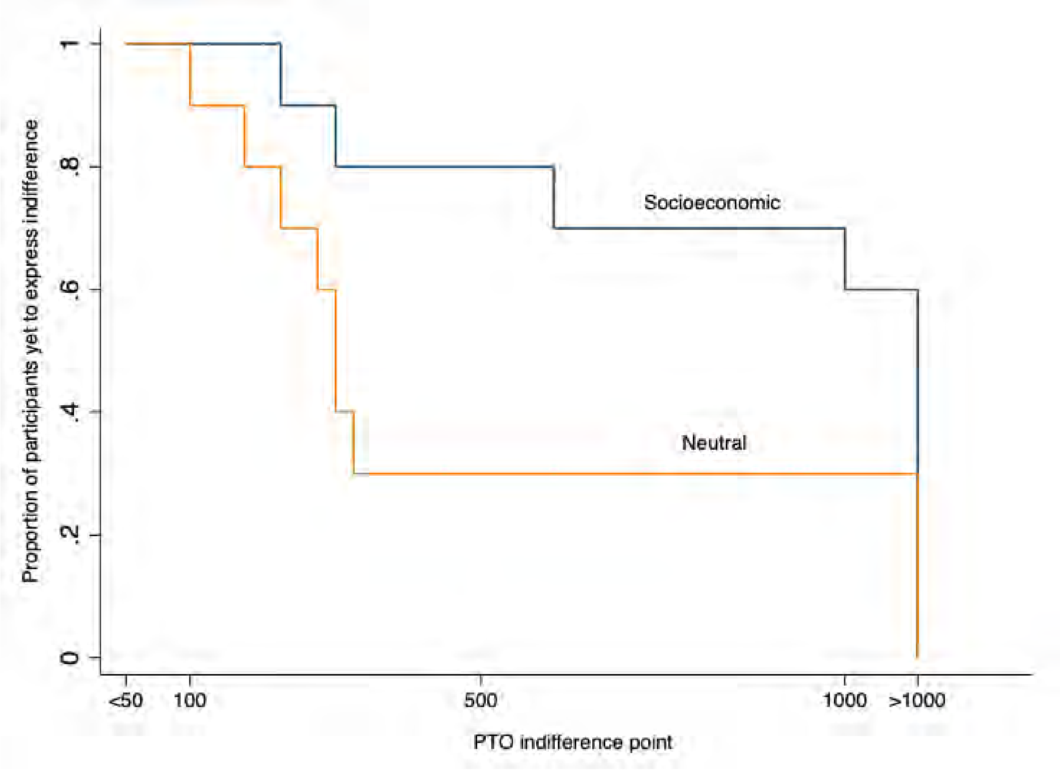
Figure 4.10: *Neutral arm, life expectancy PTO indifference points (n=10)*



Comparing life-expectancy PTO responses across group-types (n=20)

Figure 4.11, below, compares PTO indifference points for the life-expectancy exercise across the two arms. The x-axis shows the PTO indifference point. The y-axis shows the proportion of respondents who were yet to express indifference between the two options at a given x-axis value. If participants across the two arms were equally willing to prioritise the group with lower life-expectancy, we would expect to observe two overlapping curves in this figure. Instead, the socioeconomic arm is, generally, to the right of the neutral arm. This shows that participants in the socioeconomic arm had higher PTO indifference points that participants in the neutral arm. The median PTO indifference point in the neutral arm was 300, whilst in the socioeconomic arm it was greater than 1000. This trend is broadly consistent with Hypothesis A (the UK-public are more averse to inequalities in lifetime health between socioeconomic groups than they are to inequalities in lifetime health between neutrally labelled groups).

Figure 4.11: *Comparison of PTO indifference points by group-type: life expectancy*

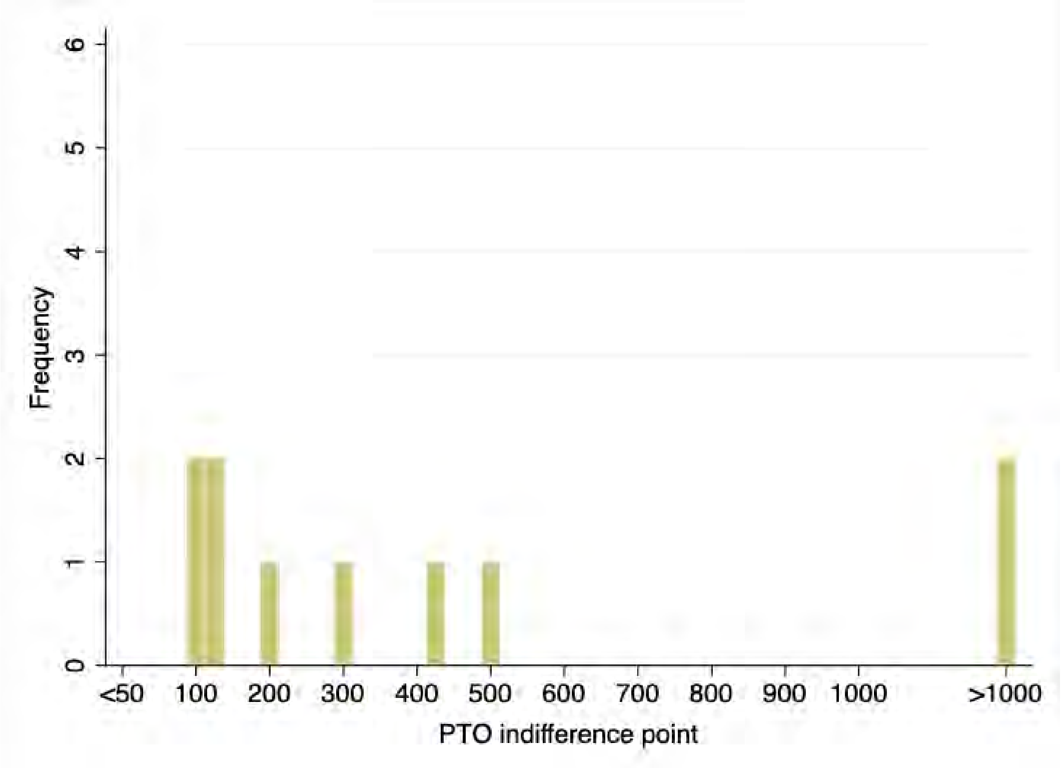


4.3.2.1.2. Pain relief

Socioeconomic arm pain relief PTO responses (n=10)

For the pain exercise, two respondents gave off the scale pro-poor responses. Two expressed indifference between helping 100 poorer people and 100 richer people. The remaining six made pro-poor choices, with indifference points between 125 and 500. Figure 4.12, below, provides the distribution of PTO indifference points for this task.

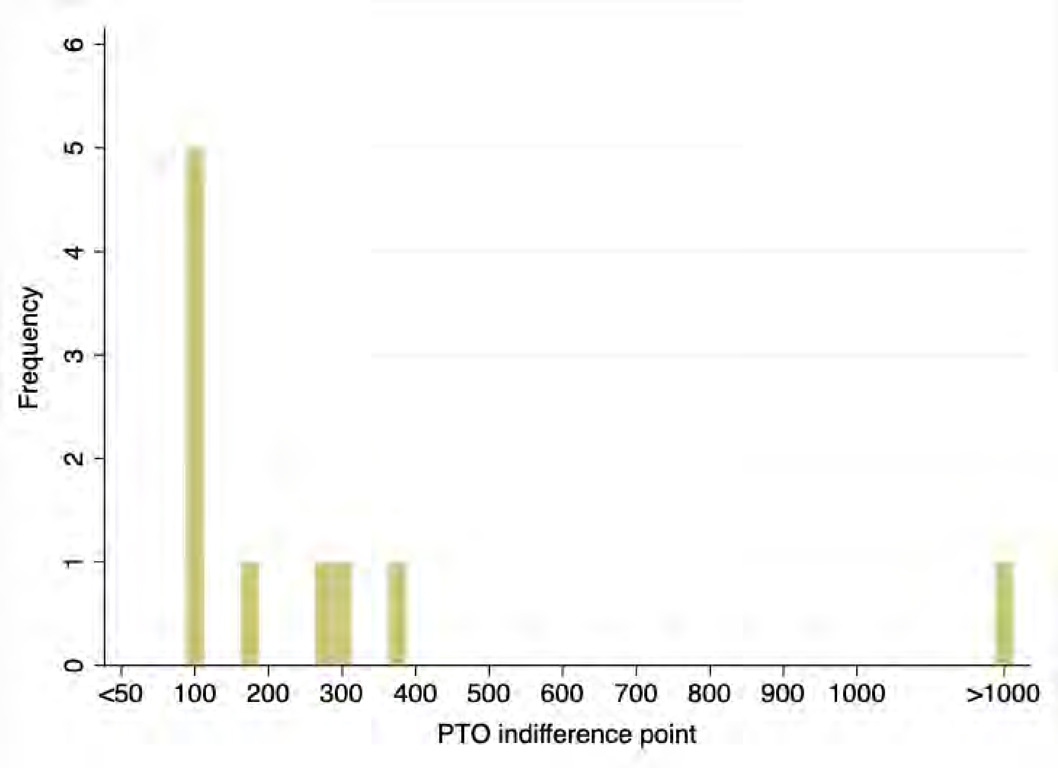
Figure 4.12: *Socioeconomic arm, pain relief PTO indifference points (n=10)*



Neutral arm pain relief PTO responses (n=10)

For the pain relief intervention, one respondent gave an “off-the-scale’ response in favour of people with Disease A (lower life-expectancy). Four further participants favoured people with Disease A; albeit to a lesser degree, with indifference points between 175 and 375. Five expressed indifference between relieving the pain of 100 people with Disease A, or 100 people with higher Disease B. Figure 4.13, below, provides the distribution of PTO indifference points for this exercise.

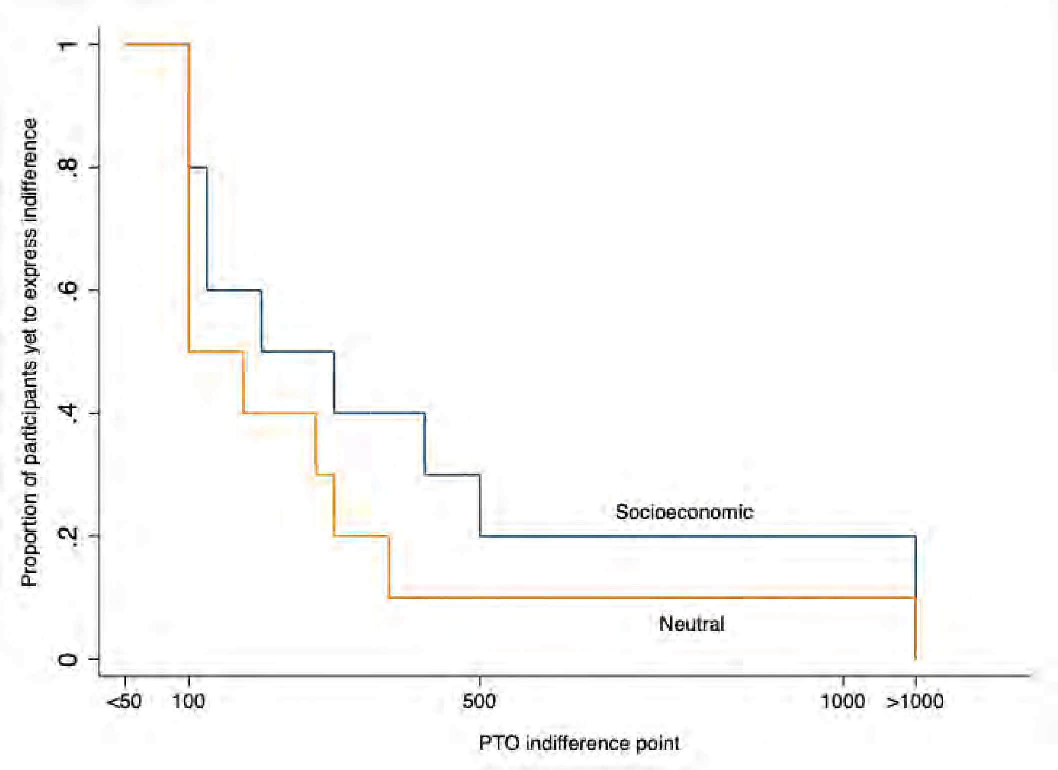
Figure 4.13: *Neutral arm, pain relief PTO indifference points (n=10)*



Comparing pain-relief PTO responses across group-types (n=20)

Figure 4.14, below, compares the PTO indifference points for the pain relief exercise across the two arms. As in Figure 4.11, above, the socioeconomic arm curve is, generally, to the right of the neutral arm. This shows that the pain-relief PTO indifference points of participants in the socioeconomic arm were, generally, higher than for those in the neutral arm. The median PTO indifference point in the socioeconomic arm was 250, and the median in the neutral arm was 138.

Figure 4.14: *Comparison of PTO indifference points by group-type: pain relief*



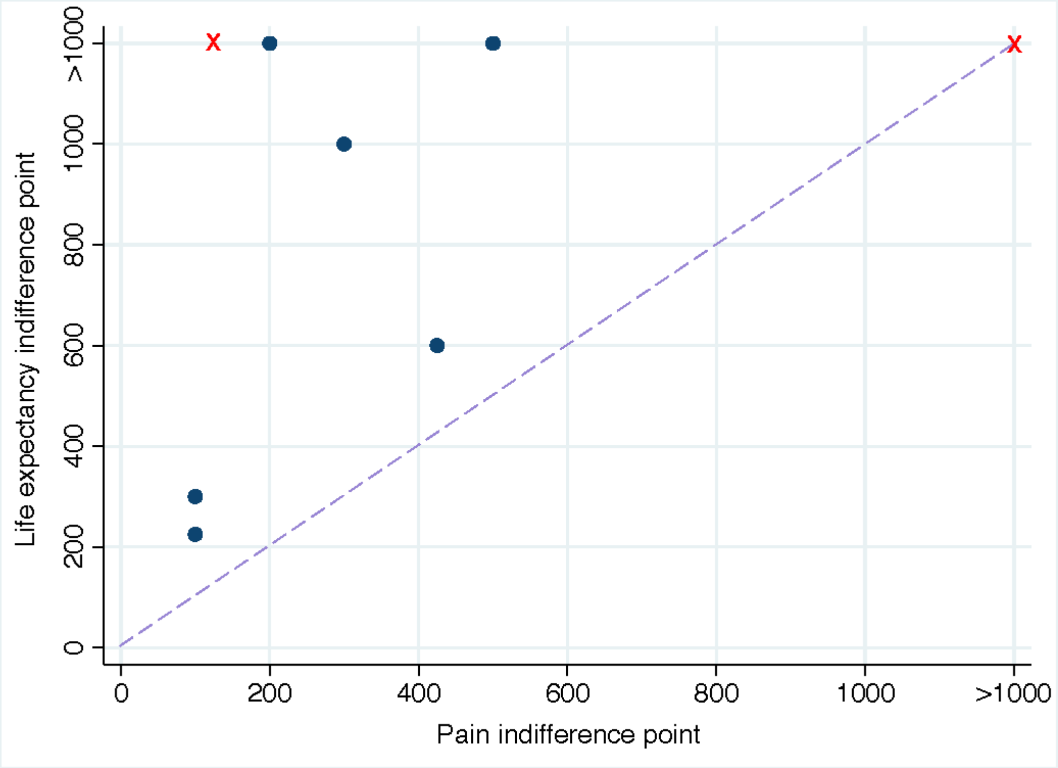
This figure is broadly consistent with Hypothesis A (the UK-public are more averse to inequalities in lifetime health between socioeconomic groups than they are to inequalities in lifetime health between neutrally labelled groups), although the differences between group-types are less pronounced than for the life-expectancy PTO. Notably, the ratio of the median indifference point for the two arms for the pain exercises was 1.8 (250/138), compared to >3 for the life-expectancy tasks (>1000/300).

4.3.2.2. Hypothesis B: the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health if an intervention improves life-expectancy than they are if it improves quality-of-life

Comparing across health gain types in the socioeconomic arm (n=10)

Figure 4.16, below, compares each respondents PTO indifference points for the two health gain types. The y-axis denotes a participants life-expectancy PTO indifference point, and the x-axis shows their pain relief indifference point. The diagonal line is a line of equality between the two. If participants were equally willing to prioritise the poorer group for either type of health gain, we would expect the points to be clustered around the line of equality. Instead, we see the majority are above this line. Eight of the ten participants were more willing to prioritise the poorer group over the richer group for the life-expectancy intervention than they were for pain relief. Two gave off-the-scale pro-poor responses for both.

Figure 4.15: *Socioeconomic arm, comparing indifference points by health gain type. Red X indicates two respondents had the same combination of indifference points.*



This trend is broadly consistent with Hypothesis B (the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health if an intervention improves life-expectancy than they are if it improves quality-of-life). The median indifference point for the life-expectancy exercise (>1000) was more than four times higher than that for the pain-relief exercise (250). In the interest of transparency, an equivalent figure for the neutral arm is provided in Appendix A4.1.

4.3.3. Objective 3: evaluating participant understanding of the PTO tasks

All twenty participants demonstrated good understanding of the exercises. Each explained the PTO tasks in a manner consistent with the study materials. Similarly, each provided logical reasons for their choices for both exercises. These are detailed further in Section 4.3.4, below. Participants rated their own understanding of both exercises highly. When asked, “on a scale of 0-10, with 0 being not all, and 10 being very well, how well do think you understood the questions about improving life-expectancy”, 16 of the 20 participants rated their understanding as 9 or 10. Three responded with a 7 or 8, and one scored themselves a 5. This individual clarified they gave this response because they did not understand *why* they were being asked the question, rather than *what* they were being asked. This individual was in the neutral arm, and appeared to perceive the decision as being one government should make, rather than something they should be asked their opinion on. Specifically, they stated: “I don’t know the intention of asking this question. It’s unclear to me. I just give my own opinions”; “It was about which option I will opt for, but I don’t know actually” and “I think it doesn’t matter to me, which option the government decides”. For the equivalent question about the pain relief exercises, 16 participants scored their understanding as a 9 or 10, and four scored themselves an 8. Participant feedback on the study materials provided no evidence of misunderstanding.

4.3.4. Objective 4: identifying factors participants considered when responding

This section first reports the explanations participants gave for the life-expectancy exercises. Following this, it details the rationales they gave for the pain-relief tasks. After this, it compares participant rationales across group-types (relevant to Hypothesis A). Subsequently, it contrasts rationales across health-gain types in the socioeconomic arm (relevant to Hypothesis B).

4.3.4.1. Life expectancy

Socioeconomic arm

Participants in the socioeconomic arm explained their life-expectancy choices by making reference to both health, and non-health factors. Nine justified their decisions by making statements consistent with outcome egalitarianism: a desire to equalize the life expectancy of the two socioeconomic groups. Four referred to the number of people that the interventions would help. Three explained their choices by arguing that the richer group would be more likely to obtain private healthcare. Three cited the wider economic impact of the interventions. For example, when explaining their thought process when asked to choose between helping 100 poorer people or 1000 richer people, one stated “somebody is going to have the fund their [the richer people’s] pensions, and all the healthcare, benefits and things”. Two justified their choices by referring to the broader inequalities between poorer and richer people. For example:

> *"it’s not just that these people are poorer than these people, it’s that these are the poorest fifth of society themselves, so for me it wasn’t just a choice between the people with slightly less money deserve it more, it was just thinking that if you are in the poorest fifth of society, as far as I am aware, there is lots of things that sort of are skewed against you”.*

The other noted “I felt that these people are probably people that have struggled anyway in life, and, probably deserve to have that extra little extra bit spent on them by society, in order to benefit them”. Other rationales cited by single individuals include: (1) the fact that, even with the intervention, the life-expectancy of the poorer group remained below that of the richer group (80 years vs 84 years); (2) the judgement that living to 84 “is a, you know, quite a reasonable age to live to”; (3) the perception that favouring the poorer group would give them “a bit more retirement life”.

Neutral arm

Participants in the neutral arm justified their life-expectancy choices using solely health-related reasons. Seven of the ten explained their choices by making statements consistent with outcome egalitarianism. For example, one explained their decision to favour an option that favoured people with Disease A (lower life expectancy) by stating “it was reducing the life expectancy gap between the two different diseases, so it seemed the fairest thing to do”. Five explained their choices by referring to the higher number of people who would benefit from option that favoured the group with higher life-expectancy. Two justified their choices by arguing the life-expectancy of people with Disease B (84 years) was already high. For example, one stated “I thought Option B, well they’ve already got quite a long, or longer, life expectancy” and “it sounds like they haven’t got it too bad at the moment anyway”. Other reasons cited by single respondents include: (1) arguing that perfect quality of life at age 77 is higher than perfect quality of life at 84, and (2) noting that a 3 year benefit is a higher proportional gain to someone with a life expectancy of 77 years than someone with a life expectancy of 84 years.

4.3.4.2. Pain relief

Socioeconomic arm

Participants in the socioeconomic arm explained their pain-relief choices by making reference to both health, and non-health factors. Four cited the number of people who would benefit from the interventions. Six justified their choices by arguing the richer group could obtain pain-relief privately. Three explained their decisions by referring to productivity of the potential recipients. For example, one stated poorer people were “more likely to be in jobs that require their body, manual jobs, menial tasks”. Three referred to the broader inequalities between the socioeconomic groups. For example, one stated “poor people I think, again, they, they probably would have struggled more through, through the rest of life”. Two participants made arguments consistent with gain egalitarianism: the view that improvements in people’s health should be valued equally. For example, one stated

"I think you shouldn't only receive pain relief just because you're poor".

Neutral arm

Respondents in the neutral arm explained their pain relief choices using solely health rationales. Four referred to the number of people who would benefit from the interventions. Five justified their choices by making statements consistent with gain egalitarianism. For example, one stated "If there are two groups of people who are in distress or suffering, basically … one isn't more deserving than another to be relieved of pain if that option is there". Five explained their decisions by referring to the inequality in future pain-free life-expectancy between the two groups[10]. For example, one stated "I felt that, because these people are going to live longer and have more time after the pain, pain free, that it was worthwhile giving it to these people who were not really going to live that long without the pain". One participant in the neutral arm explained their pain relief PTO choices by making a statement consistent with QALY-based outcome egalitarianism: the view that it would be better if we each experienced an equal number of QALYs in our lifetime. When justifying a decision to favour the people with Disease A (lower life expectancy) this individual stated "it seems fairer for your life to be better if you die, like, earlier".

4.3.4.3. Comparing participant rationales across the socioeconomic and neutral arm (relevant to Hypothesis A of this thesis)

Participants in the socioeconomic arm cited a range of non-health reasons for their choices. For example: (1) the economic productivity of the people who would benefit from the interventions; (2) the downstream costs associated with helping/not helping the individuals (e.g. pensions); and (3) the broader non-health inequalities that exist between socioeconomic groups. In addition, they also cited a health-related factor that decision-makers may not wish to be reflected in economic evaluation: (4) the inequality in access to private healthcare between socioeconomic groups. In contrast, no respondent in the neutral

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[10] Both groups are currently 70 years old, and the pain in either group will last for 5 years. People with Disease A have a life-expectancy of 77 years. This equates to a future pain-free life expectancy of two years (77-75=2). People with Disease A have a life-expectancy of 84 years. This equates to a future pain-free life expectancy of seven years (84-75=9).

arm cited these rationales. Five participants in the neutral arm cited the inequality in future pain-free life-expectancy between the two groups when justifying their pain relief decisions. Conversely, no respondent in the socioeconomic arm explained their choices in this way.

4.3.4.4. Comparing participant rationales across health-gain types in the socioeconomic arm (relevant to Hypothesis B of this thesis)

Participants rationales differed across the two health gain types. Notably, nine explained their life-expectancy decisions by referring to the inequality in life-expectancy between the two groups, whilst none explained their pain-relief choices in this way. Furthermore, six justified their pain relief decisions by making reference to private healthcare, whilst only three did so for the life-expectancy intervention.

4.3.5. Objective 5: highlighting ways the study materials could be improved.

Participant suggestions

Seventeen participants made no substantive suggestions when asked how the study materials could be improved. Three stated they had not initially noticed the number of people in Option B (the richest fifth of society/Disease B) changing during the PTO tasks, and suggested this be highlighted in future studies.

Transcript review

Two potential modifications were identified through the review of the interview transcripts. First, participant rationales highlighted the fact that respondents were told the age of the people who would benefit from the pain relief intervention (70 years old), but were not told the age of the people who would benefit from the life-expectancy intervention. If not resolved, this could act as a confounding factor in future tests of Hypothesis B (health gain type). This could be remedied by stating the age of the people who would benefit from the life-expectancy intervention: a change that was made for subsequent studies.

Second, the frequency at which participants in the socioeconomic arm cited private healthcare highlighted that the study materials did not state whether the interventions were available privately. Given this, it is possible some respondents assumed they were not available privately, whilst other assumed they were. This could be resolved by making clear whether or not this is the case. In response, the study materials were modified so they explicitly stated the intervention was not available via any other means.

4.4. Discussion

The five objectives

This pilot had five objectives: (1) to test the mechanical operation of the PTO exercises; (2) to provide insight into the potential effect sizes likely to be observed in future fielding; (3) to evaluate participant understanding of the PTO tasks; (4) to identify the factors they considered when responding; and (5) to highlight ways the study materials could be improved.

The first objective (mechanical operation) was achieved by asking participants to complete the PTO exercises, and then reviewing the Qualtrics-record of their completion for evidence of deviation between the intended study design, and what participants were shown. No deviations were identified. The PTO design mechanically functioned as intended.

The second objective (effect sizes) was explored separately for the two hypotheses. Participant PTO indifference points across the two group-types were compared in order to provide insight into the effect size that may be observed in a future test of Hypothesis A (the UK-public are more averse to inequalities in lifetime health between socioeconomic groups than they are to inequalities in lifetime health between neutrally labelled groups). The observed trend in participant responses was consistent with Hypothesis A for both health-gain types. For the life-expectancy intervention, the median PTO indifference point of in the socioeconomic arm was more than three times higher than in the neutral arm (>1000 compared to 300). For the pain-relief intervention, the median indifference point in the socioeconomic arm was 1.8 times that of the neutral arm (250 compared to 138). These trends suggests there is potential merit in exploring Hypothesis A further. In addition they indicate that there may be an interaction between group type, and health gain type, with differences in preferences by group type, potentially, being more pronounced for life-expectancy interventions than for pain-relief interventions.

The PTO indifference points of participants in the socioeconomic arm were compared across two health-gain types in order to give an indication of the likely effect size that may be observed in a future test of Hypothesis B (the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health if an intervention improves life-expectancy than they are if it improves quality-of-life). The observed trend was consistent with Hypothesis B. Of the ten respondents in the socioeconomic arm: eight were more willing to prioritise the poorer group over the richer group for the life-expectancy intervention rather than the pain relief intervention; and, two were equally willing to prioritise the poorer group over the richer group for either intervention. The median PTO indifference point for the life-expectancy intervention was more than four times higher than that for the pain-relief intervention (>1,000 compared to 250). This trend motivates further testing of Hypothesis B.

The third objective (evaluating understanding) was addressed by asking participants to explain what they were asked to do in the PTO tasks, to clarify the reasons for their choices, and to rate their own understanding of the exercises. All participants explained the tasks proficiently, and gave logical reasons for their decisions. Similarly, the majority rated their subjective understanding highly. In totality, this suggests participants understood the PTO tasks. In combination with the findings regarding the first objective (mechanical operation), this suggests it would be reasonable to use modified versions of the piloted tasks in future studies.

The fourth objective (the factors considered when responding) was explored by asking participants to explain their choices. Respondent rationales were then thematically analysed, and reported by arm and health-gain type.

In the socioeconomic arm, participants justified their life-expectancy and pain relief decisions by making reference to both health, and non-health rationales. In the neutral arm, respondents explained their choices using solely health-based rationales. This response pattern is consistent with the logic underlying Hypothesis A of this thesis: that members of the public asked questions about prioritising the health of different socioeconomic groups are likely to be influenced by non-health differences between those groups.

Nine out ten participants asked questions about socioeconomic groups explained their life-expectancy choices by referring to the inequality in life-expectancy between the two groups, whilst none explained their pain-relief choices in this way. This suggests the UK-public's aversion to socioeconomic inequalities in health *may* be "health-domain specific", with an inequality in one domain of health being perceived as more relevant to a decision about an intervention that would improve that domain of health, rather than another. If this is the case, this may, at least in part, explain the trend in PTO responses observed between health-gain types in this study[11].

If inequality aversion is health-domain specific, this would mean that the piloted study design is not optimally suited to test the two hypotheses. This is because each includes the words "lifetime health" (e.g. for Hypothesis A: "the UK-public are more averse to inequalities in lifetime health"), whilst the current study design uses life-expectancy as the sole metric of lifetime health. Given this, it is possible that conveying lifetime health using both life-expectancy and quality-of-life may prompt participants to respond differently to the PTO tasks than if it were conveyed using solely life-expectancy.

The fifth objective (ways the study materials could be improved) was addressed by (1) asking participants for their suggestions on how the study materials could be improved, and (2) reviewing interview transcripts for evidence of misunderstanding, or interpretation of the PTO materials in a manner that would compromise the tests of the two hypotheses. Three participants stated that they had not initially noticed the number of people in one of the groups changing, and suggested this be highlighted. Participant rationales highlighted two further potential improvements. First, clarifying the age of people who would benefit from the life-expectancy intervention. Second, stating whether or not the interventions could be obtained privately.

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[11] Note that respondents were only briefed on inequalities in life-expectancy, not pain.

Strengths and limitations

This study is the first choice-experiment (albeit a pilot study) to report participants stated reasons for prioritising health gains provided to socioeconomic groups with differing levels of lifetime health. As a result, it is the first to report evidence that participants asked questions about socioeconomic groups are influenced by non-health factors. If combined with additional evidence consistent with Hypothesis A (group types), this finding would motivate a normative debate about whether the HR-SWFs applied in DCEA should apply estimates of aversion to inequalities in health between socioeconomic groups, or neutrally labelled groups. A key limitation of this study is the fact I undertook all qualitative analysis alone, and my work not validated by a second reviewer. It would have been preferable to have this analysis conducted, and validated, by a broader team of researchers. In addition, it should be noted the sample were not representative of the UK-public: participants were all members of staff at the University of Sheffield. Given this, it is uncertain whether the results observed can be extrapolated to the general population. Furthermore, as noted in Section 4.2.1. it is possible that the graphics, and terms, used to convey information to participants may have prompted them to respond in a more inequality averse manner than if more objective alterantives been used. As a result, this study may overstate the public's willingness to prioritise the disadvantaged.

4.5. Issues identified following thesis submission

During my viva on this thesis, the examiners identified two issues with the PTO design, and analysis that were not addressed in the document submitted. This subsection explains these issues, and their potential implications. When considering these issues, it should be noted both were identified following the completion of all empirical work. Given this, this text is equally applicable to the two further *de novo* studies reported.

The asymmetry between pro-rich and pro-poor choices in the PTO design[12]

In the PTO protocol, the number of people in the poorer group was fixed at 100 throughout. Subsequently, the number of people in the richer group was varied from a starting point of 100 in order to explore participants preferences for prioritising the two groups. However, this variation was not unlimited, or symmetrical: the number of people in the richer group was truncated at a maximum value of 1000, and a minimum of 50. As a consequence of this protocol, a pro-poor individual can express a maximum weight of 10:1 on a gain to a poorer person compared to a richer person before being recorded as having "off the scale" pro-poor preferences[13]. Conversely, an individual who is pro-rich can only express a maximum weight of 2:1 on a gain provided to a richer person compared to a poorer person before being recorded as having "off the scale" pro-rich preferences[14]. As a result of this asymmetry, this PTO protocol has potential to introduce bias against individuals with pro-rich preferences; and equally in the neutral context, against people with pro-Disease A preferences.

In the context of this chapter, this issue is somewhat of a moot point, because no individual expressed pro-rich/pro-Disease A preferences to any degree. As a consequence. extending the pro-rich protocol would not have had an impact on the responses recorded. However, this will not be the case in the chapters that follows. As a result, if I were to field this form of PTO design again, I would modify the design to make pro-rich and pro-poor variation symmetrical in order to remove this potential source of bias.

In addition, when considering this issue it should be be noted that the PTO results were primarily analysed based on medians and rank based procedures. As you will see in the chapters that follow, only a small minority of respondents in any of the exercises express off the scale pro-rich/pro-Disease A preferences. As the PTO protocol asymmetry is not relevant to the medians-based analyses. In contrast, this effect could have impacted the rank-based tests, as these take into account the response of every participant; however, due to the small number of participants with off the scale pro-rich/pro-Disease A

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[12] This issue applies equally to the neutral arm, but this issue is explained using the socioeconomic arm in the interest of simplicity.

[13] i.e. by choosing to benefit 100 poorer people over 1,000 richer people.

[14] i.e. by choosing to benefit 50 richer people over 100 poorer people.

response this impact would likely have been minor[15].

The decision not to use a ratio of means analysis of the PTO design

In prior literature on PTO, two forms of analysis are proposed (Baker et al., 2010; Petrou et al., 2013): (1) a median of ratios approach; and (2) a ratio of means approach. In this thesis, I apply the first of these methods. In this approach, the "ratios" of each participant are first estimated: the ratio of the number of people in the two impacted groups at the point each participant expressed indifference[16]. Subsequently, the preferences of participants as a whole are quantified by taking the median of those responses. Conversely, in a ratio of means approach, the group a respondent prefers is assigned a value of 1, and the group they do not prefer is assigned a value of the number of people in the preferred group over the number of people in the unfavoured group at that respondents indifference point[17]. Subsequently, the mean score for each group across all participants is estimated, and the ratio of two means is used as a way of quantifying the preferences of the group as a whole.

These different methods have different properties. For example, the median of ratios approach is insensitive to the strength of preference respondents either side of the median have. Conversely, the mean of ratios approach takes into account the strength of every participant's preferences. In this thesis, I opted to use a ratio of medians approach over a ratio of means one. This is because my PTO protocol is truncated at either end (as discussed in the prior subsection). If i had opted for a ratio of means approach it is not clear what value respondents with "off the scale" preferences should take the analysis. These individuals would be known to have a preference in a specific range, but it would be unclear which value in that range should be selected. Conversely, a ratio of medians approach is insensitive to the precise strength of the preferences of individuals beyond

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[15] Note that, whilst this effect might have been minor in the studies I report here, this may not be the case in future studies. Given this, I would consider modifying the PTO protocol if I were to use this design again.

[16] e.g. if a participant expressed indifference between helping 100 poorer and 100 richer individuals their ratio would be 1:1.

[17] e.g. if the respondent expressed indifference between helping 100 poorer people and 50 richer people, the richer group would be assigned a value of 1, and the poorer group would be assigned a value of 0.5.

the median respondent, and so is unimpacted by this issue[18]. As a result, I opted to use a median or ratios approach rather than a ratio of means one.

4.6. How this chapter contributes to the thesis as a whole

In totality, this chapter: (1) suggests it would reasonable to use a modified version of the PTO study to test the two hypotheses of this thesis in future work; (2) provides PTO results that are broadly consistent with both Hypothesis A (group types) and Hypothesis B (health gain types); albeit, based on very small sample sizes; (3) provides evidence that participants asked questions about socioeconomic groups state they are influenced by non-health factors. This is consistent with the logic underlying Hypothesis A (group types). In combination with Chapters 1 and 2, these findings motivate future direct tests of the two hypotheses using a variant of the PTO study piloted.

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[18] Assuming the median response is not itself truncated.

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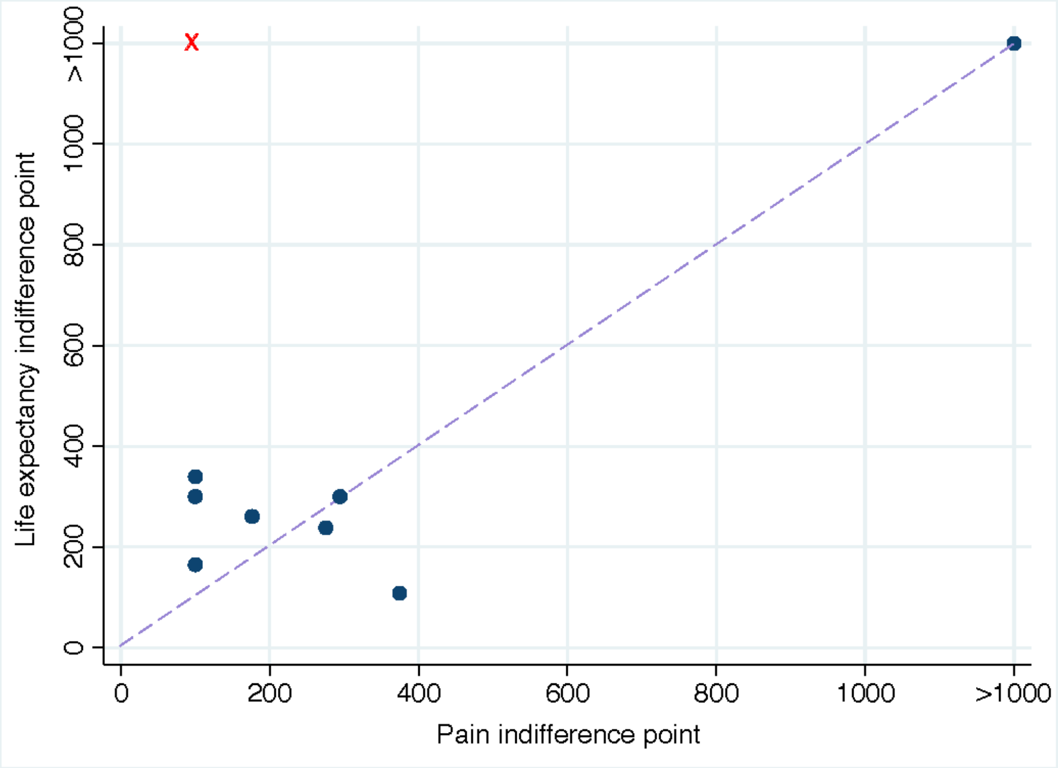
APPENDIX A4.1. Neutral arm health gain type comparisons

Figure 4.16: *Neutral arm, comparing indifference points by health gain type. Red X indicates two respondents had the same combination of indifference points.*



APPENDIX A4.2. Pilot study interviewer protocol

Chapter 4: Pilot Study
Interviewer Protocol

This document is a protocol for the conduct of the interviewer (“you”) for the pre/pilot study

Tick the items on this sheet as you go through them.

--

Morning of interview

Ensure you have a pen to complete this checklist

Check interview schedule for day

Ensure you have gift vouchers for today (pilot only)

Ensure dictaphone battery full + capacity available

Take laptops + chargers + external mouse with you to interviews

Ensure you have a print out of this script

Ensure you have study information sheet, consent form + post study information sheet

Ensure you have Piktochart print outs (laminate) for verbal questions

--

30 minutes prior to scheduled start time

Go to room

Check internet connection (if non-functional, check CICs service status on phone, if can't get Wi-Fi tether laptop to phone and use 3G)

Set up computers

Ensure dictaphone functional + test audio quality

Ensure phone in room logged out

Put "do not disturb" sign up on outside of room

Get this checklist out

--

5 minutes prior to scheduled start time

Wait outside room for participant (or meet in reception for SARG room)

--

At arrival

Welcome + thank participant for coming

Introduce yourself

Give information sheet + consent form

Give participant time to review

Any questions? *(+ clarify)*

Collect + check consent form

File consent form into folder + put in bag

Allocate random number from Excel sheet

Click "informed consent form signed" – "Yes" response in Qualtrics.

Enter random number into Qualtrics prompt screen.

Explain dictaphone

Start dictaphone

State date, time, location

State random number into dictaphone

Initiation of exercises

Interviewer:

"Ok. We are now going to begin the interview. I am Simon. I am a PhD student at the University of Sheffield, and I am doing a project about what the public think about health, and how they think government should make decisions about health."

"This is a pilot interview – a test, before we ask more people to be interviewed. The questions we are asking are new, and we are interested in what you think about them. If you don't understand something, something isn't clear, or things are confusing, let me know. That's the point of this interview, so don't feel bad if you feel this way, that's useful for us to know."

"Ok. There is a computer in front of you, and on this computer, there are a number of questions which we would like you to answer. Are you ok using a computer?"

<If no, offer to click for participant>

"Ok. These questions will be explained on the computer, but if you have any questions, or you are unsure about anything, just ask me and I will do my best to answer them."

"The questions are going to be about between different options that the government could choose, and these options will impact different groups of people. These aren't real situations, and they won't impact real people – they are entirely made up; but, the answers you give could influence the way governments act in future. So, think carefully about your choices. Remember there are no right and wrong answers, we are just interested in what you think."

"Any questions?"

--

Exercise 1

"Ok. I am going to ask you to start the first exercise now. Take as much time as you need, and if you feel stuck on anything, or are unsure, just let me know. The exercise has got a back button in it, so if you forget something, or change your mind you can go backwards."

"Ok. As you go through the questions, at some point the computer will tell you that I am going to ask you some questions, and ask you to pass the laptop to me – at this point, let me know. Ok?"

Initiate Exercise 1

Wait for participant to flag being asked to answer questions, take laptop.

"Ok. Thank you for that. Now I am going to ask you a few questions about the exercise"

Note whether question indicates they were randomised to **Neutral** or **Income** group.

Ask the questions on screen.

--

If **Income ask Qs below,** if Neutral go to next heading

--

<Interviewer - Pass participant printed copies of **income LE** intro questions>

Inc.Ex1.Q1. *"What was this question about?"*

Inc.Ex1.Q2. "*Why did you answer the way you did? What were you thinking?"*

<Pass participant the next **income LE** Q they answered (e.g. B=200, or B=50)>

Inc.Ex1.Q3. *"What about in this next question, what were you thinking here?"*

Inc.Ex1.Q4. Open probe on when judgement changed - e.g.) *"so you chose Option A until B impacted 500 people, and then changed to B. Why did you choose B here?"*

"Ok. Thank you for your responses. Now we will move on to the second exercise"

If **Neutral**:

--

Interviewer - Pass participant printed copies of **neutral** LE intro questions.

Neu.Ex1.Q1. *"What was this question about?"*

Neu.Ex1.Q2. *"Why did you answer the way you did? What were you thinking?"*

Pass participant the next **neutral LE** Q they answered (e.g. B=200, or B=50)

Neu.Ex1.Q3. "*What about in this next question, what were you thinking here?"*

Neu.Ex1.Q4. Open probe on when judgement changed - e.g.) "*so you chose Option A until B impacted 500 people, and then changed to B. Why did you choose B here?"*

"Ok. Thank you for your responses. Now we will move on to the second exercise"

Exercise 2

"This second exercise will be similar to the first one, but instead of choosing between increasing life expectancy of two different groups, you will be asked about a different type of health gains – not life expectancy"

"If you have any questions, or are unsure about anything as you go through the exercise, feel free to ask me, and I will do my best to answer them"

"Like last time, at some point the computer will tell you that I am going to ask you some questions, and ask you to pass the laptop over. At this point stop, and tell me. Ok?"

Initiate Exercise 2

Wait for participant to flag being asked to answer questions.

When participant does so, note whether they were randomised to income or neutral (this will be the same as in the previous section).

If **Income** ask the questions below, if neutral skip to the next heading.

These will be displayed on the screen.

Income

<Pass participant print-outs of **income pain** initial question.>

Inc.Ex2.Q1. *"What was this question about?"*

Inc.Ex2.Q2. "*Why did you answer the way you did? What were you thinking?"*

<Pass participant the next **income pain** Q they answered (e.g. B=200, or B=50).>

Inc.Ex2.Q3. "*What about in this next question, what were you thinking here?"*

Inc.Ex2.Q4. Open probe on when judgement changed - e.g.) *"so you chose Option A until B impacted 500 people, and then changed to B. Why did you choose B here?"*

Inc.Ex2.Q5. *"Do you think these pain questions were different to the ones about life expectancy? If so, why?"*

If **Neutral:**

<Pass participant print-outs of **neutral pain** initial question>

Neu.Ex2.Q1. "*What was this question about?"*

Neu.Ex2.Q2. "*Why did you answer the way you did? What were you thinking?*

<Pass participant the next neutral pain Q they answered (e.g. B=200, or B=50)>

Neu.Ex2.Q3. *"What about in this next question, what were you thinking here?"*

Neu.Ex2.Q4. Open probe on when judgement changed - e.g.) *"so you chose Option A until B impacted 500 people, and then changed to B. Why did you choose B here?"*

Neu.Ex2.Q5. *"Do you think these pain questions were different to the ones about life expectancy? If so, why?"*

--

BOTH INCOME AND NEUTRAL

"Thank you. The computer is going to ask you a few questions about your understanding of the questions you have answered"

"Some of these questions will ask you to tell me things rather than answer on the computer. When the computer says this, let me know."

Ask participant to click on to computer questions

Participant answers questions re: understanding + difficulty.

Expect verbal responses to:

Un.Q1. What could have be clearer, or better explained?

Un.Q2. Why did you find things difficult, or easy?

Un.Q3. How could we improve this survey, and the questions we asked?

Participant will then answer questions re: demographics

Wait for interviewee to indicate the computer has asked them to pass the laptop back.

Say:

"What is your postcode? This won't be recorded in the computer. I will put your postcode in a website to find out something about where you live, and then record that, but not record your postcode"

Take postcode, enter into: http://imd-by-postcode.opendatacommunities.org/

Enter participant IMD decile.

Wrapping up

"Ok. Thank you. Do you have any more questions for me, or suggestions"?

"Ok. Thank you for taking part. That was really useful."

“I am now going to stop the audio recording, and then I can sort out your gift vouchers”.

Stop audio recording.

Get out £15 gift vouchers (3 x £5) – tick off gift voucher serial IDs from Excel check-list.

Give gift vouchers.

Give post-study information sheet.

Thank participant again.

Participant leaves room.

--

Immediately Post-interview

Pack things away

Ensure dictaphone secured

Ensure consent form secure

Ensure this form secure

Ensure you have all print outs you brought with you.

--

As soon as reasonably possible after interview

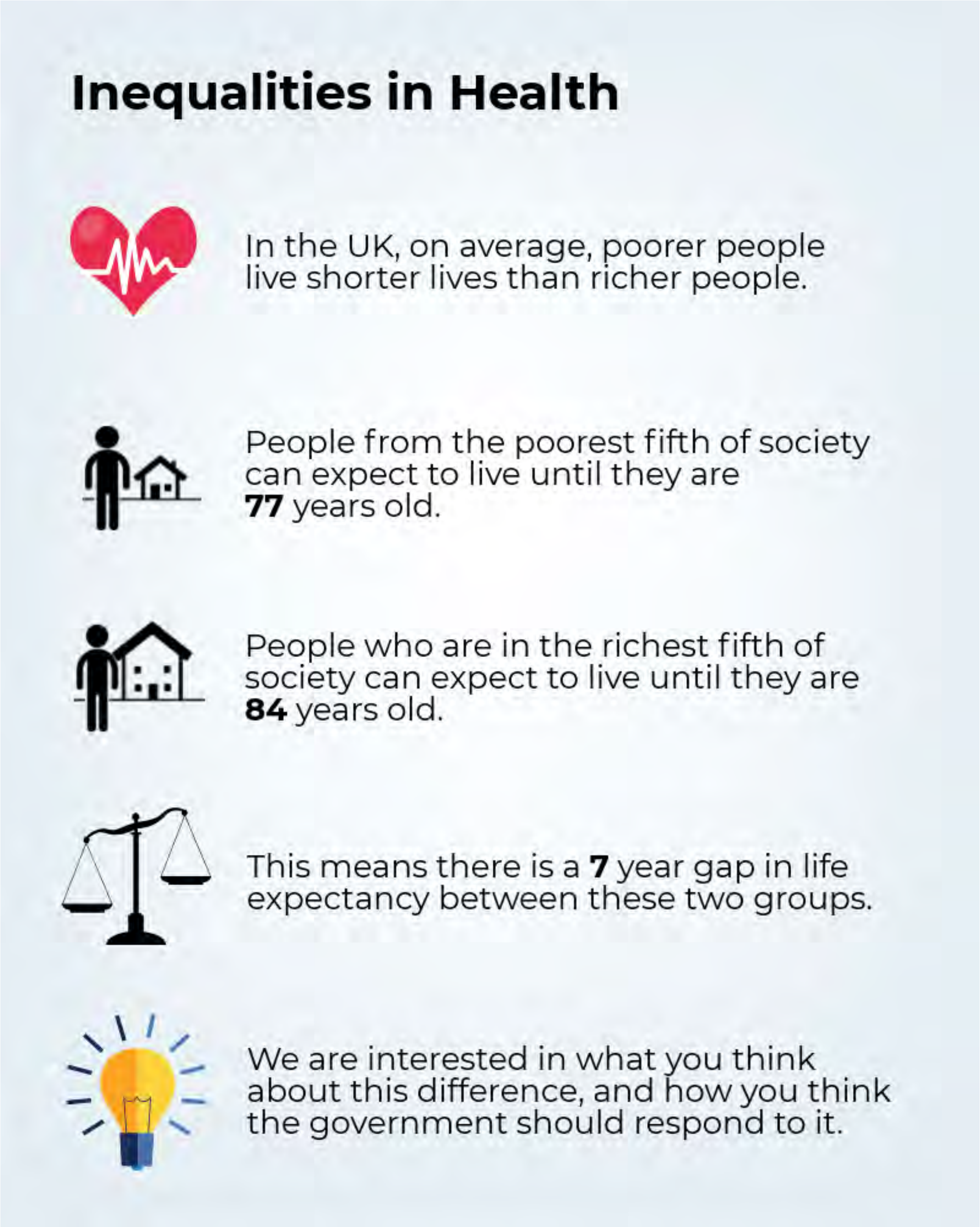
Transfer recording to encrypted laptop/desktop

Transfer consent form to secure storage

Shred this form.

APPENDIX A4.3. Pilot study participant briefings

Socioeconomic arm: Introduction 1



Inequalities in Health

In the UK, on average, poorer people live shorter lives than richer people.

People from the poorest fifth of society can expect to live until they are **77** years old.

People who are in the richest fifth of society can expect to live until they are **84** years old.

This means there is a **7** year gap in life expectancy between these two groups.

We are interested in what you think about this difference, and how you think the government should respond to it.

Socioeconomic arm: Introduction 2

What we would like you to do

Imagine you are in the government.

Today, you have been asked to make some choices about health.

These choices will have different impacts on people from the richest fifth of society and the poorest fifth of society.

Think carefully about your choices - these are imaginary situations, but your responses could impact the way governments act in future.

Socioeconomic arm: Life-expectancy exercise briefing 1

Exercise 1

These options will change the life expectancy of people from different groups.

The extra years of life provided will be in perfect health - equal to a 100 on the scale used in the earlier question about your own health.

The government can only fund one of the two options, not both.

If you think both are equally as good, and don't mind which the government chooses, then click both options.

Note that respondents in this exercise were not told the potential beneficiaries were currently 70-years old. This was revised prior to the studies reported in Chapters 5 and 6.

Socioeconomic arm: Pain exercise briefing 1

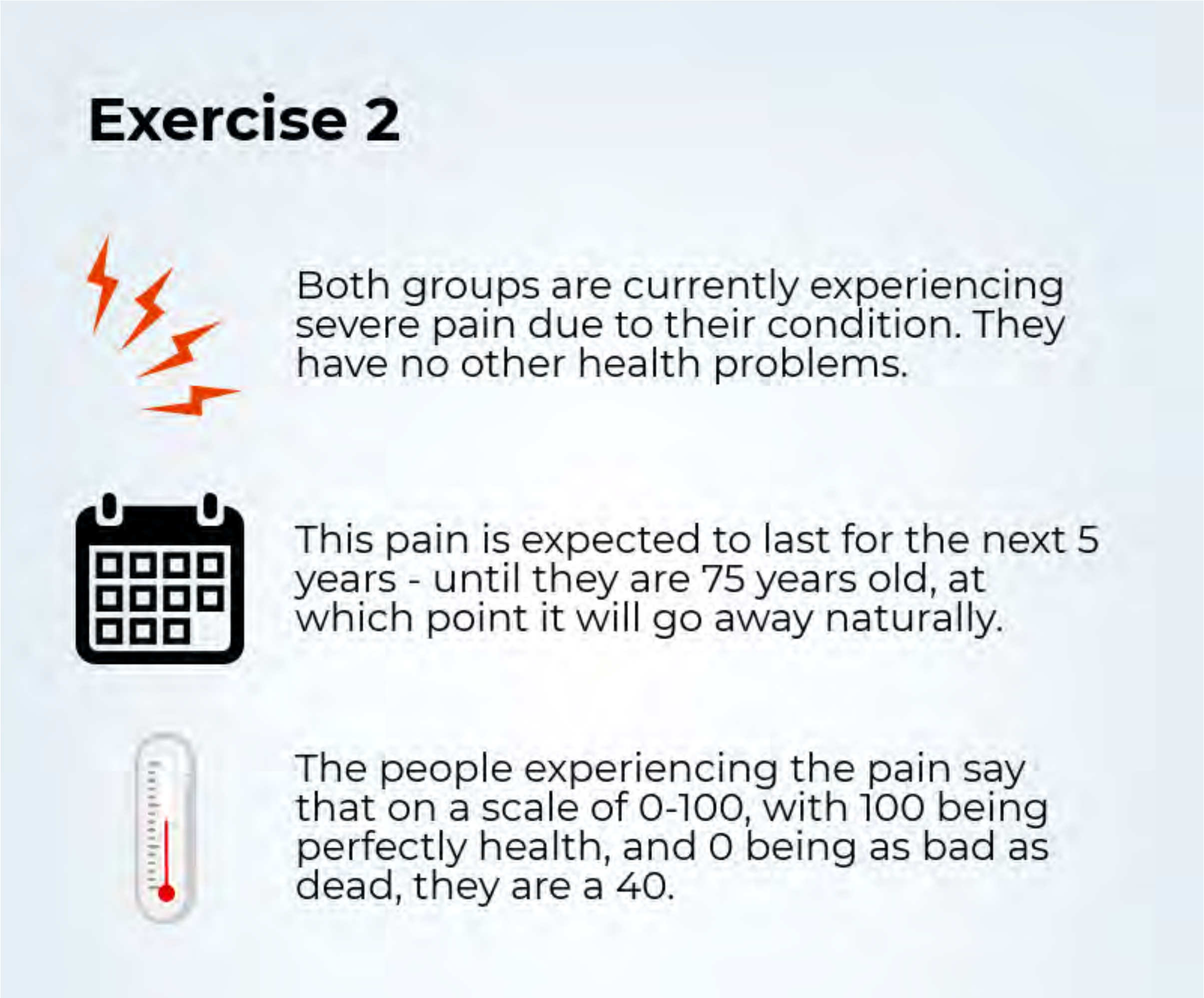
Exercise 2

Now imagine that the two groups are made up of **70** year olds, who have a health condition.

One of the groups is from the poorest fifth of society, and these people have a life expectancy of **77** years.

The other group is from the richest fifth of society, and these people have a life expectancy of **84** years.

Socioeconomic arm: Pain exercise briefing 2



Exercise 2

Both groups are currently experiencing severe pain due to their condition. They have no other health problems.

This pain is expected to last for the next 5 years - until they are 75 years old, at which point it will go away naturally.

The people experiencing the pain say that on a scale of 0-100, with 100 being perfectly health, and 0 being as bad as dead, they are a 40.

Socioeconomic arm: Pain exercise briefing 3

Exercise 2

A new treatment has become available that can completely relieve the pain of people with the condition today.

The new treatment will increase the health of those that receive it to 100 on a 0-100 scale.

It won't change the life expectancy of those that receive it.

Socioeconomic arm: Pain exercise briefing 4

Exercise 2

Imagine you are a member of the government, whose job it is to decide who receives the new treatment.

You have been asked to make some choices between different treatment options - these will impact different groups in different ways.

The government can only fund one of the two options presented for each question, not both.

If you think both are equally as good, and don't mind which the government chooses, then click both options.

Chapter 5: Face-to-face fielding

This chapter reports a face to face fielding of a variant of the PTO exercises piloted in Chapter 4. The study was designed to test both Hypothesis A (group types) and Hypothesis B (health gain types). Eighty members of the general public took part in Sheffield and Hull in May/June 2019.

This core of this chapter is presented in the format of a manuscript: "Does the UK-public's aversion to inequalities in health differ by group-labelling and health-gain type? A choice-experiment" (McNamara, Tsuchiya, & Holmes, 2020b). This paper has recently been published in Social Science and Medicine.

Following the paper, five appendices are provided. The first (A5.1) contains the online appendices associated with the manuscript. The second (A5.2) clarifies how this chapter contributes to the thesis as a whole. The third (A5.3) provides the interviewer guide for the study. The fourth (A5.4) gives more detail on the briefing participants received. Finally, the fifth (A5.5) provides the rationale for choice statements participants were shown.

The McNamara et al. (2020b) manuscript features three hypotheses: (1) the UK-public are more averse to inequalities in health between socioeconomic groups than they are to inequalities in health between neutrally labelled groups; (2) this difference is, at least in part, driven by the role non-health information plays in determining aversion to inequalities in health between socioeconomic groups; and (3) the UK-public are more willing to prioritise groups with lower lifetime health over groups with higher lifetime health if an intervention improves life-expectancy than if it improves quality-of-life.

The first hypothesis of the paper is Hypothesis A of this thesis. The second concerns the logic underlying Hypothesis A of this thesis: that, if asked to prioritise the health of different socioeconomic groups, the UK-public are likely to be influenced factors other than the health of those groups. This is of interest, because as outlined in Chapter 1 it is not normatively obvious whether non-health factors should be considered when defining the HR-SWFs applied in economic evaluation. The third includes Hypothesis B of this thesis (the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health if an intervention improves life-expectancy than they are if it improves quality-of-life), but is more expansive: it is not limited to socioeconomic groups. This broader hypothesis was used in the McNamara et al. (2020b) paper because the design of the study allowed the impact of health-gain type to be evaluated between both socioeconomic groups, and neutrally labelled groups. Whilst this neutral-group comparison is beyond the scope of this thesis, this additional comparison was easy to implement, and may be of interest to readers of Social Science and Medicine, and so was included in the McNamara et al. (2020b) paper. In order to ensure the manuscript is applicable to this thesis, the paper reports results for Hypothesis 3 discretely for each group-type.

The PTO tasks detailed in McNamara et al. (2020b) differ from those piloted in Chapter 4 in four key ways. First, two quality-of-life types were tested: pain and mobility. This was designed to provide two distinct tests of the Hypothesis B (health gain types) using two forms of quality-of-life. Second, respondents were explicitly told that there was no other way the people they could help could improve their health. This was designed to clarify that the interventions were not available privately – an issue highlighted by the way participants explained their choices in the pilot study. Third, when the number of people who benefit from one of the interventions first changed, this was highlighted to respondents by modifying the colour of text that showed the number of people who would benefit from that intervention. This alteration was a direct result of participant feedback from piloting. Fourth, respondents were told the people who would benefit from either intervention were currently 70 years old. As noted in Chapter 4, in the pilot, respondents were told this for the pain-relief exercise, but not for the life-expectancy exercise. This was standardised across health-gain types in order to reduce the potential confounding caused by this difference. An age of 70 was used in attempt to reduce the impact of productivity impacts on participant responses.

As per the pilot, respondents were not briefed on inequalities in quality-of-life, and this information was not included in the choice sets. Instead, they were told about inequalities in life-expectancy alone. I opted to take this approach for this study, with the intention of exploring the impact of providing information on inequalities in quality-of-life in future studies. The implications of this decision are discussed within the McNamara et al. (2020b) paper, Appendix A5.2, and Chapter 7 (Discussion).

Authorship statement

The manuscript that forms the main body of this chapter was written with two co-authors: Aki Tsuchiya and John Holmes. A "CRediT" author statement (Elsevier, 2020) for this paper is as follows:

Simon McNamara: Conceptualization, Methodology, Software, Investigation, Formal analysis, Data curation, Writing - Original draft preparation, Project administration. **Aki Tsuchiya**: Supervision, Writing - Reviewing and Editing. **John Holmes**: Supervision, Writing - Reviewing and Editing.

I am the sole author of the second, third, fourth and fifth appendices.

5.1. McNamara et al. (2020b)

RESEARCH ARTICLE

Chapter 5

Does the UK-public's aversion to inequalities in health differ by group-labelling and health-gain type? A choice-experiment.

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Funding information
This work was supported by the Wellcome Trust Doctoral Training Centre in Public Health Economics and Decision Science [108903/Z/19/Z], and the University of Sheffield.

Abstract

Public health policy has two primary aims: promoting population health and reducing health inequalities. When these aims conflict, policy-makers must determine the relative importance to place on each in decision-making. We conducted a computer-based, face-to-face, choice-experiment to explore how the UK-public think government should act in these situations; and to explore how "inequality-aversion" may differ depending on the groups between which a health inequality exists and type of health an intervention provides. We tested three hypotheses: (1) the UK-public are more averse to inequalities in health between socioeconomic groups than they are to inequalities in health between neutrally labelled groups; (2) this difference is, at least in part, driven by the role non-health information plays in determining aversion to inequalities in health between socioeconomic groups; and (3) the UK-public are more willing to prioritise groups with lower lifetime health over groups with higher lifetime health if an intervention improves life-expectancy than if it improves quality-of-life. Eighty people participated in Sheffield and Hull in May/June 2019. Each participant completed three Person-Trade-Off exercises between interventions that would improve population health and reduce health inequalities, or improve population health by a larger amount but increase health inequalities. Participants were randomised to exercises involving scenarios with socioeconomic groups or neutrally-labelled groups, and each answered questions about three health-benefit types: increased life-expectancy; pain-relief; and mobility-improvement. Following the exercises, participants provided rationales for their selections. Respondents were (1) more averse to inequalities in health between socioeconomic groups than neutrally labelled groups. Participant rationales suggest (2) this divergence is partly motivated by factors other than health: for example, financial inequality between socioeconomic groups. The sample was also (3) more willing to prioritise neutrally labelled groups with lower lifetime health if an intervention improves life-expectancy rather than if it improves quality-of-life.

1 | INTRODUCTION

We live in an unequal world, formed of unequal nations [1]. In many of these nations, people who live in relatively deprived communities can expect to experience shorter lives than people who do not [1]. For example, people who live in the most deprived quintile of neighbourhoods in England have a life-expectancy at birth 7.5-years lower than people who live in the least deprived quintile [2]. Similarly, people who live in deprived communities in England can expect to experience greater morbidity in their lifetime [3], and to live, on average, with lower health-related quality-of-life [2].

Public health policy-makers in the United Kingdom want to reduce inequalities in health; however, they also want to improve population health [4, 5, 6, 7]. These objectives sometimes conflict with each other. For example, an intervention may improve population health but increase inequalities in health [8]. In these cases, decision-makers must trade-off efficiency and equality to decide whether or not a policy is introduced.

Cost-effectiveness analysis (CEA) is a tool that policy-makers can use to evaluate the efficiency of health interventions [9]. In CEAs, health is typically quantified using the “Quality Adjusted Life Year” (QALY) [10, 11]. Conventionally, QALY-based CEAs are conducted under the assumption that all incremental QALYs are of equal value irrespective of who receives them [12]. This “distributionally naïve” approach fails to reflect decision makers’ stated objective to reduce inequalities in health. Distributional cost-effectiveness analysis (DCEA) is a new form of “distributionally sensitive” CEA [13] In contrast to conventional CEA, in DCEA the impacts of an intervention on both population health and the social distribution of health are formally modelled, and then valued using a health-related social welfare function (HRSWF). Whilst conventional CEA applies an additive HRSWF grounded in the judgement that our aim is QALY maximisation, DCEA can implement alternative HRSWFs, including those that reflect a concern for inequality.

Asaria et al. [13] identify two distributionally sensitive HRSWFs that could be used in DCEA: one based on the Atkinson social welfare function [14] and one based on the Kolm social welfare function [15]. A key parameter in these HRSWFs is the “inequality aversion parameter”. This number defines the relative priority placed on average health and the reduction of inequalities in health in the analysis undertaken. In the context of the allocation of public resources in democratic countries, McNamara et al. [16] argue the health inequality aversion parameters applied in DCEAs should be defined based on the views of the public in those countries.

Globally, a number of studies have elicited the public’s aversion to inequalities in health between socioeconomic groups using “benefit trade off” (BTO) choice-experiments. In these studies, participants are typically asked to choose between pairs of hypothetical scenarios that offer varying levels of life-expectancy, or variants upon, to different socioeconomic groups. Participant responses are then analysed in order to determine whether, and to what extent, they are willing to prioritise improvements in the life-expectancy of disadvantaged socioeconomic groups over improvements in the life-expectancy of advantaged groups. For example, Abasolo and Tsuchiya [17, 18] conducted two BTO studies of this kind, and found that the Spanish public are willing to prioritise disadvantaged socioeconomic groups with lower life-expectancy for gains in life-expectancy over advantaged groups with higher life-expectancy. Lal et al. [19] conducted a similar life-expectancy gain based BTO study, and found the Australian public are willing to prioritise disadvantaged socioeconomic groups for gains in life-expectancy. Hurley, Mentzakis and Walli-Attaei [20] conducted a BTO study and found evidence the Canadian public are averse to inequalities in “health adjusted life-expectancy” between groups with differing incomes. Similarly, a recent systematic review of UK health inequality aversion elicitation studies McNamara et al. [21], found evidence that the UK-public are willing to prioritise disadvantaged groups for gains in life-expectancy and “years in full health over the average person’s life”.

Whilst these studies have asked participants questions about life-expectancy, or variants thereupon, none of them explored whether the public are as willing to prioritise disadvantaged socioeconomic groups for gains in quality-of-life.

A range of studies have explored the public's aversion to inequalities in health between groups or individuals with unknown socioeconomic status (henceforth "neutrally" labelled groups/individuals). For example, Edlin, Tsuchiya and Dolan [22] fielded a BTO study and found the UK-public are averse to inequalities in lifetime QALYs between two neutrally labelled groups. This aversion to inequalities in health between neutrally labelled groups is mirrored by the findings of Petrou et al. [23] in the UK; Wiseman [24] and Richardson et al. [25] in Australia; Ubel et al. [26, 27] in the USA; Olsen [28] in Norway; and Hurley et al. [20] in Canada. In totality, these studies suggest that, in many counties, the public are averse to inequalities in lifetime health between neutrally labelled groups; however, no study has explored whether the UK-public are as averse to inequalities in health between neutrally labelled groups as they are to inequalities in health between socioeconomic groups.

In this paper, we build on these two gaps in this literature, and explore three hypotheses relevant to the conduct of distributionally-sensitive economic evaluations in the UK.

Hypotheses 1 and 2

Pinho and Botelho [29] find Portuguese students are more averse to inequalities in health between socioeconomic groups within the working age population, than to inequalities in health between neutrally labelled groups. Similarly, Hurley et al. [20] find the Canadians are more averse to inequalities in health between groups with different levels of income than to inequalities in health between people of unknown income. These findings suggest aversion to inequalities in health between socioeconomic groups may be driven, at least in part, by non-health differences between these groups; for example: inequalities in income. This is of interest, because it is not obvious whether health-related resource decisions should consider these factors. For example, it could reasonably be argued that health alone should determine how health-related resources are allocated [30]. In this paper we do not make the case for a specific position on this issue. Instead, we note it is only of practical relevance if inequality aversion differs between a socioeconomic and neutrally-labelled context.

Whilst this issue has been not explored *within* a study using a sample of the UK-public, a systematic review [21] compared findings across studies using neutrally labelled groups and those using socioeconomic groups, and concluded that the UK-public appear to be more averse to socioeconomic inequalities in health than they are to inequalities between neutrally labelled groups. This leads to the first two hypotheses explored in this study. Hypothesis 1: the UK-public are more averse to inequalities in health between socioeconomic groups than they are to inequalities in health between neutrally labelled groups. Hypothesis 2: this divergence is driven, at least in part, by the role non-health information plays in determining aversion to inequalities in health between socioeconomic groups.

Hypothesis 3

The studies on aversion to socioeconomic inequalities in health discussed above have, typically, asked participants to make choices between interventions, or scenarios, that would vary the life-expectancy of different socioeconomic groups. No study has explored whether the public are equally willing to sacrifice prospective gains in quality-of-life as they are to sacrifice such gains in life-expectancy in return for greater equality in life-time health between socioeconomic groups. This is a notable omission, because evidence suggests that people may value incremental QALYs provided to others differently depending on how those QALYs are composed, independently of an inequality in health. For example, Lancsar et al.[31] conducted a discrete choice experiment and found that the Australian public place a higher social value on incremental QALYs that are the result of combinations of both extension of life and quality-of-life gains, rather than one of the two in isolation; although there were no statistically significant differences between the social value respondents placed on QALYs that were the result of gains in life-expectancy alone or gains in quality-of-life alone, and the authors did not explore participants rationales for making the choice they did.

If the public were found to have health-gain type specific preferences regarding the prioritisation of disadvantaged socioeconomic groups, this would be an important finding for DCEA, because QALY-based DCEAs are "blind" to the way an incremental QALY gain is composed: they assume that, given an inequality in lifetime health between two groups of a set QALY magnitude, the public are willing to prioritise the group with lower lifetime health for a QALY-gain to the same degree, irrespective of whether that gain is the result of improvements in length of life or quality of life. If this were found not to be the case, this would motivate the development of new forms of distributionally-sensitive economic evaluation that are capable of reflecting differential levels of willingness to prioritise disadvantaged groups depending on the type of health-benefit an intervention provides.

We anticipate that decisions about interventions that improve quality-of-life are likely to prompt participants to become more efficiency-focused than questions about life-expectancy-improving interventions. This is because we think they will experience a stronger affective reaction to the idea of failing to alleviate people's quality-of-life problems, rather than failing to extend life-expectancy, and so will act in a more consequentialist way for these choices. This motivates our third hypothesis. Hypothesis 3: the UK-public are more willing to prioritise groups with lower lifetime health over groups with higher lifetime health if an intervention improves life-expectancy than they are if it improves quality-of-life.

2 | METHODS

2.1 | Survey Design

We fielded a cross-sectional, face-to-face, survey in order to test our hypotheses. This survey included a series of pairwise person-trade-off (PTO) exercises [32] designed to elicit participants' levels of health inequality aversion.

The pairwise PTO method is a form of choice-experiment, in which respondents are asked to make choices between pairs of hypothetical interventions that have the potential to benefit different numbers of people from different groups; in this case: one which would benefit a number of people in a group with lower life-expectancy or one which would benefit a number of people in a group with higher life-expectancy. The number of people in each of these groups is then varied logically in response to a participant's choices, in order to determine the relative priority they place on increasing average population health and reducing inequalities in health. We used PTO because the majority of studies that elicit the UK-public's aversion to socioeconomic inequalities in health have used variations of a single BTO method. Use of an PTO therefore allows us to explore whether the UK-public are still found to be averse to socioeconomic inequalities in health if an alternative method is applied. Figure 1, below, shows the overall design of the survey.

We 1:1 randomised participants to one of two arms. In one arm, participants were asked PTO questions about policy options that would improve the health of different socioeconomic groups (people from the poorest or richest fifth of society). In the other, participants were asked the same PTO questions using neutrally labelled groups (people with Disease A or Disease B). Respondents in each arm answered PTO questions about interventions that provided three types of health benefit: increased life-expectancy; pain-relief; and mobility-improvement. We randomised the order of the three choice-sets. Following completion of the PTO exercises, we explored participant's reasons for making their choices using a series of "rationale for choice statement" questions adapted to their arm. Finally, we asked all participants the same broader "value statement" questions to determine how much they agreed with various ways the government or NHS could consider inequalities in health in their decision-making. The survey was programmed in, and hosted by, Qualtrics. Study graphics were developed in Piktochart.

Below, we first describe the PTO exercises partici-

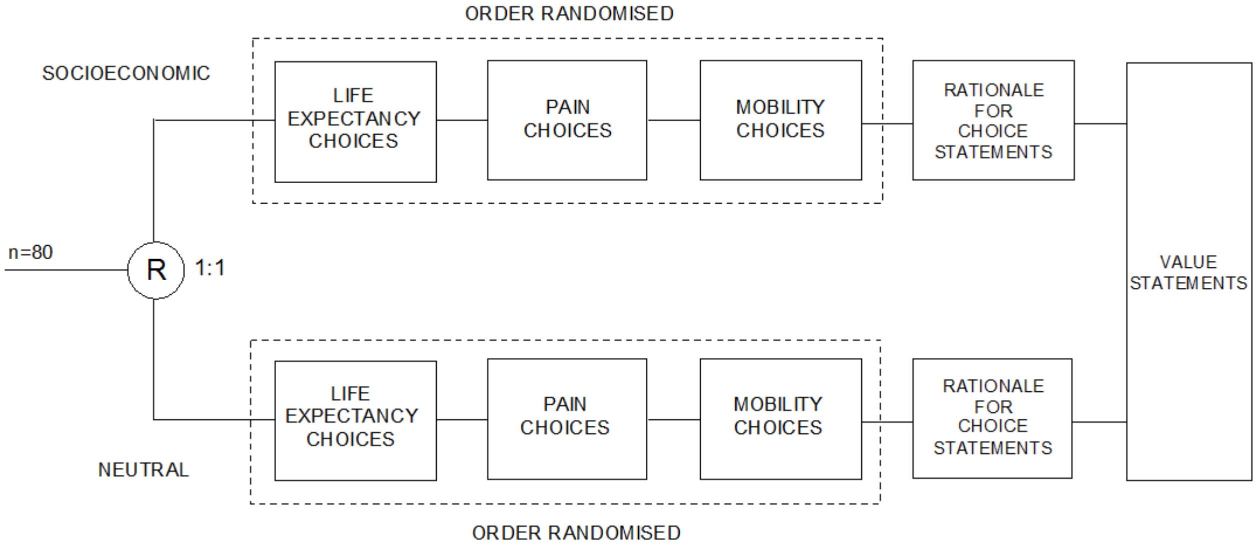


FIGURE 1 Study design.

pants in the socioeconomic arm completed. We then explain how the exercises in the neutral arm differed from these. After this, we provide further information on the rationale for choice statements. The value statement questions are not directly relevant to the three hypotheses explored in this paper, and so are reported solely in the Online Supplementary Appendix.

2.2 | The PTO exercises in the socioeconomic arm.

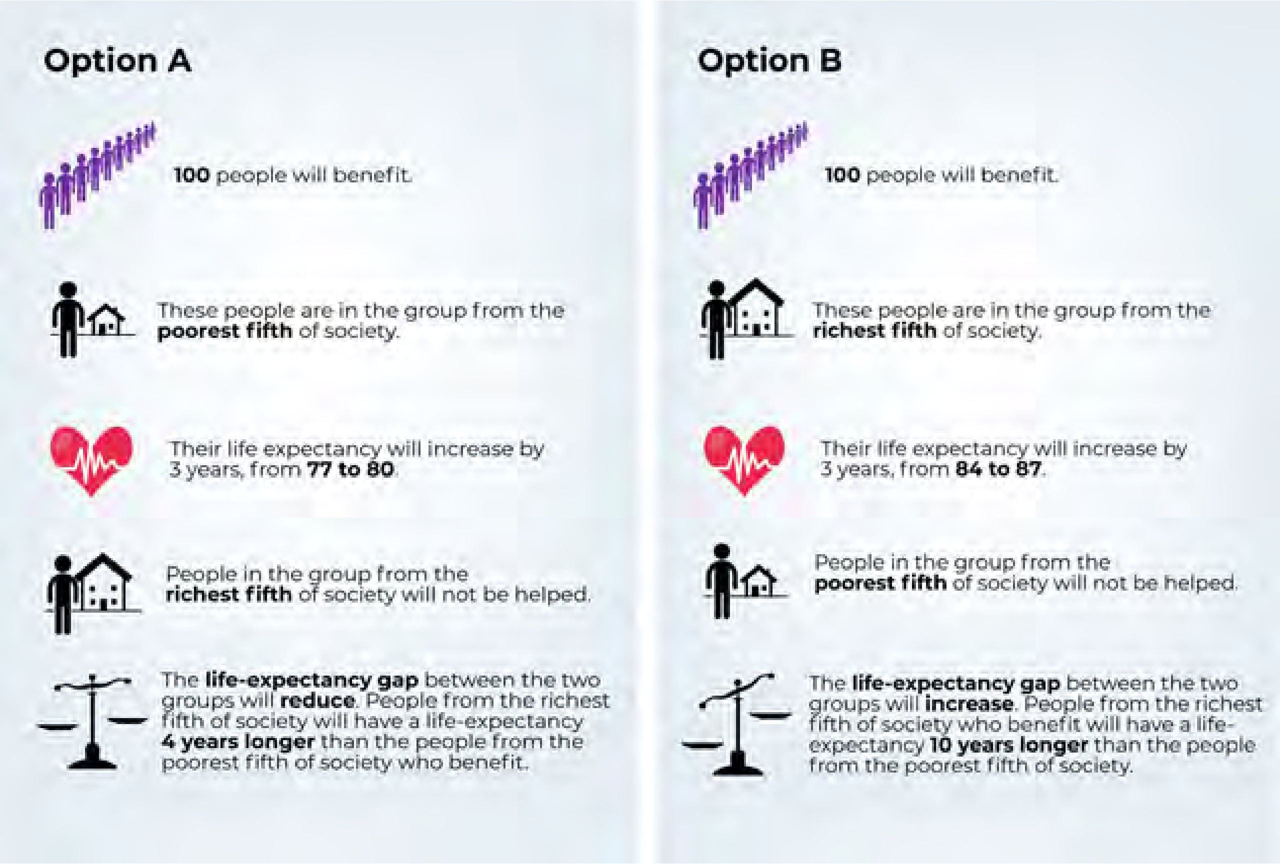
Briefing

We informed participants that people from the poorest fifth of UK-society have a life-expectancy of 77 years, and that people from the richest fifth of UK-society have a life-expectancy of 84 years [2]. We then instructed them to imagine they were in government, and that they had been asked to make decisions about policies that would impact peoples' health. Participants were informed that some of these policy options would benefit people from the poorest fifth of society, and that some would benefit people from the richest fifth of society. We stated that the policies were not real, but that the government use the results of surveys like this to make real policy decisions, so the respondents should think carefully about their choices. Participants were told that all policy options impacted people who were currently 70 years old, and that the government could only fund one of the two options presented in each choice. In addition, we informed respondents that there was no other way the benefits of the policy-options could be obtained. We then explained to them that, if they felt each option in a pairwise choice was equally good, they could say they didn't mind which option the government chose.

The PTO questions for improving life-expectancy.

The life-expectancy policy-options improved the life-expectancy of people who benefited from them by three years. We told participants that the people who received this benefit would experience perfect health for those three years (a three QALY benefit) so that people from the poorest fifth of society who benefited from the intervention would have their life-expectancy increased from 77 years to 80 years, and that people from the richest fifth of society who benefited would have their life-expectancy increased from 84 years to 87 years. We clarified that the intervention which benefited the group with lower life-expectancy would reduce the life-expectancy gap between the two

FIGURE 2 The initial choice: socioeconomic arm; life expectancy.



Option A

100 people will benefit.

These people are in the group from the **poorest fifth** of society.

Their life expectancy will increase by 3 years, from **77 to 80**.

People in the group from the **richest fifth** of society will not be helped.

The **life-expectancy gap** between the two groups will **reduce**. People from the richest fifth of society will have a life-expectancy **4 years longer** than the people from the poorest fifth of society who benefit.

Option B

100 people will benefit.

These people are in the group from the **richest fifth** of society.

Their life expectancy will increase by 3 years, from **84 to 87**.

People in the group from the **poorest fifth** of society will not be helped.

The **life-expectancy gap** between the two groups will **increase**. People from the richest fifth of society who benefit will have a life-expectancy **10 years longer** than the people from the poorest fifth of society.

groups, and that the intervention that benefited the group with higher life-expectancy would increase the life-expectancy gap between the two.

In the first PTO question, we presented participants with a pairwise choice between interventions that would benefit either 100 people from the poorest fifth of society or 100 people from the richest fifth of society. They were asked "which option should the government choose?". This choice was presented as shown in Figure 2 below. An equivalent figure for the neutral arm, and examples of the graphics used for the other health types, are provided in the Online Supplementary Appendix.

If a participant expressed indifference between the two options, this was recorded and they moved on to the next health-type; if they had completed all three health-types, they instead moved on to the rationale for choice questions. If a respondent selected one of the two options, we varied the number of people in the richer and asked them to choose again. This process was designed to explore the participant's willingness to sacrifice gains in population health in order to reduce, or increase, the inequality between the two groups. If a participant chose the policy option that benefited people from the poorest fifth of society, we increased the number of people from the richest fifth of society who would benefit from the alternative policy by 100 people (e.g. to 200 people following the initial question). Conversely, if they chose the intervention that helped people from richest fifth of society, we reduced the number of people who would benefit from this intervention down by 50 people (e.g. to 50 people following the initial question). This logically determined +100 or -50 variation continued until a participant either expressed indifference between two options; made a choice beyond the range programmed in the survey (>1000 people, or <50 people from the richest fifth of society); or, could be inferred to have an indifference point between two of the numbers tested. For example, a participant who chose to benefit 200 people from the richest fifth of society rather than 100 people from the poorest fifth of society, and subsequently chose to benefit 100 people from the poorest fifth of society over 150 from the richest fifth of society was assumed to have an indifference point of 175 (midway between the two prior values). If a participant gave an "off the scale" response, their indifference point was recorded as >1000 or <50 respectively. Throughout, we fixed the number of people who would benefit from the intervention targeted at people from the poorest fifth of society at 100 people.

The PTO questions about pain.

In this exercise, we told respondents that the 70-year-olds are currently experiencing severe pain due to a health condition. We informed them that the people with the pain say that, on a scale of 0-100 with 100 being "in perfect health" and 0 being "as bad as dead" they are a 40. Respondents were told that this pain was going to last for the next 5-years, before going away naturally. We stated that the policy options would completely relieve the pain of those who benefited for those 5 years, and that in this period these people would be in perfect health (equivalent to a 3-QALY benefit; although this was not stated to participants). Respondents were informed that the policy options would not improve the life-expectancy of the people who benefited from them and that, as a result, the intervention would not impact the life-expectancy gap between the two groups. The respondents then took part in a PTO exercise for these policy options. This was conducted as described for the life-expectancy intervention.

The person-trade-off questions about mobility problems.

For the mobility exercise, we told respondents that the 70-year-olds are currently experiencing severe problems in walking about due to a health condition. The duration and severity of these problems was identical to those used in the pain questions, as was the magnitude of the benefit offered, and the PTO protocol.

2.3 | The person trade off exercises in the neutral arm

The neutral arm was identical to the socioeconomic arm with the exception that participants were told the groups consisted of individuals with Disease A (a replacement for the poorer group with life-expectancy of 77 years) and Disease B (a replacement for the richer group with life-expectancy of 84 years). Examples of the graphics used in the neutral arm are provided in the Online Supplementary Appendix.

2.4 | Quantifying inequality aversion

If a respondent expressed indifference between two options, we assumed they valued both options equally. Consequently, we inferred the relative weight a participant placed on improving the health of people in the disadvantaged group compared to improving the health of people in the advantaged group by calculating the ratio of the number of people in each group at the point they expressed indifference. For example, if a participant expressed indifference between helping 100 people from the poorest fifth of society and 500 people from the richest fifth of society, they were inferred as placing a relative weight of 5:1 on improvements in the health of the poorer group.

We evaluated Hypothesis 1 (the UK-public are more averse to inequalities in health between socioeconomic groups than they are to inequalities between groups for which no socioeconomic information is available), by comparing indifference points across the socioeconomic and neutral arms. This was conducted discretely for each type of health and tested using a Mann-Whitney U-test (unpaired data). We evaluated Hypothesis 3 (the UK-public are more willing to prioritise groups with lower lifetime health over groups with higher lifetime health if an intervention improves life-expectancy than if it improves quality-of-life) by comparing indifference points across types of health. This was conducted discretely for each arm and tested using a Wilcoxon-signed rank test (paired data).

2.5 | Rationale for choice statements

Following completion of all the choice exercises, we presented participants with “rationale for choice” statements, and asked them to select those statements that informed their choices. These statements were arm and health type-specific, and were generated by the authors based upon rationales given by participants in a prior study that elicited inequality aversion [16]. Irrespective of the order the three health-type PTO exercises were completed in, all participants first answered rationale for choice questions about the options that improved life-expectancy, then those that relieved pain, and subsequently, those that improved mobility.

We included rationale for choice statements linked to non-health factors (e.g. money) in the socioeconomic arm in order to test Hypothesis 2 (non-health factors influence aversion to socioeconomic inequalities in health), for example: “it is better to help the poorer people, because they have less money than the richer people” and “it is better to help the poorer people, because richer people could use their money to distract them from their pain”. In both arms we included a series of direct-health-related rationale for choice statements, for example: “it is better to help the poorer group, because they have a lower life expectancy” and “it is better to help the poorer group, because the richer group already have a long life-expectancy”. A complete list of non-health statements provided to participants in the socioeconomic arm is provided in Figure 6, below. The direct-health-related statements provided to participants in both arms are detailed in Figure 8 and Figure 9 below.

2.6 | Pilot

We piloted the choice-experiment with 20 non-academic members of staff at the University of Sheffield in October 2018 [16]. Following completion of the choice-task, SM interviewed participants to explore their understanding of the exercises, and gain insight into the rationale for their choices. Participants demonstrated high levels of understanding, and provided rationales for their choices consistent with the study design. A small number of participants noted that they had not immediately noticed that their choice of Option A (the intervention that benefited the group with lower life-expectancy) lead to the number of individuals in the higher life-expectancy group increasing and that they had to go backwards in the exercise after realising the number was changing. In response, we modified the materials so the first change in the number of people in each exercise was presented in purple text.

2.7 | Sample size justification

For the primary study, sample size was determined using participant responses to the pilot study. As the person trade off procedure was truncated at the upper (>1000), and lower bounds (<50), and rank-based testing procedures were utilised, this was not done via conventional power-based sample-size calculations. Instead, we estimated the likely effect sizes for both hypotheses using the pilot data, and conducted mock hypothesis tests of this initial data, in order to provide an estimate of the likely sample size required to detect these effects. This analysis indicated that a sample size four times larger than the pilot (n=80) would be sufficient to test the two hypotheses in the primary fielding. Further information on the effect sizes observed in the pilot is available in [16].

2.8 | Fielding

We fielded the survey via two “hall tests” held in conveniently located, broadly comparable, cities in the north of England: Sheffield (25th May 2019) and Hull (1st June 2019). A market research company (“Accent”) was commissioned to recruit and field the study. On both days, a convenience sample of 40 passers-by was recruited in city centre locations (total n=80). A quota system based on age, gender and socioeconomic status was used to recruit a sample broadly representative of the population of the United Kingdom. Each respondent reviewed the study information sheet, signed an informed consent form before participating, and received a £5 "thank-you" in return for their time. Seven Accent employees recruited participants, explained the survey, and supervised the respondents whilst they completed the survey on a laptop computer connected to the internet. SM was present throughout in order to observe the interviews, and clarify anything to participants or the interviewers.

2.9 | Ethics

Ethics approval for the study and pilot was granted by the Research Ethics Committee of the School of Health and Related Research (ScHARR) at the University of Sheffield (ID: 022496).

3 | RESULTS

Participants

We randomised 41 people to the socioeconomic arm, and 39 to the neutral arm. During data-cleaning, we noted two participants in the socioeconomic arm had ticked 41 of 43 potential rationale for choice statements. As many of these statements are in direct conflict with each other, we excluded both these individuals from the primary analysis set. We report more information on these individuals and associated sensitivity analyses in the Online Supplementary Appendix. These sensitivity analyses have a minor impact on the results reported here.

Participant characteristics are reported in Table 1, below. In comparison to national census data for England/Wales, the sample were more educated, less ethnically diverse, and more likely to live in a deprived area. Participants in the socioeconomic arm were more likely to be male than in the neutral arm, more likely to have a degree their highest level of qualification, and more likely to support the Labour or Conservative party.

3.1 | Hypothesis 1: the UK-public are more averse to inequalities in health between socioeconomic groups than they are to inequalities in health between neutrally labelled groups.

Comparing across arms, and for all three health types, participants were more willing to prioritise people in the socioeconomic arm who were labelled as being from the poorest fifth of society than they were to prioritise people in the neutral arm with an equivalent health profile who were labelled as having Disease A. Figure 3, Figure 4, and Figure 5, below show the trade-off indifference points in the socioeconomic arm and neutral arm for life-expectancy, pain, and mobility, respectively. In these figures, the y-axis indicates the proportion of participants yet to express indifference between two options. The x-axis shows the number of people in the higher life expectancy group (people from the richest fifth of society/Disease B). In the choice-exercises we fixed the number of people in the lower life-expectancy group at 100 throughout. As a result, an x-axis value of 100 implies equal weight is given to people in both groups, a value <100 implies a preference for the group with higher life-expectancy, and a value >100 implies a preference for the group with lower life-expectancy. If there was no difference in aversion between the two arms, we would expect to observe two identical curves for each. In contrast, all three of the socioeconomic arm curves are higher than the corresponding neutral arm curves, indicating that participants in the socioeconomic arm were more willing to sacrifice the health of people from the richest fifth of society in order to benefit people in the poorest fifth of society than participants in the neutral arm were to prioritise the health of people with Disease A over Disease B.

For each health type, the median respondent in the socioeconomic arm placed a higher weight on helping the poorer group compared to the richer group than the median respondent in the neutral arm placed on helping people with Disease A over people with Disease B.

TABLE 1 Participant characteristics in the analysis set

		Total (n=78)	**Socioeconomic** (n=39)	**Neutral** (n=39)	**England/ Wales***
Male		41%	49%	33%	49%
Age (mean)		42	43	40	39
Education Level	Degree	42%	44%	39%	27%
	A-levels (or equivalent)	28%	21%	36%	12%
	GCSEs (or equivalent)	22%	21%	23%	28%
	Other qualifications	1%	3%	0%	10%
	No qualifications	6%	10%	3%	23%
	Don’t know	1%	3%	0%	0%
Ethnicity	White	97%	97%	97%	86%
	Black/African/Caribbean/Black British	3%	3%	3%	3%
	Asian/Asian British	0%	0%	0%	8%
	Mixed/Multiple ethnic groups	0%	0%	0%	2%
	Other ethnic group	0%	0%	0%	1%
Political Affiliation**	Labour	31%	36%	26%	-
	Green	15%	15%	15%	-
	Conservative	13%	15%	10%	-
	Liberal Democrat	8%	5%	10%	-
	Other	6%	5%	8%	-
	None	27%	23%	31%	-
Postcode Deprivation Level***	IMD5 (least deprived quintile)	13%	-	-	-
	IMD4	13%	-	-	-
	IMD3	23%	-	-	-
	IMD2	18%	-	-	-
	IMD1 (most deprived quintile)	32%	-	-	-
Subjective Richness Ranking****	5 (richest fifth)	1%	3%	0%	-
	4	13%	18%	8%	-
	3	24%	23%	26%	-
	2	45%	41%	49%	-
	1 (poorest fifth)	17%	15%	18%	-

* 2011 census data, utilised as a proxy for data for the whole United Kingdom.

** “Forgetting about their policies on Brexit, which political party do you traditionally think of yourself as supporting?”

*** Figures based on the 77 valid postcodes recorded during recruitment. Note that these cannot be linked to individual responses.

**** ”If the number 100 was the richest person in the UK, and the number 0 was the poorest person in the UK, how rich do you think you are?”

In the neutral arm, the median respondents in the pain and mobility exercises were unwilling to prioritise the group with lower life-expectancy. Conversely, the median respondent in the life-expectancy exercise in the neutral arm was willing to prioritise the group with lower life-expectancy. In contrast, in all three socioeconomic arm exercises the median respondent in each exercise made choices consistent with an aversion to inequalities in lifetime health. Note that, if our aim is to generate an estimate of inequality aversion based on health alone, the difference between these two arms equates to the bias associated with the introduction of the “richest” and “poorest” labels.

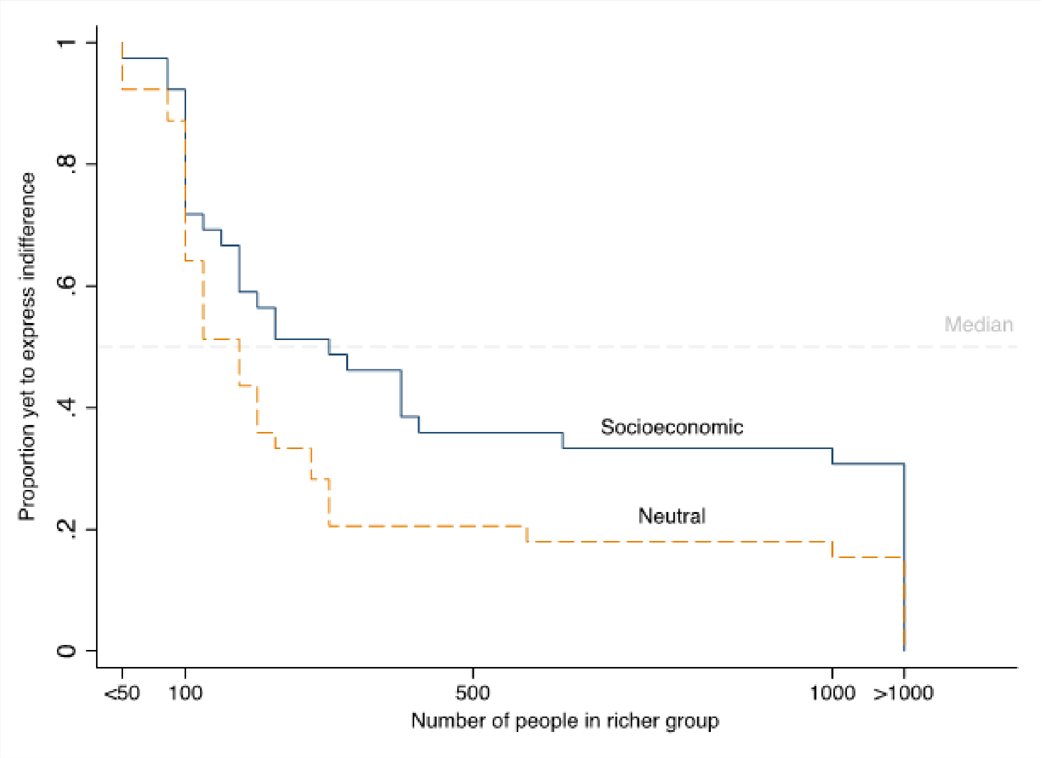


FIGURE 3 Trade-off indifference points: life-expectancy.

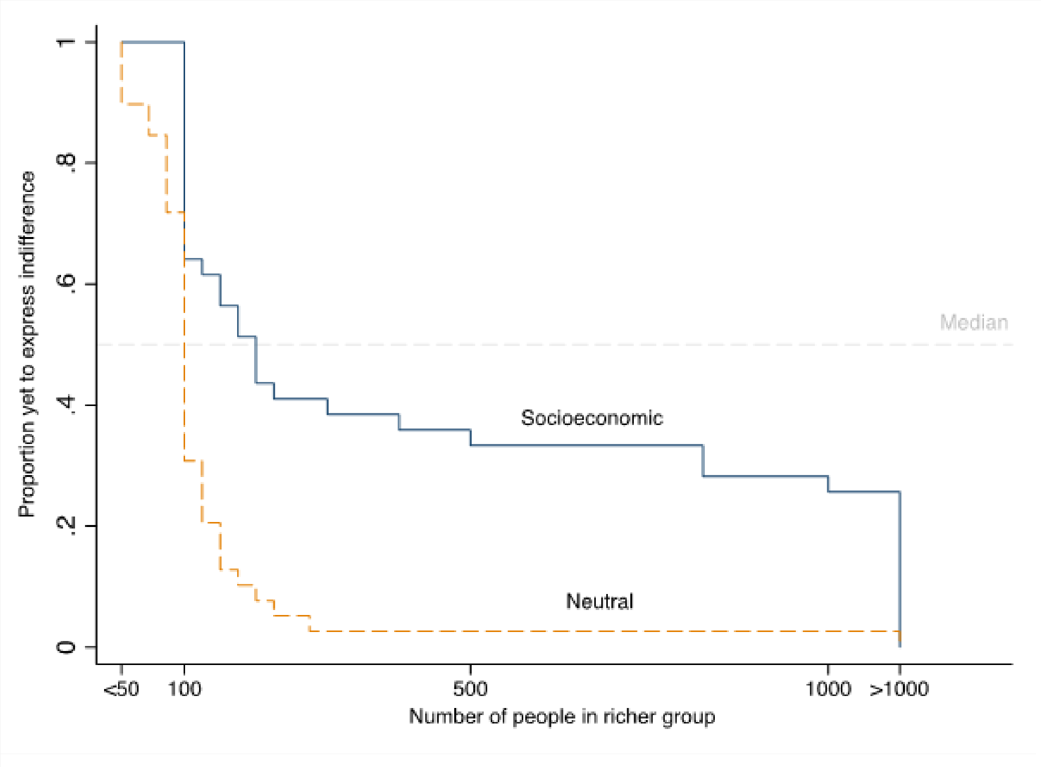


FIGURE 4 Trade-off indifference points: pain.

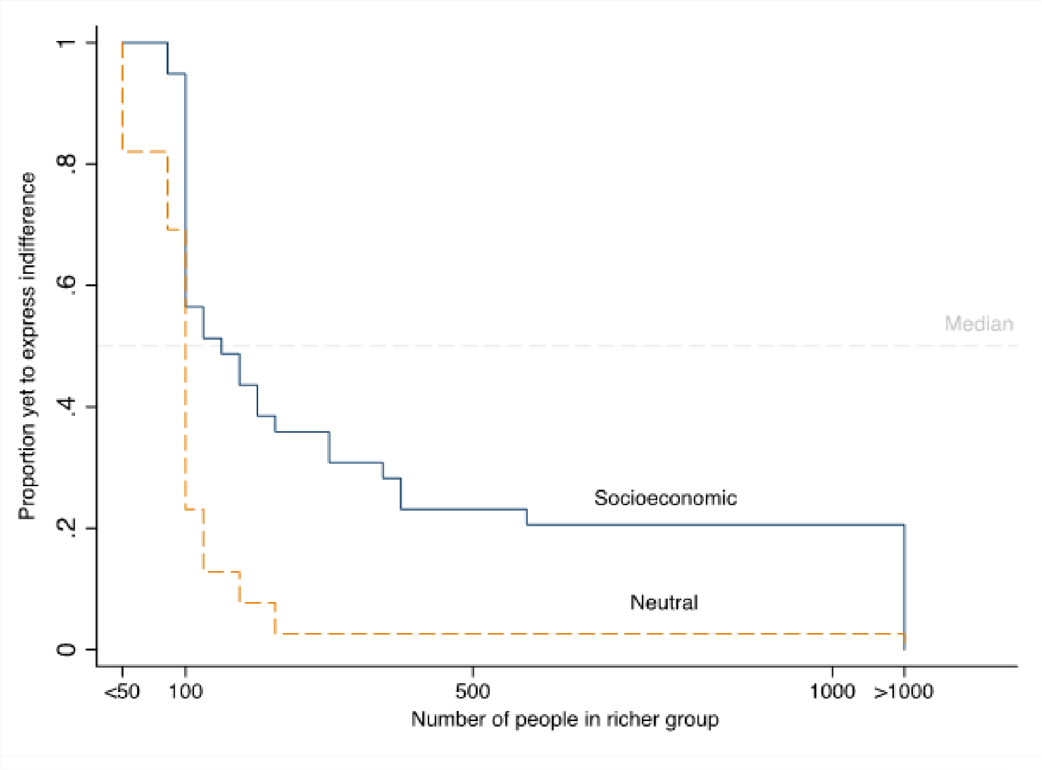


FIGURE 5 Trade-off indifference points: mobility.

Table 2, below, shows the relative weight the median respondent in each exercise placed on improving the health of the group with lower life-expectancy compared to improving the health of the group with higher life-expectancy. The Mann-Whitney U-test p-values for all three health types were statistically significant at $\alpha = 0.05$.

TABLE 2 Relative weight median respondent placed on a health-gain to a person in the group with lower life-expectancy, compared to a person from the group with higher life-expectancy

	Relative weight given to a gain to group with lower life-expectancy		Socioeconomic
Health Type	Socioeconomic arm	Neutral arm	vs Neutral p-value*
Life-Expectancy	3.00	1.75	0.04
Pain	2.00	1.00	<0.01
Mobility	1.50	1.00	<0.01
Life-Expectancy vs Pain p-valueψ	0.10	<0.01	
Life-Expectancy vs Mobility p-valueψ	0.05	<0.01	

*one-sided p-values for Mann-Whitney U-tests of Hypothesis 1.

ψ one-sided p-values for Wilcoxon signed-rank test of Hypothesis 3.

3.2 | Hypothesis 2: this difference is, at least in part, driven by the role non-health information plays in determining aversion to inequalities in health between socioeconomic groups.

Figure 6, below, shows the proportion of respondents in the socioeconomic arm who selected each of the non-health rationale for choice statements. Note that these rationales are not relevant to choices between neutrally labelled groups, and so were not presented to participants in the neutral arm. These responses indicate that participants in the socioeconomic arm were influenced by non-health information. For example, 31% stated that they chose to benefit the poorer group for the life-expectancy improving intervention "because they have less money than the richer people". Similarly, 33% stated they chose to favour the poor group for the pain-relief intervention "because poorer people are disadvantaged in many other ways in their life". For each health type, a substantial minority of respondents justified their responses by stating that the richer group could improve their health problems through private healthcare (49% for the life-expectancy intervention, 36% for the pain-relief option and 31% for the mobility-improving policy) – despite the fact that participants were explicitly told that there was no other way the people with the health problems could get the health benefit the intervention provided. These responses are consistent with the idea that the divergence between the UK-public's aversion to inequalities in health between socioeconomic and neutrally labelled groups is, at least in part, motivated by non-health factors.

3.3 | Hypothesis 3: the UK-public are more willing to prioritise groups with lower lifetime health over groups with higher lifetime health if an intervention improves life-expectancy than if it improves quality-of-life.

In both the socioeconomic and neutral arms, there was evidence participants were more willing to prioritise people with lower life-expectancy if an intervention improved life-expectancy, rather than if it improved quality-of-life.

Socioeconomic arm

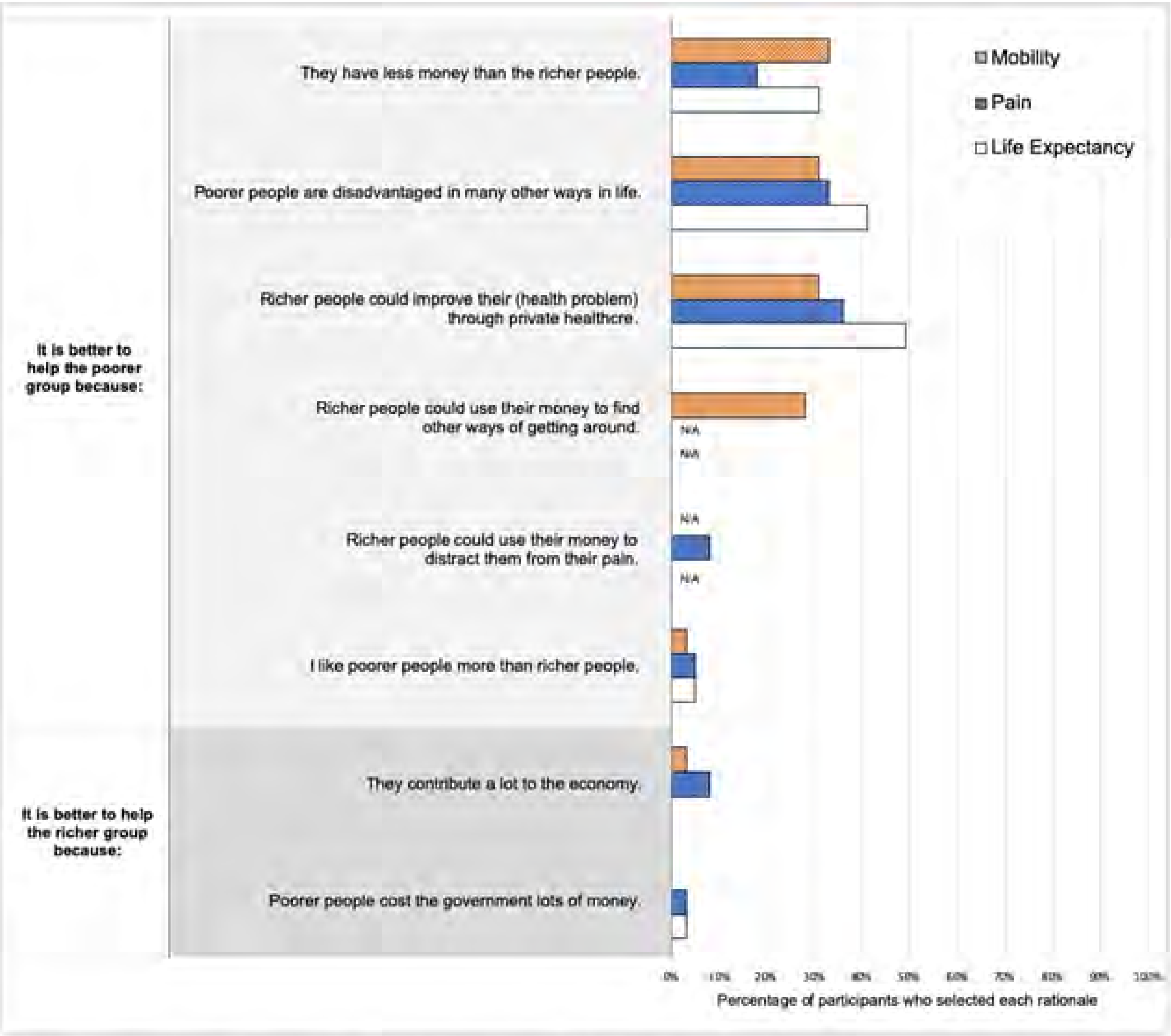
Figure 7, below, shows the trade-off indifference points for each health-type. If prioritisation preferences were equivalent across health-types, we would expect to see three overlapping curves in this figure. In fact, for all trade-off values >100, the life-expectancy curve remains above the mobility curve, and the above or equal to the pain-curve.

Table 2, above, shows the median weight in the life-expectancy exercise was higher than for the two quality of life exercises. The p-value for the Wilcoxon signed-rank test comparing the life-expectancy and pain-relief responses was 0.05. The equivalent value for the comparison of the life-expectancy and mobility-improvement responses was 0.10.

Neutral arm

Figure 8, below, shows the trade-off indifference points for all three health types in the neutral arm, and provides clear evidence in support of Hypothesis 3.

Table 2, above, shows the relative weight the median respondent in each exercise in the neutral arm placed on improving the health of people with Disease A over people with Disease B for each health type. In the life-expectancy exercise, the median respondent was willing to prioritise the group with lower life-expectancy for the life-expectancy intervention. In contrast, the median respondents in both the pain and mobility exercises were unwilling to prioritise the group with lower life-expectancy for either quality of life intervention. The p-values for the two Wilcoxon sign-rank tests comparing the life-expectancy responses to the quality-of-life responses were both <0.01.



* N/A = Not applicable (the statement was not offered to participants in this exercise).

FIGURE 6 Socioeconomic arm, non-health rationale for choice responses: percentage of people who selected this rationale for each health type*.

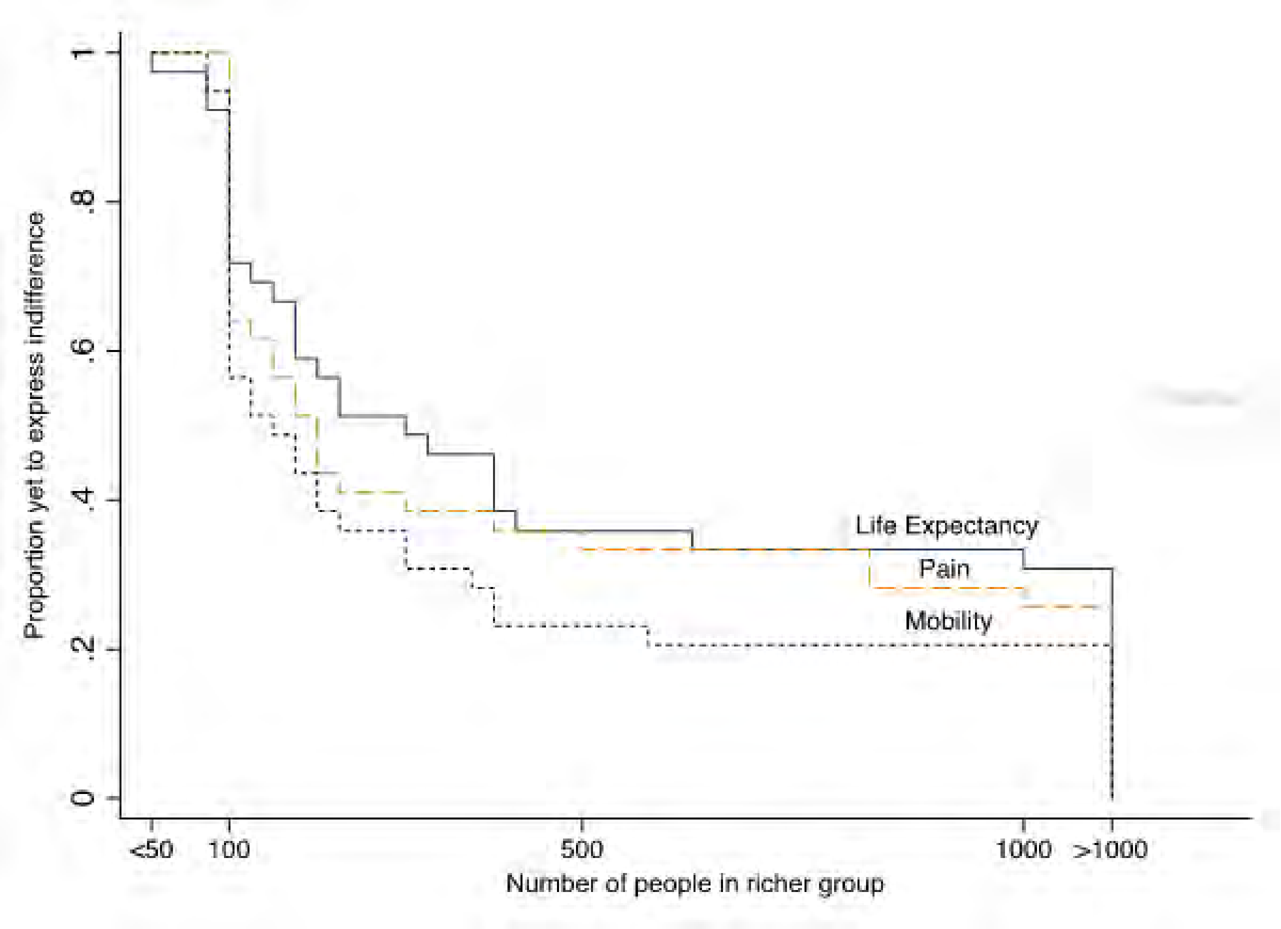


FIGURE 7 Socioeconomic arm trade-off indifference points - health type comparison

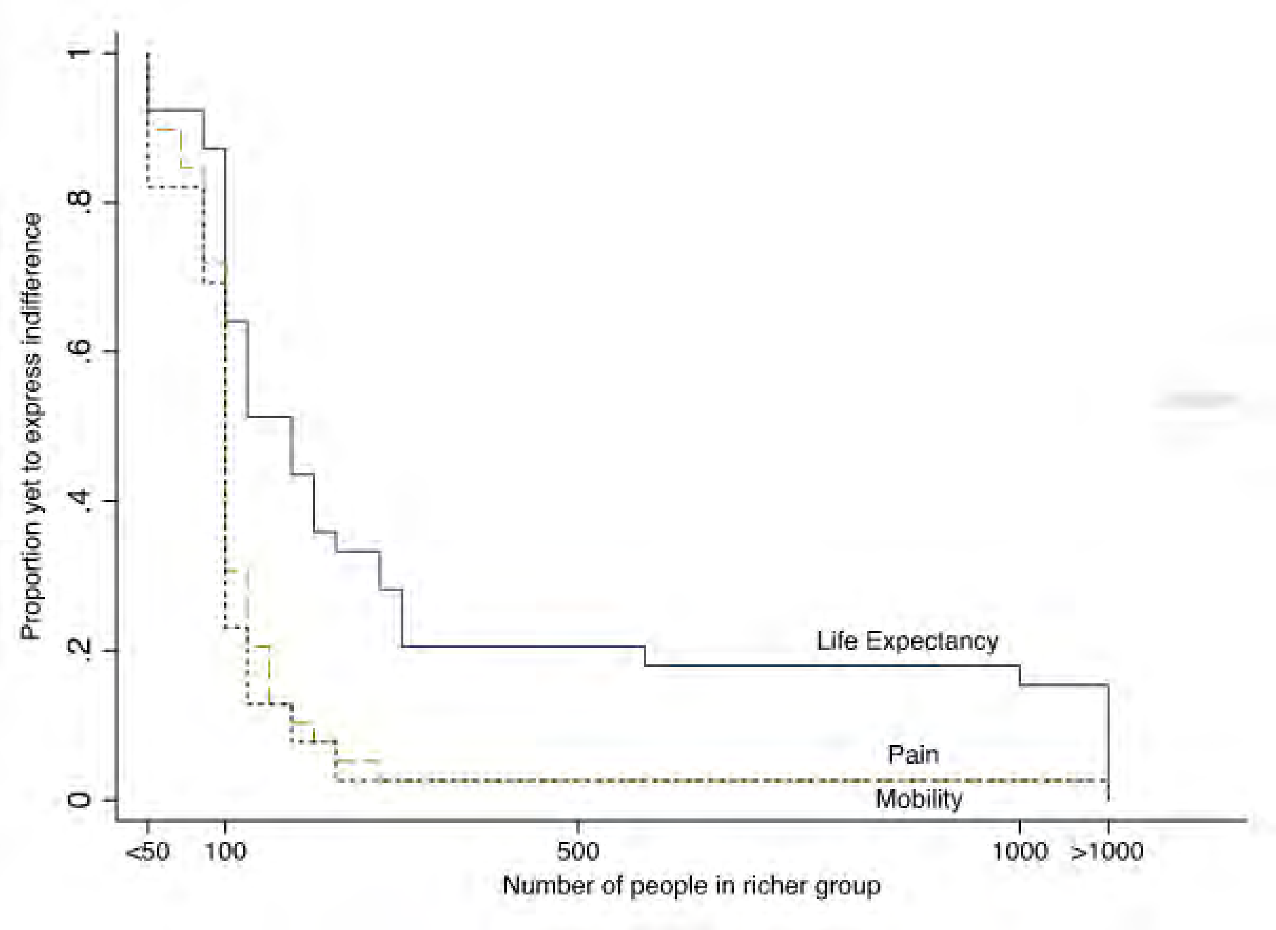


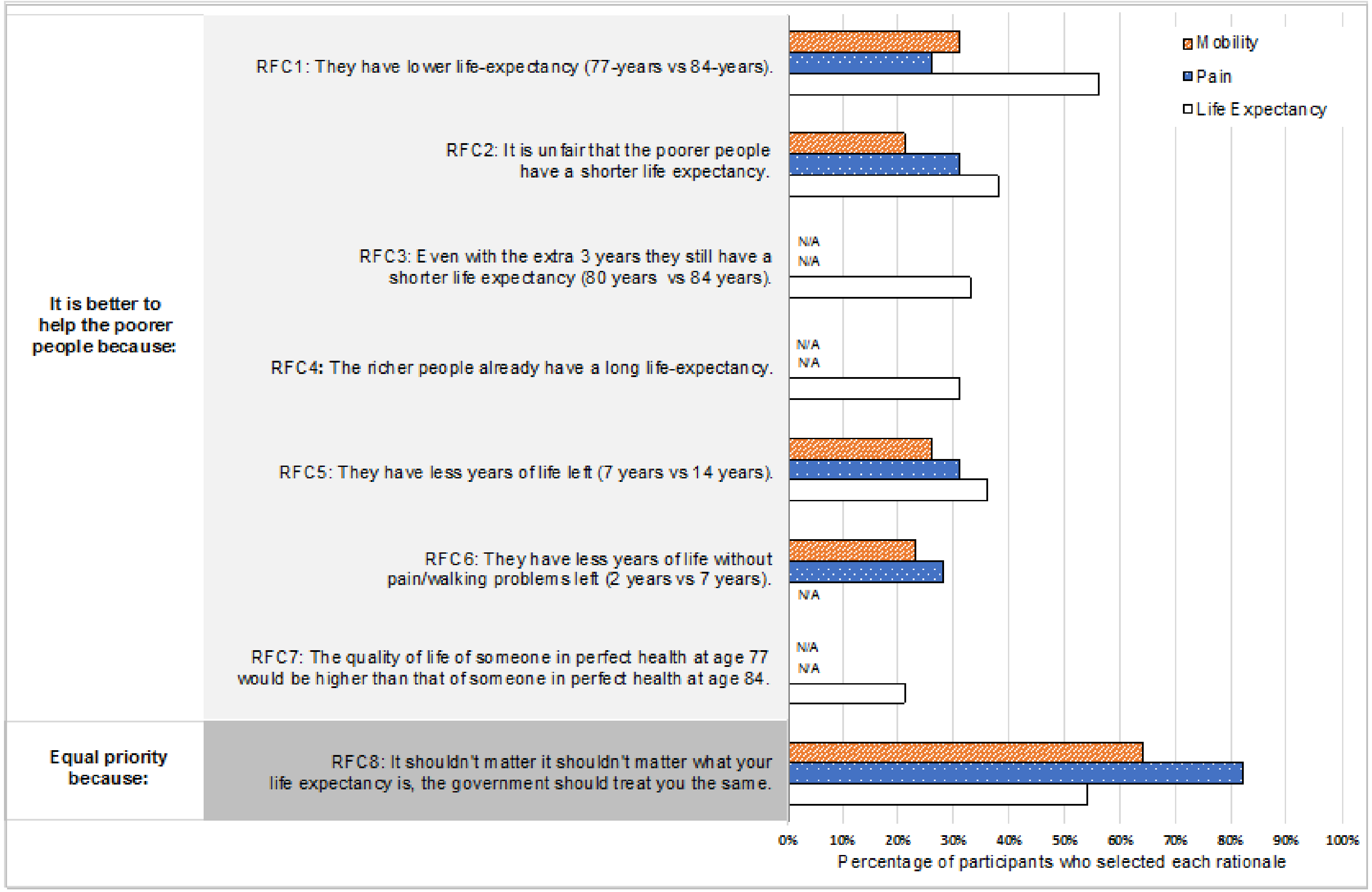
FIGURE 8 Neutral arm trade-off indifference points - health type comparison

Rationale for choice responses - why might participants have been more willing to prioritise a group with lower lifetime health for an intervention improves life-expectancy rather than one that improves quality-of-life?

Figure 9 and Figure 10, below, show the direct-health-related rationale for choice responses for participants in the socioeconomic and neutral arms, respectively. These results show that participant choices were influenced by a wide range of factors, many of which differed in frequency between health types. For example, the first rationale presented in each figure (RFC1) is the statement: “it is better to help the poorer people [people with Disease A in the neutral arm], because they have lower life-expectancy (77 years vs 84 years)". In the socioeconomic arm, 56% explained their response to the life-expectancy exercise by selecting this statement. Similarly, 46% in the neutral arm selected this statement for the life-expectancy exercise. In contrast, for the pain and mobility exercises only 26% and 31% of those socioeconomic arm selected this rationale, and only 31% and 18% did so in the neutral arm.

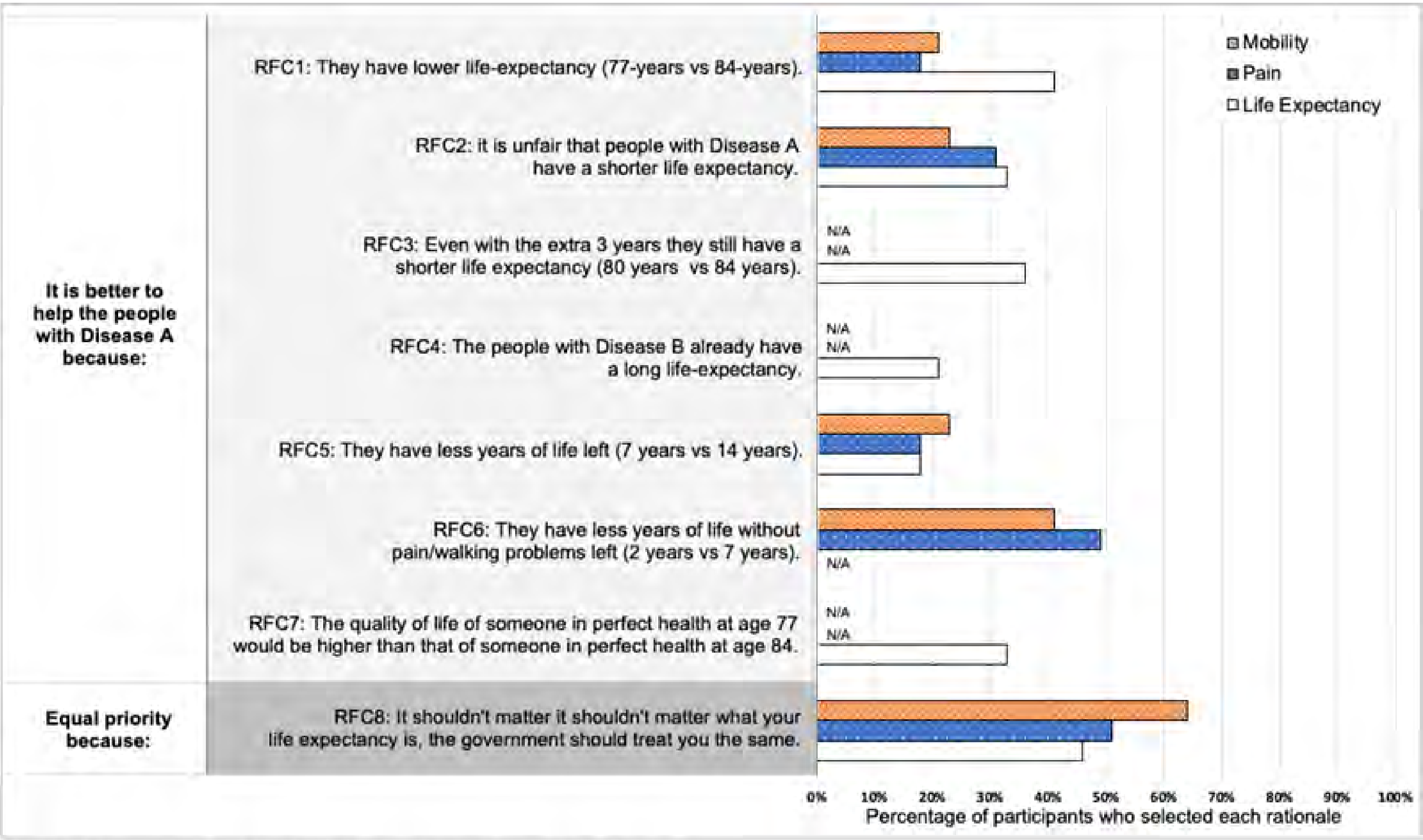
This pattern is mirrored in the rationale presented at the bottom of each of the two figures (RFC8): “it shouldn’t matter what your life-expectancy is, the government should treat you the same”. In the socioeconomic arm, 54% of participants selected this for the life-expectancy exercise, whilst 82% and 64% selected it for the pain and mobility exercises. Similarly, in the neutral arm 46% explained their life-expectancy choices by selecting this rationale, compared to 51% in the pain exercise and 64% in the mobility exercise. This variation suggests that, for some participants, the inequality in life-expectancy between the two groups was perceived as being more relevant to a prioritisation decision about an intervention that improved life-expectancy, rather than one that improved quality-of-life.

In addition, it is notable that a proportion of respondents selected the three rationales that were only applicable to the life-expectancy exercise (RFC3, RFC4, RFC7). In the figures below, these rationales are the three statements that have one bar to right of them, and the term “N/A” (not applicable) written twice above the bar. The first of the three statements presented in each figure (RFC3) is: “it is better to help the poorer people [people with Disease A], because even with the extra 3 years they still have a shorter life expectancy (80 years vs 84 years)”. Thirty-three percent of those in the socioeconomic arm and 36% in the neutral arm responded that their choice was motivated by this statement. The next rationale specific to the life-expectancy exercise shown in each figure (RFC4) is: “It is better to help the poorer people [people with Disease A], because the richer people [people with Disease B] already have a long life-expectancy”. Thirty-one percent of people in the socioeconomic arm and 21% in the neutral arm selected this rationale. The final of the three statements presented in each figure (RFC7) is: “it is better to help the poorer people [people with Disease A], because the quality of life of someone in perfect health at age 77 would be higher than that of someone in perfect health at age 84”.This statement was selected by 21% in the socioeconomic arm and 33% in the neutral arm. As these rationales were not relevant to the choices about the quality-of-life interventions, and each would favour prioritising the group with lower life-expectancy, it is plausible that these rationales may explain, at least in part, why participants were more willing to prioritise the lower life-expectancy group in the life-expectancy exercise than they were in the quality-of-life exercises.



* N/A = Not applicable (the statement was not offered to participants in this exercise).
RFC = Rationale for choice.

FIGURE 9 Socioeconomic arm rationale for choice responses (direct-health-related only); percentage of people who selected this rationale for each health type.*



* N/A = Not applicable (the statement was not offered to participants in this exercise).
RFC = Rationale for choice.

FIGURE 10 Neutral arm rationale for choice responses; percentage of people who selected this rationale for each health type*

4 | DISCUSSION

In this study, we explored three hypotheses: (1) the UK-public are more averse to inequalities in health between socioeconomic groups than they are to inequalities in health between neutrally labelled groups; (2) this difference is, at least in part, driven by the role non-health information plays in determining aversion to inequalities in health between socioeconomic groups; and (3) the UK-public are more willing to prioritise groups with lower lifetime health over groups with higher lifetime health if an intervention improves life-expectancy than if it improves quality-of-life.

Hypotheses 1 and 2

We find evidence consistent with the hypothesis that the UK-public are more willing to prioritise the health of people from deprived socioeconomic groups than they are to prioritise the health of people with equivalent health in neutrally labelled groups. This finding is aligned with the findings of Hurley et al. [20], Pinho and Botelho [29], and of the cross-study comparison in a review of relevant literature conducted by McNamara et al. [21].

While we acknowledge that consideration of aversion to inequalities in health across socioeconomic groups requires a multi-variate social objective function, and is therefore is not compatible with the univariate characteristic of the original Atkinson Social Welfare Function [14], we have calculated the inequality aversion parameter from our results in order to facilitate a like-for-like comparison with previous studies. In an Atkinson function (functional form provided in Online Appendix), an inequality aversion parameter of 0 denotes no inequality aversion, parameters >0 denote inequality aversion, and as the parameter increases, so the strength of that aversion increases. In this study, the Atkinson parameter we estimate for life-expectancy inequality across socioeconomic groups is 12.63. This figure is comparable to the corresponding figures derived by Robson et al. (Atkinson parameter = 10.95) [33], Ali et al. (10.87 or greater) [34], and Cookson et al. (10.9 and 5.4) [35], and consistent with other literature that suggests the public are willing to prioritise disadvantaged socioeconomic groups with lower life-expectancy over advantaged socioeconomic groups with higher life-expectancy for interventions that improve life-expectancy [17, 18, 19, 36, 37]. Similarly, the corresponding parameter we estimate for the neutral arm [6.43], is comparable to those estimated by Edlin et al. (5.76 and 7.63) [22], and consistent with existing evidence of aversion to inequalities in health between neutrally labelled groups [28, 23, 25, 26, 27, 24].

Rationale for choice responses suggests that the difference between arms was driven, at least in part, by the influence of non-health information in the questions about socioeconomic groups, in particular, the financial inequality between richer and poorer people, the broader disadvantage faced by poorer people, and the perceived potential for the richer people to improve their health via private healthcare. This raises a critical question for those interested in distributionally sensitive economic evaluations: should these methods apply estimates of inequality aversion that are influenced by non-health information, or estimates based on health alone? In this paper, we do not make a case for either possibility; we simply point out that those conducting, and using, DCEAs should be aware of this issue, and should think carefully about it before using DCEAs to inform resource allocation decisions.

While the neutral and socioeconomic arms were intended to be identical with the exception of group-type, there are differences between the two that may have impacted our results. For example, the socioeconomic arm were asked questions about two socioeconomic quintiles that account for 40% of the UK population, while we did not tell the neutral arm what proportion of the population are within groups A and B. This is potentially important, because evidence suggests our willingness to help others depends on the number of people faced with the same problem that we cannot help [38]. Furthermore, we did not provide the neutral arm with information about people who did not have Disease A and B, whilst participants in the socioeconomic arm may have considered the “middle” 60% not in the richest/poorest fifth when answering. Similarly, we did not provide information about inequalities in quality-of-life. As those in the socioeconomic arm may have had existing knowledge about, or inferred the existence of, socioeconomic inequalities in quality-of-life, it is possible they considered this when responding, whilst those in the neutral arm did not.

Hypothesis 3

Our sample was significantly more willing to prioritise neutrally labelled groups with lower life-expectancy over neutrally labelled groups if an intervention improves life-expectancy than they are if it improves quality-of-life. In the socioeconomic arm, we observed a similar trend in aversion across health benefit types, but this was only statistically significant at the 10% level.

Rationale for choice responses suggests that differences in the willingness to prioritise the group with lower life-expectancy across intervention types was partly influenced by the fact that fewer participants considered an inequality in life-expectancy to be relevant to a decision about an intervention that improved quality of life, compared to a decision about an intervention that improved life-expectancy. As noted in the introduction of this paper, QALY-based DCEA assumes that, given an inequality in lifetime health between two groups of a set QALY magnitude, the public are willing to prioritise the group with lower lifetime health for a QALY gain, irrespective of how that QALY gain is composed. If taken at face value, our results suggest this assumption may not hold. However, it should be noted that we did not explicitly tell participants that each intervention provided a 3 QALY-gain. Instead, we provided them with information about the intervention which equated to a 3 QALY-gain. Given the cognitive burden associated with this task, it is possible we would have observed different results if we had explicitly told participants the QALY-gain the interventions provided. In addition, whilst we assumed the QALY-model was an appropriate way to equalise the size of the health gain provided across health-gain types, evidence suggests that the public may be willing to pay more for QALYs that improve their own health through life-extension rather than improve their own quality-of-life [39]. Given this, it is possible that participants may have perceived the different QALY gain types as being of different social value, independently of the inequality between the two groups. Also, we did not brief participants about inequalities in quality-of-life. If this had been done, this may have increased their willingness to prioritise the group with lower life-time health for the quality-of-life improving interventions.

The primary strength of this study is that it was administered face-to-face. We used this mode, because we wanted participants to engage in the tasks, and think carefully about the issues. Having attended the study fielding, we believe we achieved this. However, the decision to use a face-to-face, rather than for example an online, design did mean we could include substantially fewer participants, across a much smaller geographical spread, than would otherwise have been possible. It would be valuable to repeat this part of study in a larger representative sample of the UK-public. Other strengths of this study include the use of a general-public sample; the testing of three novel and policy relevant hypotheses; and the collection of rationale for choice data.

One limitation of this study is the way we represented the socioeconomically neutral groups. It is possible that the use of the term "disease" impacted the way participants thought about the exercises, and that different results may have been observed had uninformative neutral terms been used (e.g. "A" and "B"). It should also be noted that we did not account for time preference, and it is possible that some participants may have preferred to extend the life-expectancy of those with lower life-expectancy as they perceived the present value of extending their life by 3-years as being higher than for the higher life-expectancy group. In addition, it is possible that our PTO results were influenced by concern for intra-group inequality (i.e. by benefiting only a proportion of people from the impacted groups). It is not clear what impact this may have had on our results. A further limitation is the fact that we are attempting to elicit preferences about complex issues in a simplistic way. In this format, we did not, and could not have, fully explained the breadth of inequalities in health between socioeconomic groups. Equally, we did not explain to participants the hypothesised causes of these inequalities, or the give them information about what different people think about the injustice, or otherwise, of those inequalities. Furthermore, we did not give them opportunity to deliberate with others. Given this, the preferences elicited in this study should be regarded as being based on lay-understandings of the causes of inequalities in health and of the implication of prioritising health-gains to different groups. In future work, it would be interesting to repeat this survey in a sample of individuals who have greater knowledge of inequalities in health, for example members of the public who have received a significant, multi-day briefing on inequalities in health, or public health decision-makers. It should also be noted that this study applied one of many reasonable methodologies and choice-framings. For example, we highlighted the number of people from each group who would benefit from the intervention, and did not state the number of people who would not. Alternative methods and/or framings may have produced different results. Given this, and the issues identified above: (1) the PTO data should be regarded as being consistent with Hypotheses 1 and 3, rather than definitive evidence in support of them; (2) our results should be regarded as suggesting the assumptions underlying DCEA may not hold, rather than provided strong evidence they do not.

In conclusion, we find evidence that suggests the UK-public are more averse to inequalities in health between socioeconomic groups than they are to those between neutrally framed groups. We provide evidence that non-health factors influence prioritisation questions about the health of different socioeconomic groups. We find evidence consistent with the idea that the UK-public are more willing to prioritise a group with lower lifetime health for an intervention that improves life-expectancy, rather than one that improves quality-of-life.

Acknowledgements

This work was supported by the Wellcome Trust Doctoral Training Centre in Public Health Economics and Decision Science [108903/Z/19/Z] and the University of Sheffield. We would like to thank attendees of the Winter 2019 Health Economists' Study group meeting in York for their comments on the pilot of this study, and in particular Koonal Shah who acted as discussant. We would also like to thank Matthew Robson, and attendees at seminars at the University of York, the University of Liverpool, the University of Newcastle and the University of Linköping for their comments on this study and/or the pilot of this study. This document was formatted using the Wiley and Overleaf "Wiley Journal Template" LaTeX template. This template was developed by the two parties during 2017/2018, and is available for use under Creative Commons CC BY 4.0. We thank Wiley and Overleaf for developing this LaTeX template, and making it freely available. We thank Zeeshan Hashmi for his support in type-setting this manuscript.

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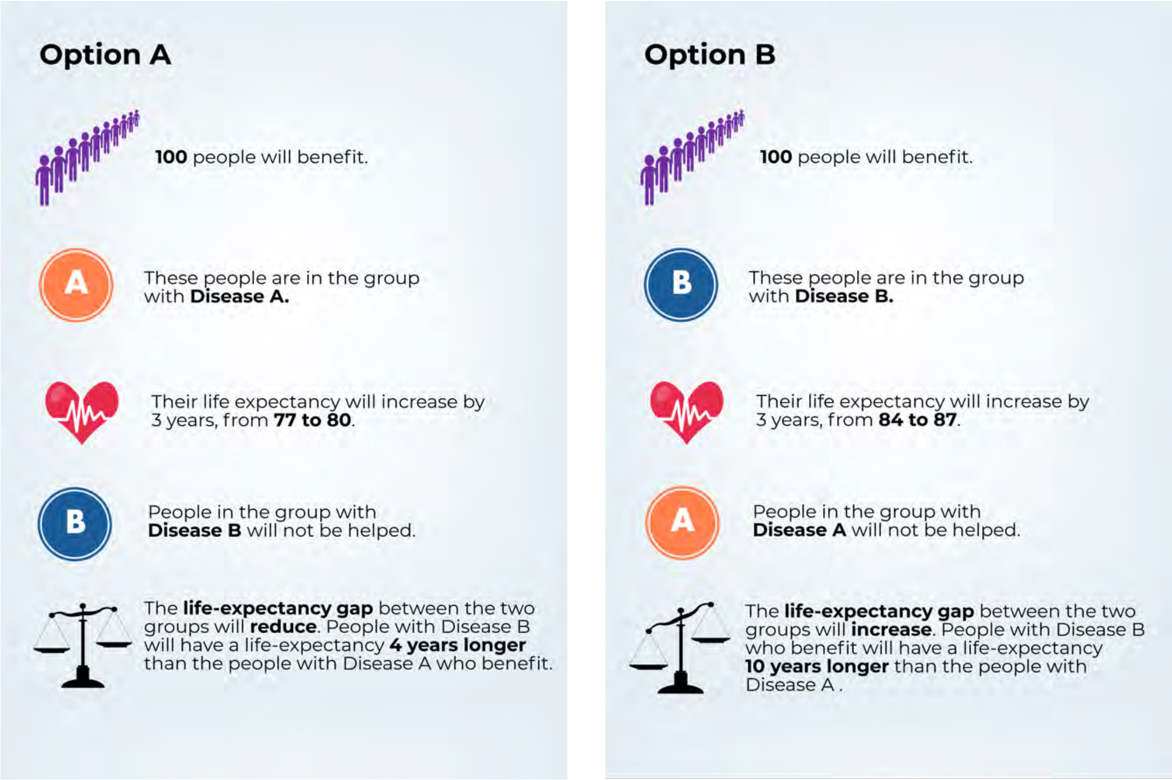
APPENDIX A5.1. The McNamara et al. (2020b) online appendices

Online Appendices for McNamara et al. (2020b)

Figure 1. The initial choice - neutral arm; life-expectancy.



Option A

100 people will benefit.

These people are in the group with **Disease A.**

Their life expectancy will increase by 3 years, from **77 to 80**.

People in the group with **Disease B** will not be helped.

The **life-expectancy gap** between the two groups will **reduce**. People with Disease B will have a life-expectancy **4 years longer** than the people with Disease A who benefit.

Option B

100 people will benefit.

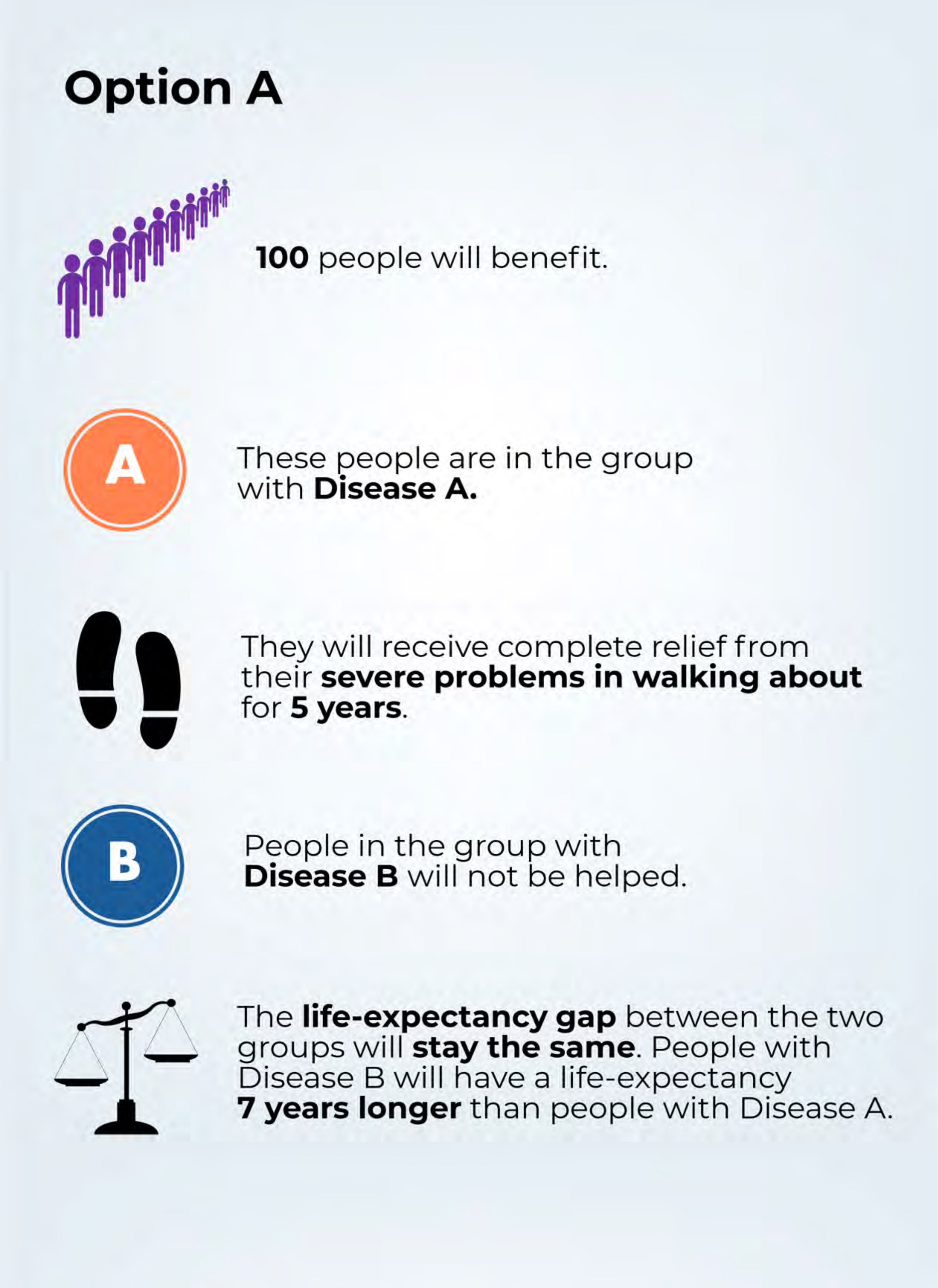
These people are in the group with **Disease B.**

Their life expectancy will increase by 3 years, from **84 to 87**.

People in the group with **Disease A** will not be helped.

The **life-expectancy gap** between the two groups will **increase**. People with Disease B who benefit will have a life-expectancy **10 years longer** than the people with Disease A .

Figure 2. An example of the graphics used to convey mobility problems.



Option A

100 people will benefit.

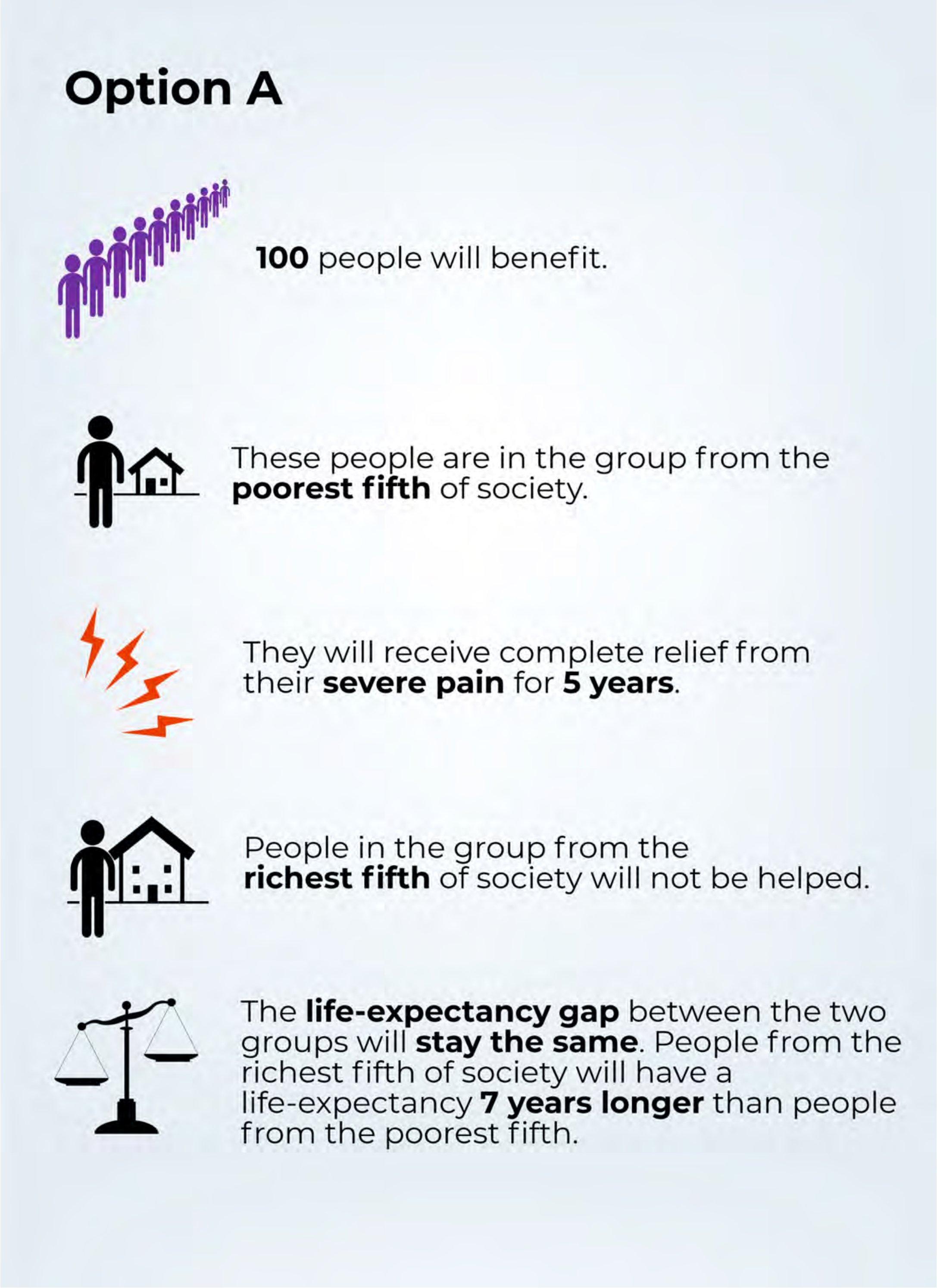
These people are in the group with **Disease A.**

They will receive complete relief from their **severe problems in walking about** for **5 years**.

People in the group with **Disease B** will not be helped.

The **life-expectancy gap** between the two groups will **stay the same**. People with Disease B will have a life-expectancy **7 years longer** than people with Disease A.

Figure 3. An example of the graphics used to convey pain



Option A

100 people will benefit.

These people are in the group from the **poorest fifth** of society.

They will receive complete relief from their **severe pain** for **5 years**.

People in the group from the **richest fifth** of society will not be helped.

The **life-expectancy gap** between the two groups will **stay the same**. People from the richest fifth of society will have a life-expectancy **7 years longer** than people from the poorest fifth.

Sensitivity analyses including the individual who may, or may not, have been a straightliner.

In the analysis set we excluded two individuals who selected a high volume (41 of 43) of contradictory rationale for choice statements. One of these individuals also responded to the value statements in a clearly illogical way (strongly agreeing with all 11 contradictory statements). In response, we were confident this individual was not engaged in the study, and so excluded them from the analysis set. The second individual gave a pattern of responses to the value statement questions that was not clearly illogical. As a result, we could not confirm definitively whether or not they were engaged in the study or not. Due to their illogical responses to the rationale for choice questions, and the fact that these immediately followed the person-trade off exercise, we assume this individual was not engaged in the choice tasks, and so excluded them from the primary analysis set. Table 1, below, shows the impact of including this individual on the results observed. Note that the individual was in the socioeconomic arm and so the neutral arm results remain unchanged following their inclusion.

Table 1. Relative weight median respondent placed on a health-gain to a person in the group with lower life-expectancy, compared to a person from the group with higher life-expectancy (potential non-straightliner included)

	Relative weight given to a gain to group with lower life-expectancy		
Health Type	*Socioeconomic arm*	*Neutral arm*	*Socioeconomic vs Neutral p-value**
Life-Expectancy	2.63	1.75	*0.05*
Pain	1.88	1.00	*<0.01*
Mobility	1.63	1.00	*<0.01*
Life-Expectancy vs Pain p-value$^{\Psi}$	*0.10*	*<0.01*	
Life-Expectancy vs Mobility p-value$^{\Psi}$	*0.09*	*<0.01*	

**one-sided p-values for Mann-Whitney U-tests of Hypothesis 1.*

Ψ *one-sided p-values for Wilcoxon signed-rank test of Hypothesis 3.*

This sensitivity analysis demonstrates that including this individual does not have a substantial impact upon the results observed. For ease of comparison, the comparable results for the analysis set (excluding this individual) are presented in Table 2 below.

Table 2. Relative weight median respondent placed on a health-gain to a person in the group with lower life-expectancy, compared to a person from the group with higher life-expectancy (analysis set)

	Relative weight given to a gain to group with lower life-expectancy		
Health Type	*Socioeconomic arm*	*Neutral arm*	*Socioeconomic vs Neutral p-value**
Life-Expectancy	3.00	1.75	*0.04*
Pain	2.00	1.00	*<0.01*
Mobility	1.50	1.00	*<0.01*
Life-Expectancy vs Pain p-value$^{\Psi}$	*0.10*	*<0.01*	
Life-Expectancy vs Mobility p-value$^{\Psi}$	*0.05*	*<0.01*	

**one-sided p-values for Mann-Whitney U-tests of Hypothesis 1.*

Ψ *one-sided p-values for Wilcoxon signed-rank test of Hypothesis 3.*

The Atkinson HRSWF functional form.

$$EDE_{Atkinson} = \overline{H}.\left[\sum\nolimits_i \left(\frac{H_i}{\overline{H}}\right)^{1-\varepsilon} f(x_i)\right]^{1/(1-\varepsilon)}$$

Table 3. Value statement responses

	Agree	**Neither**	**Disagree**
The government should prioritise the health of poorer people over richer people.	27%	43%	31%
The NHS should prioritise the health of poorer people over richer people.	31%	32%	37%
It shouldn't matter if you are richer or poorer, the government should value improvements to everyone's health equally.	94%	1%	5%
It shouldn't matter if you are richer or poorer, the NHS should value improvements to everyone's health equally.	95%	3%	3%
When the government makes decisions about health, they should just focus on the amount of benefit something provides, not who that benefit goes to.	71%	8%	21%
When the NHS makes decisions about health, they should just focus on the amount of benefit something provides, not who that benefit goes to.	79%	5%	17%
The government should just focus on improving the average health of people in the country, they shouldn't consider whether or not different groups of people have different levels of health.	65%	8%	27%
The NHS should just focus on improving the average health of people in the country, they shouldn't consider whether or not different groups of people have different levels of health.	65%	8%	27%
The government should value the health of richer people more highly, because they contribute more to the economy.	6%	12%	82%
The government should try and reduce the life expectancy gap between richer and poorer people, even if this means average life-expectancy will be lower.	49%	24%	27%
When the government makes decisions about health, they should focus on people with lower life expectancy.	42%	35%	23%

APPENDIX A5.2. How this chapter contributes to this thesis as a whole

This chapter: (1) provides evidence consistent with Hypothesis A of this thesis (the UK-public are more averse to inequalities in lifetime health between socioeconomic groups than they are to inequalities in lifetime health between neutrally labelled groups); (2) provides evidence consistent with Hypothesis B of this thesis (the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health if an intervention improves life-expectancy than they are if it improves quality-of-life); and (3) provides further evidence that participants asked questions about prioritising the health of different socioeconomic groups are influenced by non-health factors (the logic underlying Hypothesis A). Furthermore, it (4) provides further evidence that the UK-public's aversion to socioeconomic inequalities in health may be health-dimension specific, with an inequality in life-expectancy perceived as being more relevant to a decision about an intervention that improves life-expectancy, rather than one that improves quality-of-life.

Given (4), and the fact that participants in this study were presented with information on inequalities in life-expectancy but not quality-of-life, it is unclear whether the results observed for health-gain types can be extrapolated to a hypothesis about "lifetime health" more generally (i.e. Hypothesis B of this thesis). As a result, this study should be regarded as (5) providing evidence consistent with Hypothesis B, rather than strong evidence in support of it; but (6) providing evidence in support of a restricted variant of Hypothesis B: the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower *life-expectancy* over advantaged socioeconomic groups with higher *life-expectancy* if an intervention improves life-expectancy than they are if it improves quality-of-life.

When considering these conclusions, it should be noted that the characteristics of participants were not representative of the UK-public as a whole. Notably, the sample were substantially more educated than the UK-public, more left-wing politically, and more likely to live in a deprived area. These discrepancies appear to largely be a function of the way in which the sample were recruited: on street recruitment in the shopping districts of two cities in Yorkshire. Given these differences, it is possible that the results present a biased picture of the preferences of the UK-public as a whole. As a result, my findings should be interpreted with caution, both in terms of the two hypotheses, and the absolute strength of inequality aversion observed. If I were given the opportunity to explore the issues in this chapter again, I would aim to do so using a larger study, with broader range of fielding locations and a budget sufficient to sample respondents to be more representative of the population as a whole. In addition, I would be keen to test whether inequality aversion differs between cities, towns and rural locations. Furthermore, I would be interested to explore variation in inequality aversion by region of the UK.

In addition, as discussed in Chapter 4, it should be noted that the terminology and graphics used to convey information to respondents may have primed them to respond in a more inequality averse fashion than if more objective alterantives had been used. Given this, it is possible that the study reported in this chapter may overstate the public's inequality aversion. It would be interesting to explore this in a future study; for example, by randomising participants to different study materials (i.e. the current variants vs more objective alternatives) and testing whether this impacts respondents' inequality aversion.

APPENDIX A5.3. Face-to-face study interviewer guide

HEALTH PRIORITIES STUDY (Chapter 5):

INTERVIEWER GUIDE

This document:

1. Explains what the "Health Priorities Study" is about;
2. Sets out what people will be asked to do in the study, and what the interviewers will do;
3. Provides a script for you to use when talking to participants;
4. Outlines the answers to some frequently asked questions you may be asked.

If you aren't sure about something in this document, or would like to know more, please ask a member of the research team about this at the interviewer briefing.

1. What is the "Health Priorities Study" about?

Every day, governments have to make difficult decisions. Some of these decisions will impact peoples' health. For example, they might have to decide whether or not to build a new hospital, or whether or not to fund a new medicine. We are interested in what people think about these sort of these decisions, and in particular, what they think the government should do when their decisions will benefit different groups of people.

2. What will people be asked to do in the study? What will the interviewers do?

In the study, people will complete an online survey on a laptop. You will be there to recruit people to the study, to explain the survey to them before they start, and to answer any questions they have whilst they are completing it.

Before people start the survey, it is important that they read the study "information sheet", and signs two copies of the "consent form". This is so that participants understand what they will be asked to do, and so that we can show they have agreed to take part. When someone gives you the two consent forms, check that they have ticked all the "yes" boxes, and signed their name. If someone hasn't signed the consent form, or ticked all the "yes" boxes on two copies of the form, ask them to. If they do not do this, they cannot take part in the study.

After you have confirmed the participant has given their consent to take part in the study, go to your "Participant identifiers" document. Pick one of numbers that hasn't already been assigned to someone, and tick the box on the sheet to confirm you have assigned this number to the participant. Don't write anything about the participant on the "participant identifiers" document, just tick the box so that you know that number has been used in the study,

After this, write the identifier on top of one of the consent forms, and then give the participants that copy of the consent form to keep. Don't write the identifier on the other consent form, and keep it.

Then go to the survey website on the laptop – this will be bookmarked on the computer. The first page on the survey is for you to complete. You will be asked to write down your unique interviewer identifier (to be given to you on the morning of the interview) and the participant's unique identifier (the code you wrote on the consent form above).

You will also asked to confirm your location, and to confirm that the participant has given their consent to participate. The survey will also ask you whether or not this is a test of the survey, or an actual interview. This is so that you can test the survey, and have a look at the kind of questions people will be asked before you start recruiting people. **Please don't run a test of the survey after the first interview has started.**

You will then read an introduction to the survey from the script, and ask the participant if they have any questions about the study. If you aren't sure about a question you have been asked, you will be able to call over a member of the research team to help you out. In this script, you will tell the participants that you will be there to answer any questions they have, or to clarify anything they aren't sure about.

Once this is done, you will be asked to click the forward arrow on the survey, and then turn the laptop round to the participant. They will then begin the survey.

In the first question, they will be asked a question about their own health: "on a scale from 0-100, with 100 being 'perfectly healthy' and 0 being as 'bad as dead', how healthy do you feel today?".

They will then be asked to imagine that they are a member of the government, and that they have been asked to make some decisions that will impact peoples' health. They will be told that these aren't real decisions, but that the government does use these sort of surveys to decide what to do, so it is important that they think carefully about their decisions and the impact they could have on people in the real world.

Half the participants will be asked to make decisions about people with "Disease A" and "Disease B", and half will be asked to make decision about people from the "poorest fifth of society" and "people from the richest fifth of society". People will be told that people with Disease A or from the poorest fifth of society have a life-expectancy of 77 years, and that people with Disease B or from the richest fifth of society have a life-expectancy of 84 years.

The survey will randomly allocate each participant to one of these two types of groups when someone starts complete it, so you won't know which group they answering questions about. It is important that you don't mention these different types of group to people before, or when, they take part in the study, as we only want them to answer the questions for their groups, and not think about the other ones. So, if they do ask you a question at any point, ask them which groups they have been asked to make choices about before you answer, so that you don't give this away.

Participants will then be asked to make some decisions. They will be told that all the people who could benefit from these decisions are currently 70 years old.

In the first of these decisions, they will be asked to decide whether to help 100 people from one group, or 100 people in another group. They will be told that, if they think the two options are equally as good, and don't mind which the government chooses, then they should click both options. They will be told that this won't mean that the government will be able to do both options, just that the participant doesn't mind which they do. Participants will be told that there is no other way that the groups they are choosing between will be able to get the health benefit that they are being asked about (for example, a group couldn't receive the benefit from private healthcare).

Depending on what the participant chooses in the first question, the survey will then change the number of people who would benefit from the program, and ask the participant to choose again. For example, if the person chooses to benefit 100 people with Disease A, rather than 100 people with Disease B, then the next question will ask them to choose between 100 people with Disease A and 200 people with Disease B. The way the participant answers these questions will change the number, and type of questions they are asked, so some participants may finish answering them more quickly than others.

Each participant will be asked to make three types of decision like this: one about options that improve peoples' life expectancy, one that relieves peoples' pain, and one that improves peoples' walking problems. Everyone will be asked about these three, but the survey will randomly decide which order these questions are asked in.

After the participants have finished making these three types of choice, the survey will then ask them some questions about why they made the choices they did. They will be asked questions about what they thought about the survey. Finally, they will be asked to provide some demographic information, so that we have a record of the type of people that have taken part.

After the participant has completed the survey, close the survey website and ask them: *(1)* what they were asked to answer questions about (Disease A and Disease B, or poorer people and richer people), and *(2)* their postcode. Explain that this is so that we can look up some information about the area the participant lives in, and add it to their responses later, without recording where their actual postcode.

Write the postcode, and the type of questions they were asked about, on the "Postcode form" you will be given in your interviewer briefing. Finally, give the participant a copy of the "Post-study information sheet", and thank them for taking part.

3. Interview Script

In the below script, actions are written using square brackets, for example: [CLICK NEXT ON SURVEY].

Things to say are written in bold, for example: **THANK YOU.**

The script begins after the participant has handed you two copies of the consent form.

--

[CHECK THE TWO CONSENT FORMS]

[HAS THE PARTICIPANT CLICKED "YES" FOR ALL OPTIONS, AND SIGNED BOTH FORMS?]

[IF YES: CARRY ON]

[IF NO: ASK PARTICIPANT TO DO THIS. IF THEY DON'T DO THIS, END THE INTERVIEW]

[ASSIGN THE PARTICIPANT A UNIQUE IDENTIFER FROM THE "PARTICIPANT IDENTIFIER" SHEET]

[PUT A TICK NEXT TO THIS NUMBER TO SHOW IT HAS BEEN USED]

[DON'T WRITE ANYTHING ELSE ON THE "PARTICIPANT IDENTIFIER" SHEET]

[WRITE THE PARTICIPANT'S IDENTIFER ON THE TOP OF ONE OF THE CONSENT FORMS]

[GIVE THIS COPY TO THE PARTICIPANT TO KEEP]
[DON'T WRITE THE PARTICIPANT'S IDENTIFIER ON THE OTHER CONSENT FORM]

[OPEN SURVEY WEBSITE]

[COMPLETE THE FIRST PAGE WITH INFORMATION REQUESTED]

[THIS INCLUDES THE PARTICIPANT’S IDENTIFIER, AND YOUR INTERVIEWER IDENTIFIER]

[CLICK NEXT]

[SAY THE BELOW]

THANK YOU FOR AGREEING TO TAKE PART IN THE SURVEY.

I AM GOING TO TURN THE COMPUTER ROUND TO YOU IN A SECOND, AND IT WILL ASK YOU TO ANSWER SOME QUESTIONS.

THE QUESTIONS WILL ASK YOU TO IMAGINE THAT YOU ARE IN THE GOVERNMENT, AND THAT YOU HAVE BEEN ASKED TO MAKE SOME DECISIONS THAT WILL CHANGE PEOPLES HEALTH.

THE DECISIONS AREN’T REAL – YOU WON’T BE DIRECTLY CHANGING SOMEONES HEALTH WHEN YOU ANSWER.

BUT, THE GOVERNMENT DOES USE SURVEYS LIKE THIS TO DECIDE WHAT TO DO, SO PLEASE TAKE THE QUESTIONS SERIOUSLY.

THE THINGS WE ARE ASKING ABOUT DON’T HAVE ANY RIGHT OR WRONG ANSWERS, AND THIS ISN’T A TEST.

WE ARE JUST INTERESTED IN WHAT YOU THINK.

TAKE AS MUCH TIME AS YOU NEED.

AS YOU GO THROUGH THE QUESTIONS, IF YOU DON’T UNDERSTAND ANYTHING, OR AREN’T SURE ABOUT SOMETHING, JUST LET ME KNOW, AND I WILL TRY AND MAKE THINGS CLEARER.

THE SURVEY HAS A BACK BUTTON ON IT, SO IF YOU FORGET SOMETHING, OR CHANGE YOUR MIND, YOU CAN GO BACKWARDS.

ANY QUESTIONS ABOUT ANY OF THAT?

[ANSWER THEIR QUESTIONS]

[IF YOU – THE INTERVIEWER - AREN'T SURE ABOUT HOW TO ANSWER A QUESTION THEY HAVE, THEN CALL OVER A MEMBER OF THE RESEARCH TEAM]

[SAY THE BELOW]

OK. LET'S GET STARTED THEN.

WHEN THE SURVEY IS FINISHED, LET ME KNOW.

[TURN THE LAPTOP ROUND TO PARTICIPANT]

--

The participant will now be asked the survey questions.

If they ask you something whilst completing the survey, answer their question if you can.

But, make sure you ask them which groups they are choosing between before answering.

Don't tell them about the groups they aren't answering questions about.

The answers to some common questions are provided in Section 4 of this document.

If you aren't sure how to answer something, call over a member of the research team.

--

[WAIT FOR PARTCIPANT TO COMPLETE SURVEY]

[TURN LAPTOP AROUND]

[CLOSE THE SURVEY WEBSITE]

[SAY THE BELOW]

BEFORE WE FINISH, I HAVE TWO MORE QUICK QUESTIONS.

FIRST, WHAT IS YOUR POSCTODE?

[RECORD THIS ON POSCTCODE FORM]

SECOND, IN THE SURVEY, WHICH GROUPS WERE YOU ASKED QUESTIONS ABOUT?

[RECORD EITHER “A AND B” OR “POOR AND “RICH” ON THE POSTCODE FORM].

OK. FINALLY, IF YOU ARE IMPACTED BY ANY OF THE TOPICS COVERED IN THE SURVEY, OR UPSET BY THEM FOR ANY REASON, HERE ARE THE DETAILS OF ORGANISATIONS YOU MAY WANT TO CONTACT FOR FURTHER SUPPORT.

[GIVE PARTICIPANT A COPY OF THE POST-STUDY INFORMATION SHEET]

OK. THANK YOU FOR TAKING PART.

-- *Script ends* --

4. Frequently Asked Questions

--

QUESTION: Can the people get the health benefit through private healthcare? (e.g. private pain relief)

ANSWER: No. The only way they can get this benefit is from the government. There is no way they can get it privately. (If the question is about private pain relief) – There is no other way they relieve this pain, no painkiller you can buy privately would reduce it.

--

QUESTION: Can the people improve their problems in walking about in other ways? Maybe they could buy a mobility scooter?

ANSWER: Imagine that they have done all they can to improve their situation – which might include buying a mobility scooter, but that they are still having severe problems in walking about.

--

This question sometimes gets asked when people are being asked to make the choices about the options that benefit different numbers of people.

QUESTION: Is this number just going to keep going up until I change my mind?

ANSWER: Try and focus on each question individually. At some point the survey will move you on to the next section, but I can’t tell you when that might be.

--

QUESTION: What is Disease A and Disease B? It would be easier if you just told me.

ANSWER: Sorry, I can’t tell you the answer to that, just that people with Disease A have a life-expectancy of 77 years and that people with Disease B have a life-expectancy of 84 years.

--

This might get asked for the pain, and problems walking about questions.

QUESTION: How do these people just get better when they reach age 75? I don’t believe that someone would have no problems walking about when they get to that age.

ANSWER: These people have a health condition that means they get better after 5-years. We don’t know why this happens, but we know it does happen. For the question, please assume that this does happen.

APPENDIX A5.4. Face-to-face study participant briefings

Socioeconomic arm: Introduction 1

What we would like you to do

Imagine you are in the government.

Today, you have been asked to make some choices about health.

These choices will have different impacts on people from the richest fifth of society and the poorest fifth of society.

Think carefully about your choices - these are imaginary situations, but governments do use surveys like this to decide what to do in the real world.

Socioeconomic arm: Introduction 2

Poorer people and richer people

In the UK, on average, poorer people live shorter lives than richer people.

People from the poorest fifth of society can expect to live until they are **77** years old.

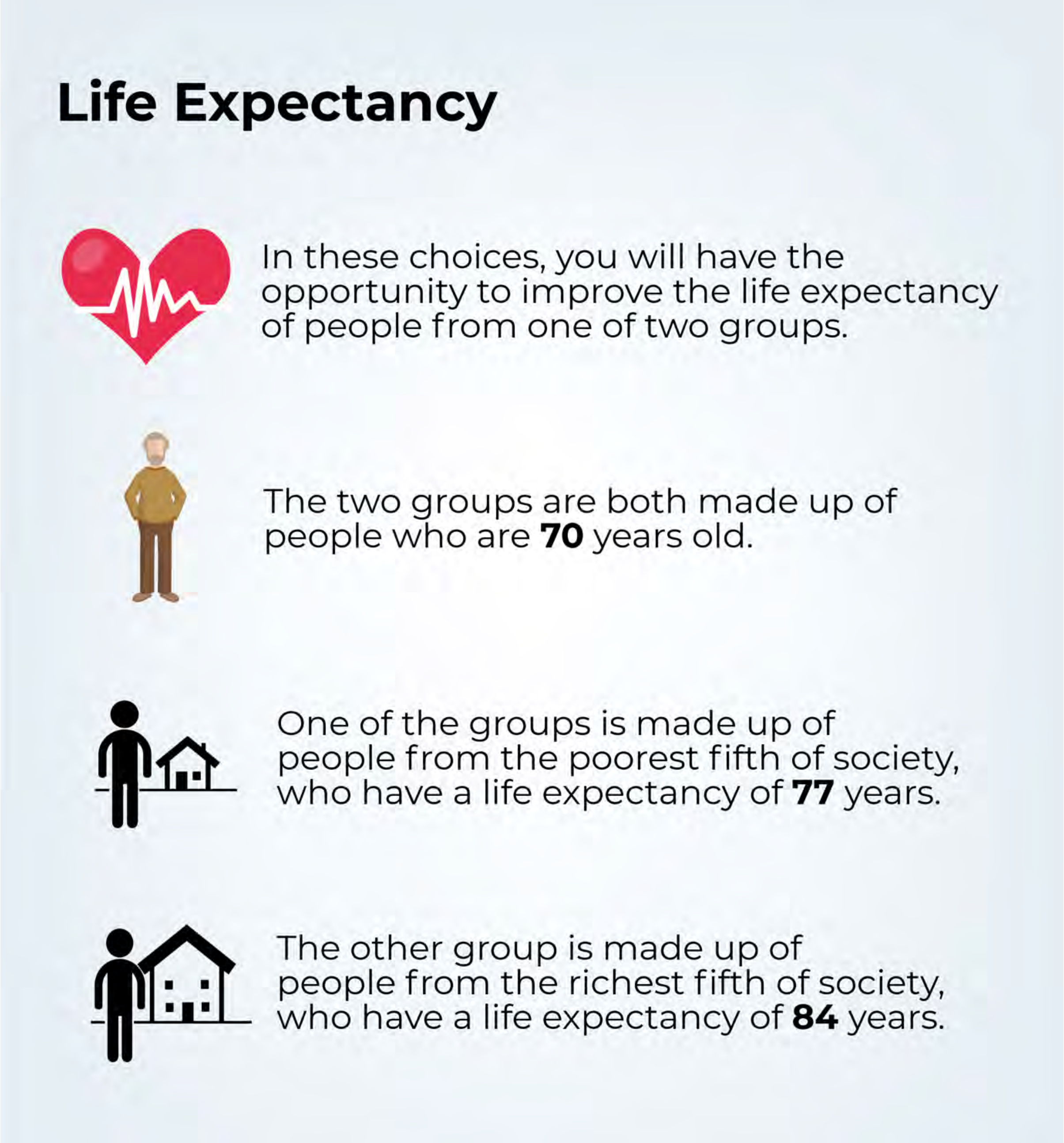
People who are in the richest fifth of society can expect to live until they are **84** years old.

This means there is a **7** year gap in life expectancy between these two groups.

Note that, in comparison to Chapter 4, the term “inequality” was removed from this briefing graphic. This change was made in an attempt to present this information in a more objective manner, as it seemed plausible that some participants may associate the term “inequality” with injustice. Whilst my intent here was to make the briefing more objective, in retrospect, using the title “Poorer and richer people” may have primed respondents to be even more inequality averse, at it emphasises the material differences between the groups. As a consequence, this revised briefing may not have been as objective as I intended.

Chapter 5 – Study materials

Socioeconomic arm: Life-expectancy exercise briefing 1



Life Expectancy

In these choices, you will have the opportunity to improve the life expectancy of people from one of two groups.

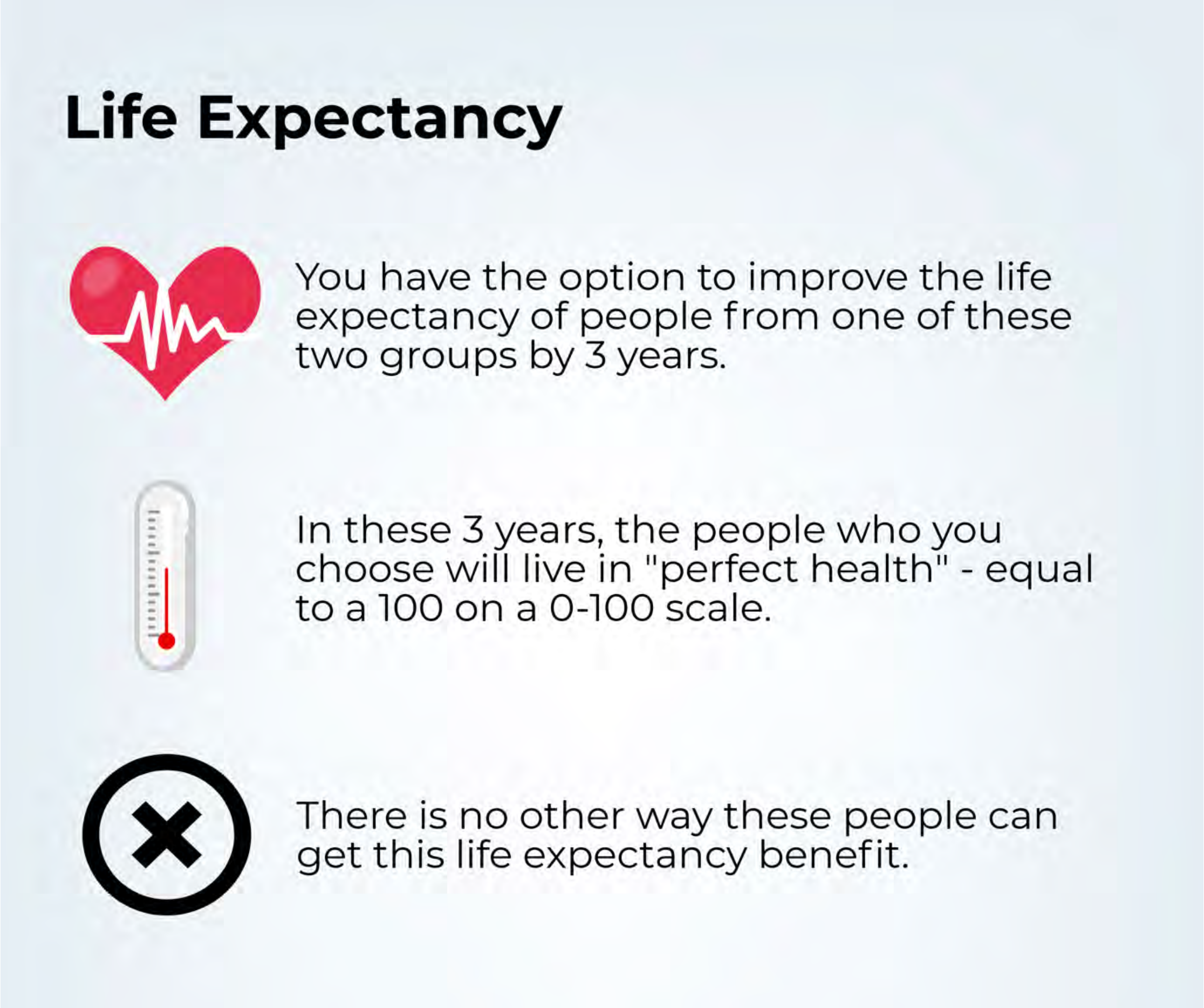
The two groups are both made up of people who are **70** years old.

One of the groups is made up of people from the poorest fifth of society, who have a life expectancy of **77** years.

The other group is made up of people from the richest fifth of society, who have a life expectancy of **84** years.

Note that in this study, respondents were told the age of people who would benefit from the life-expectancy intervention. In the pilot (Chapter 4) this was not the case. In addition, it should be noted an image of a male was presented alongside this information. In the study reported in the subsequent chapter (Chapter 6), this was revised to include an image of a male and a female. It is possible that the use of an image of a male may have prompted participants to respond differently to how they might have had an image of a female, or both a male and female been used. However, it is unclear what the impact of this may have been.

Socioeconomic arm: Life-expectancy exercise briefing 2



Life Expectancy

You have the option to improve the life expectancy of people from one of these two groups by 3 years.

In these 3 years, the people who you choose will live in "perfect health" - equal to a 100 on a 0-100 scale.

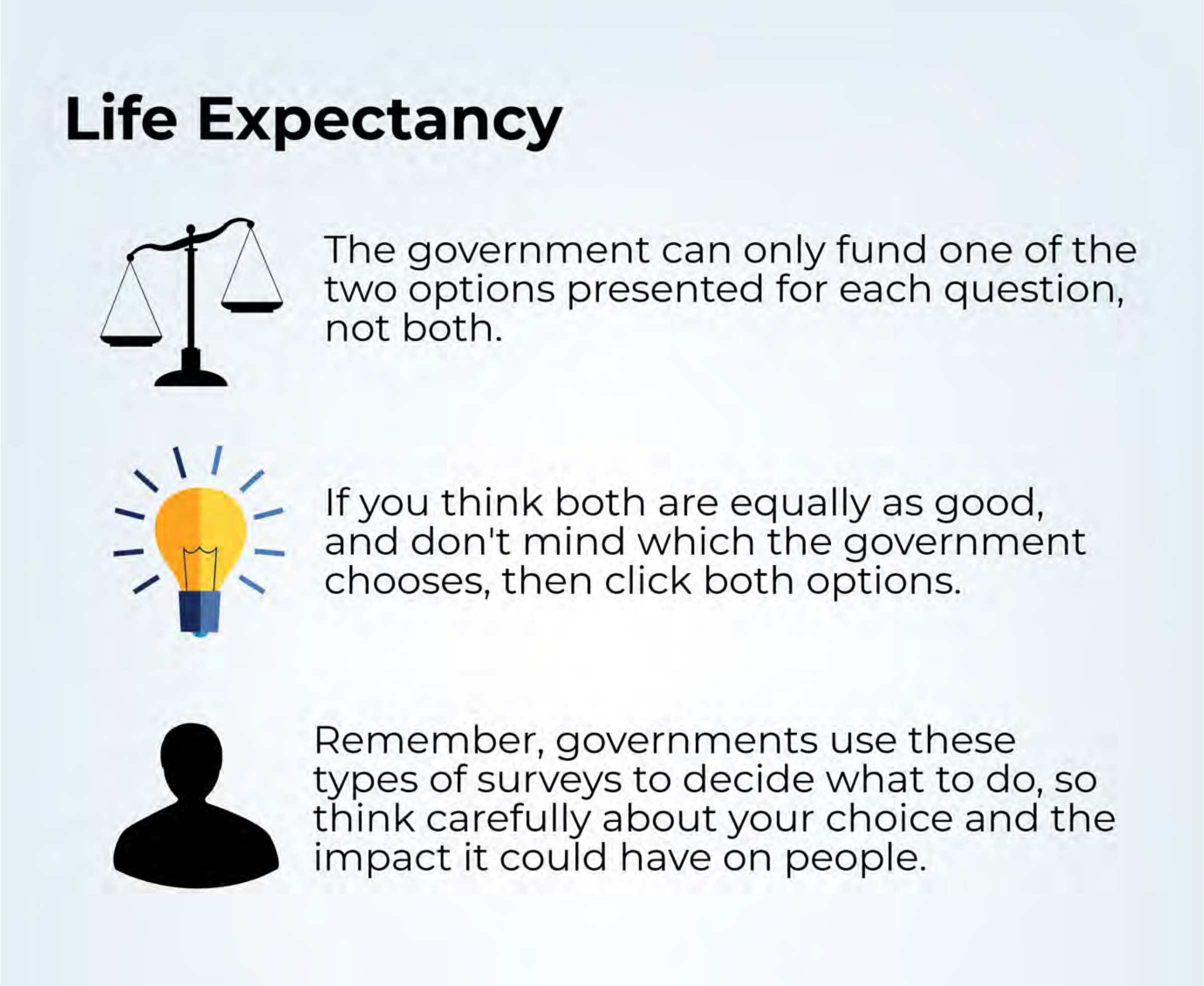
There is no other way these people can get this life expectancy benefit.

Note that in this study, respondents were explicitly told there was no other way the benefits of the intervention could be obtained This was added following the pilot. In addition, the interviewer guide further clarified that it was not possible to get the benefit of the intervention through private healthcare. Extract from interviewer guide “frequently asked questions” provided below:

QUESTION: Can the people get the health benefit through private healthcare? (e.g. private pain relief)

ANSWER: No. The only way they can get this benefit is from the government. There is no way they can get it privately. (If the question is about private pain relief) – There is no other way they relieve this pain, no painkiller you can buy privately would reduce it.

Socioeconomic arm: Life-expectancy exercise briefing 3



Life Expectancy

The government can only fund one of the two options presented for each question, not both.

If you think both are equally as good, and don't mind which the government chooses, then click both options.

Remember, governments use these types of surveys to decide what to do, so think carefully about your choice and the impact it could have on people.

Socioeconomic arm: Mobility exercise briefing 1

Problems in walking about

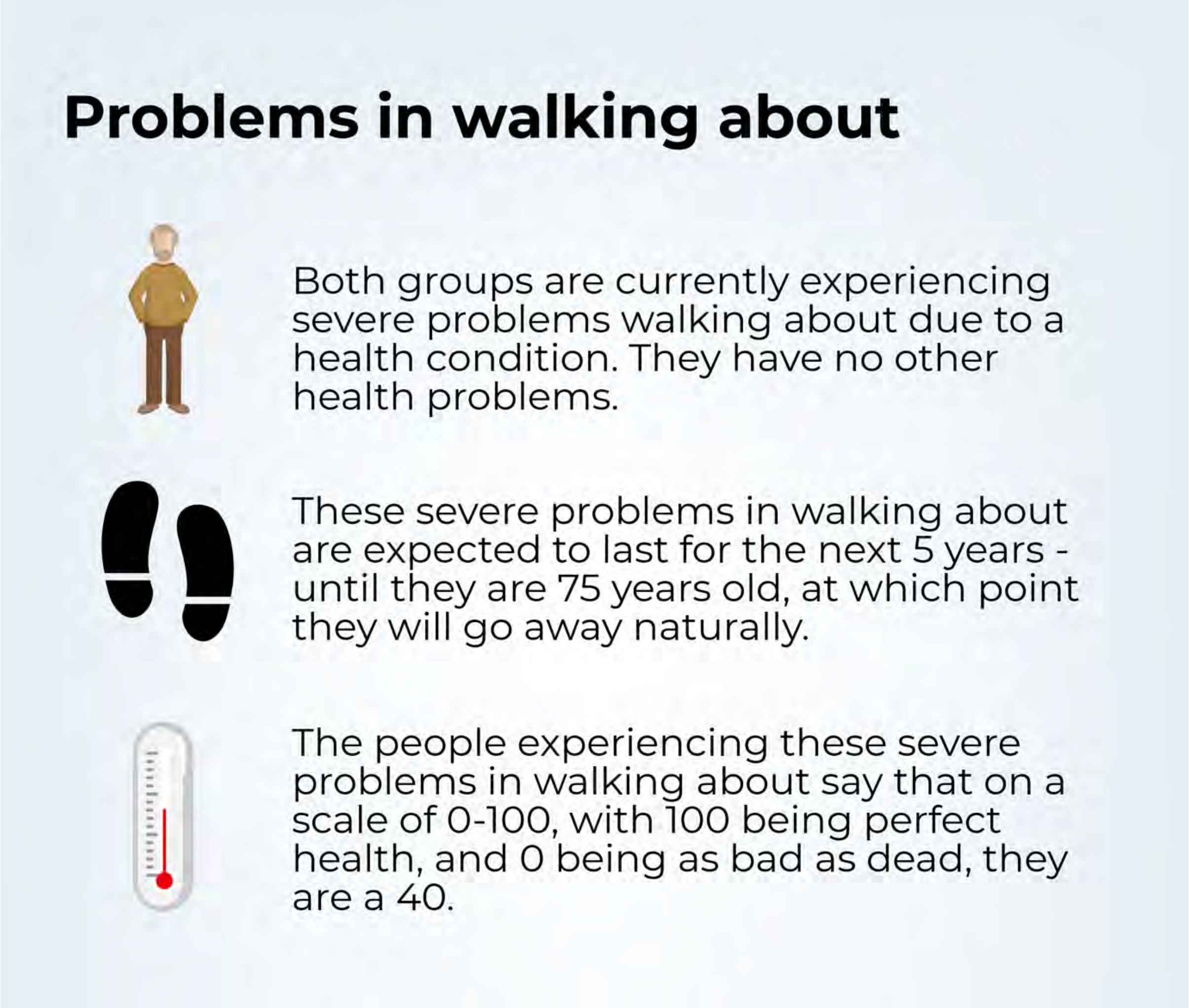
In these choices, you will have the opportunity to improve the walking problems of people from one of two groups.

The two groups are both made up of people who are **70** years old.

One of the groups is made up of people from the poorest fifth of society, who have a life expectancy of **77** years.

The other group is made up of people from the richest fifth of society, who have a life expectancy of **84** years.

Socioeconomic arm: Mobility exercise briefing 2



Problems in walking about

Both groups are currently experiencing severe problems walking about due to a health condition. They have no other health problems.

These severe problems in walking about are expected to last for the next 5 years - until they are 75 years old, at which point they will go away naturally.

The people experiencing these severe problems in walking about say that on a scale of 0-100, with 100 being perfect health, and 0 being as bad as dead, they are a 40.

Socioeconomic arm: Mobility exercise briefing 3

Problems in walking about

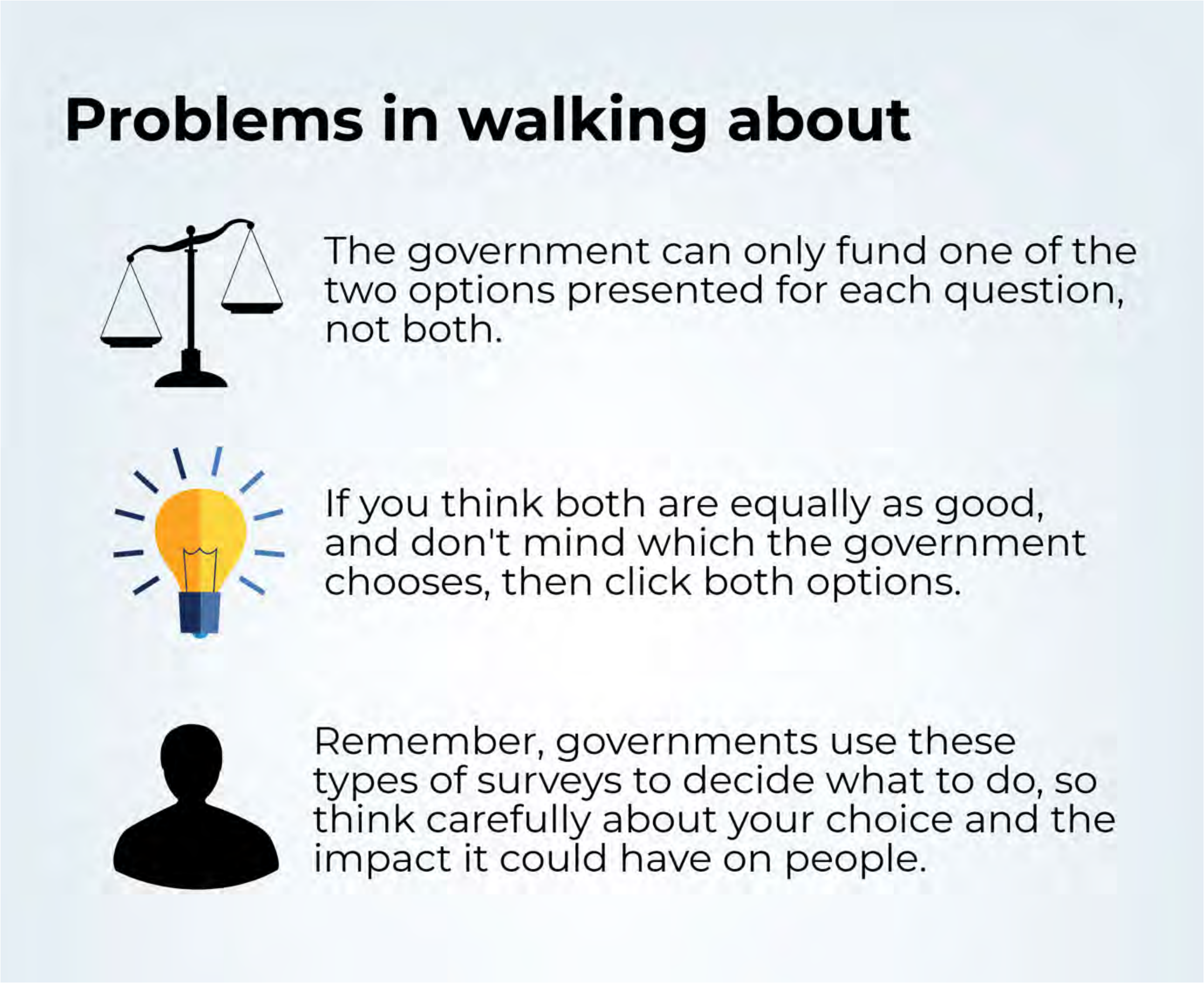
You have the option to completely relieve the severe problems in walking about of people from either the richest or poorest fifth of society.

This will increase the health of the people who you choose to "perfect health" - equal to a 100 on a 0-100 scale, for those 5 years.

It won't change the life expectancy of those that receive it.

There is no other way these people can improve their walking.

Socioeconomic arm: Mobility exercise briefing 4



Problems in walking about

The government can only fund one of the two options presented for each question, not both.

If you think both are equally as good, and don't mind which the government chooses, then click both options.

Remember, governments use these types of surveys to decide what to do, so think carefully about your choice and the impact it could have on people.

Socioeconomic arm: Pain exercise briefing 1

Pain

In these choices, you will have the opportunity to relieve the pain of people from one of two groups.

The two groups are both made up of people who are **70** years old.

One of the groups is made up of people from the poorest fifth of society, who have a life expectancy of **77** years.

The other group is made up of people from the richest fifth of society, who have a life expectancy of **84** years.

Socioeconomic arm: Pain exercise briefing 2

Pain

Both groups are currently experiencing severe pain due to a health condition. They have no other health problems.

This pain is expected to last for the next 5 years - until they are 75 years old, at which point it will go away naturally.

The people experiencing the pain say that on a scale of 0-100, with 100 being perfect health, and 0 being as bad as dead, they are a 40.

Socioeconomic arm: Pain exercise briefing 3

Pain

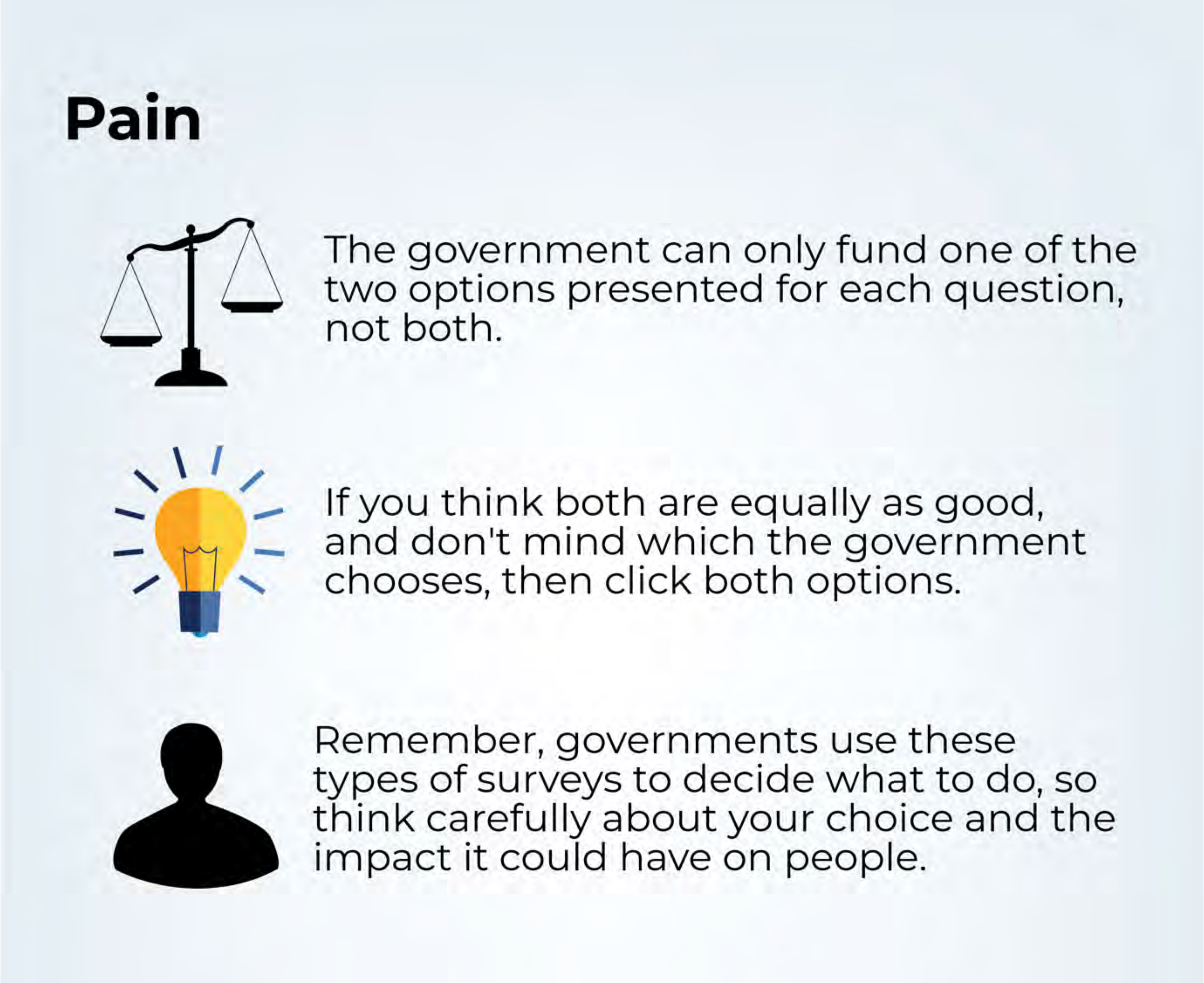
You have the option to completely relieve the pain of people from either the richest or poorest fifth of society.

This will increase the health of the people who you choose to "perfect health" - equal to a 100 on a 0-100 scale, for those 5 years.

It won't change the life expectancy of those that receive it.

There is no other way these people can relieve their pain.

Socioeconomic arm: Pain exercise briefing 4



Pain

The government can only fund one of the two options presented for each question, not both.

If you think both are equally as good, and don't mind which the government chooses, then click both options.

Remember, governments use these types of surveys to decide what to do, so think carefully about your choice and the impact it could have on people.

APPENDIX A5.5. Face-to-face study rationale for choice statements

Chapter 5: Rationale for choice (RFC) statements

This document provides each of the RFC statements used in the study reported in Chapter 5. These are first provided for the socioeconomic arm, and then the neutral arm. For each RFC, the database variable name is provided. The text shown to participants for each rationale is then presented below.

1. Socioeconomic arm (43 total RFCs)

1.1. Socioeconomic arm, life-expectancy exercise: *(15 RFCs)*

SES_LE_ RFC_1

Extra years of life are extra years of life, it shouldn't matter whether you are richer or poorer, the government should treat you the same.

SES_LE_ RFC_2

It is better to help the poorer people, because I like poorer people more than richer people.

SES_LE_ RFC_3

It is better to help the richer people, because they contribute a lot to the economy.

SES_LE_ RFC_4

It is better to help the richer people, because poorer people cost the government a lot of money.

SES_LE_ RFC_5

It is better to help the poorer people, because they have lower life-expectancy (77 years vs 84 years).

SES_LE_ RFC_6

It is better to help the poorer people, because it is unfair that poorer people have a shorter life expectancy.

SES_LE_ RFC_7

It is better to help the poorer people, because they have less money than the richer people.

SES_LE_ RFC_8

It is better to help the poorer people, because they have less years of life left (7 years vs 14 years).

SES_LE_ RFC_9

It is better to help the poorer people, because even with the extra 3 years they still have a shorter life expectancy (80 years vs 84 years).

SES_LE_ RFC_10

It is better to help the poorer people, because the richer people could get the life expectancy benefit through private healthcare.

SES_LE_ RFC_11

It is better to help the poorer people, because poorer people are disadvantaged in many other ways in their life.

SES_LE_ RFC_12

It is better to help the poorer people, because the quality of life of someone in perfect health at age 77 would be higher than that of someone in perfect health at age 84.

SES_LE_ RFC_13

Extra years of life are extra years of life, it shouldn't matter what your life expectancy is, the government should treat you the same.

SES_LE_ RFC_14

It is better to help the poorer people, because the richer people already have a long life expectancy.

SES_LE_ RFC_15

When there are different numbers of people who could benefit in each group, it is better to choose the larger group.

1.2. Socioeconomic arm, pain-relief exercise: *(14 RFCs).*

SES_PAIN_ RFC_1

Pain is pain, it shouldn't matter what your life expectancy is, the government should treat you the same.

SES_PAIN_ RFC_2

It is better to help the poorer people, because I like poorer people more than richer people.

SES_PAIN_ RFC_3

It is better to help the richer people, because they contribute a lot to the economy.

SES_PAIN_ RFC_4

It is better to help the richer people, because poorer people cost the government a lot of money.

SES_PAIN_ RFC_5

It is better to help the poorer people, because they have lower life-expectancy (77 years vs 84 years).

SES_PAIN_ RFC_6

It is better to help the poorer people, because it is unfair that poorer people have a shorter life expectancy.

SES_PAIN_ RFC_7

It is better to help the poorer people, because they have less money than the richer people.

SES_PAIN_ RFC_8

It is better to help the poorer people, because they have less years of life left (7 years vs 14 years).

SES_PAIN_ RFC_9

It is better to help the poorer people, because they have less years of pain free life left (2 years vs 7 years)

SES_PAIN_ RFC_10

Pain is pain, it shouldn't matter whether you are richer or poorer, the government should treat you the same.

SES_PAIN_ RFC_11

It is better to help the poorer people, because the richer people could get pain relief through private healthcare.

SES_PAIN_ RFC_12

It is better to help the poorer people, because poorer people are disadvantaged in many other ways in life.

SES_PAIN_ RFC_13

It is better to help the poorer people, because richer people could use their money to distract them from their pain.

SES_PAIN_ RFC_14

When there are different numbers of people who could benefit in each group, it is better to choose the larger group.

1.3. Socioeconomic arm, mobility exercise: ***(14 RFCs).***

SES_MOB_ RFC_1

Walking problems are walking problems, it shouldn't matter what your life expectancy is, the government should treat you the same.

SES_MOB_ RFC_2

It is better to help the poorer people, because I like poorer people more than richer people.

SES_MOB_ RFC_3

It is better to help the richer people, because they contribute a lot to the economy.

SES_MOB_ RFC_4

It is better to help the richer people, because poorer people cost the government a lot of money.

SES_MOB_ RFC_5

It is better to help the poorer people, because they have lower life-expectancy (77 years vs 84 years).

SES_MOB_ RFC_6

It is better to help the poorer people, because it is unfair that poorer people have a shorter life expectancy.

SES_MOB_ RFC_7

It is better to help the poorer people, because they have less money than the richer people.

SES_MOB_ RFC_8

It is better to help the poorer people, because they have less years of life left (7 years vs 14 years).

SES_MOB_ RFC_9

It is better to help the poorer people, because they have less years of life without walking problems left (2 years vs 7 years).

SES_MOB_ RFC_10

It is better to help the poorer people, because the richer people could improve their walking problems through private healthcare.

SES_MOB_ RFC_11

It is better to help the poorer people, because poorer people are disadvantaged in many other ways in their life.

SES_MOB_ RFC_12

It is better to help the poorer people, because richer people could use their money to find other ways of getting around (e.g. buying a mobility scooter).

SES_MOB_ RFC_13

Walking problems are walking problems, it shouldn't matter whether you are richer or poorer, the government should treat you the same.

SES_MOB_ RFC_14

When there are different numbers of people who could benefit in each group, it is better to choose the larger group.

2. Neutral arm (20 total RFCs)

2.1. Neutral arm, life-expectancy exercise: *(8 RFCs)*

NEU_LE_RFC_1

Three extra years of life are three extra years of life, it shouldn't matter if you have a shorter or a longer life expectancy, the government should treat you the same.

NEU_LE_RFC_2

It is better to help the people with Disease A, because they have lower life-expectancy (77 years vs 84 years).

NEU_LE_RFC_3

It is better to help the people with Disease A, because it is unfair that people with Disease A have a shorter life expectancy.

NEU_LE_RFC_4

When there are different numbers of people who could benefit in each group, it is better to choose the larger group.

NEU_LE_RFC_5

It is better to help the people with Disease A, because they have less years of life left (7 years vs 14 years).

NEU_LE_RFC_6

It is better to help the people with Disease A, because even with the extra 3 years they still have a shorter life expectancy (80 years vs 84 years).

NEU_LE_RFC_7

It is better to help the people with Disease A, because the quality of life of someone in perfect health at age 77 would be higher than that of someone in perfect health at age 84.

NEU_LE_RFC_8

It is better to help the people with Disease A, because the people with Disease B already have a long life expectancy.

2.2. Neutral arm, pain-relief exercise: *(6 RFCs)*

NEU_PAIN_RFC_1

It is better to help the people with Disease A, because it is unfair that people with Disease A have a shorter life expectancy.

NEU_PAIN_RFC_2

It is better to help the people with Disease A, because they have less years of pain free life left (2 years vs 7 years)

NEU_PAIN_RFC_3

It is better to help the people with Disease A, because they have less years of life left (7 years vs 14 years).

NEU_PAIN_RFC_4

Five years of pain is five years of pain, it shouldn't matter if you have a lower life expectancy or a higher life expectancy, the government should treat you the same.

NEU_PAIN_RFC_5

It is better to help the people with Disease A, because they have lower life-expectancy (77 years vs 84 years).

NEU_PAIN_RFC_6

When there are different numbers of people who could benefit in each group, it is better to choose the larger group.

2.3. Neutral arm, mobility exercise: *(6 RFCs)*

NEU_MOB_RFC_1

It is better to help the people with Disease A, because it is unfair that people with Disease A have a shorter life expectancy.

NEU_MOB_RFC_2

It is better to help the people with Disease A, because they have less years of life left (7 years vs 14 years).

NEU_MOB_RFC_3

It is better to help the people with Disease A, because they have less years of life without walking problems left (2 years vs 7 years).

NEU_MOB_RFC_4

Five years of problems walking is five years of problems walking, it shouldn't matter if you have a lower life expectancy or a higher life expectancy, the government should treat you the same.

NEU_MOB_RFC_5

It is better to help the people with Disease A, because they have lower life-expectancy (77 years vs 84 years).

NEU_MOB_RFC_6

When there are different numbers of people who could benefit in each group, it is better to choose the larger group.

Chapter 6: Online fielding

This chapter details the fielding of an online PTO study designed to test Hypothesis B of this thesis: the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health if an intervention improves life-expectancy than they are if it improves quality-of-life. Just over 1,500 members of the UK-public participated.

Hypothesis A (group types) was not tested in this study. This is because, at the time of designing the study, the evidence in support of Hypothesis A provided by McNamara et al. (2020b) (the study detailed in Chapter 5) appeared compelling[1]. As a result, this study was focused on Hypothesis B (health gain types).

This chapter is primarily presented in the form of a manuscript: "Does the UK-public's aversion to inequalities in health differ by group-labelling and health-gain type? A choice-experiment" (McNamara, Tsuchiya, & Holmes, 2020c).

Following the paper, I provide three appendices. The first (A6.1) provides the online appendix associated with the manuscript. The second (A6.2) clarifies the contribution this chapter makes to the thesis as a whole. The third (A6.3) provides further detail on the briefings participants received.

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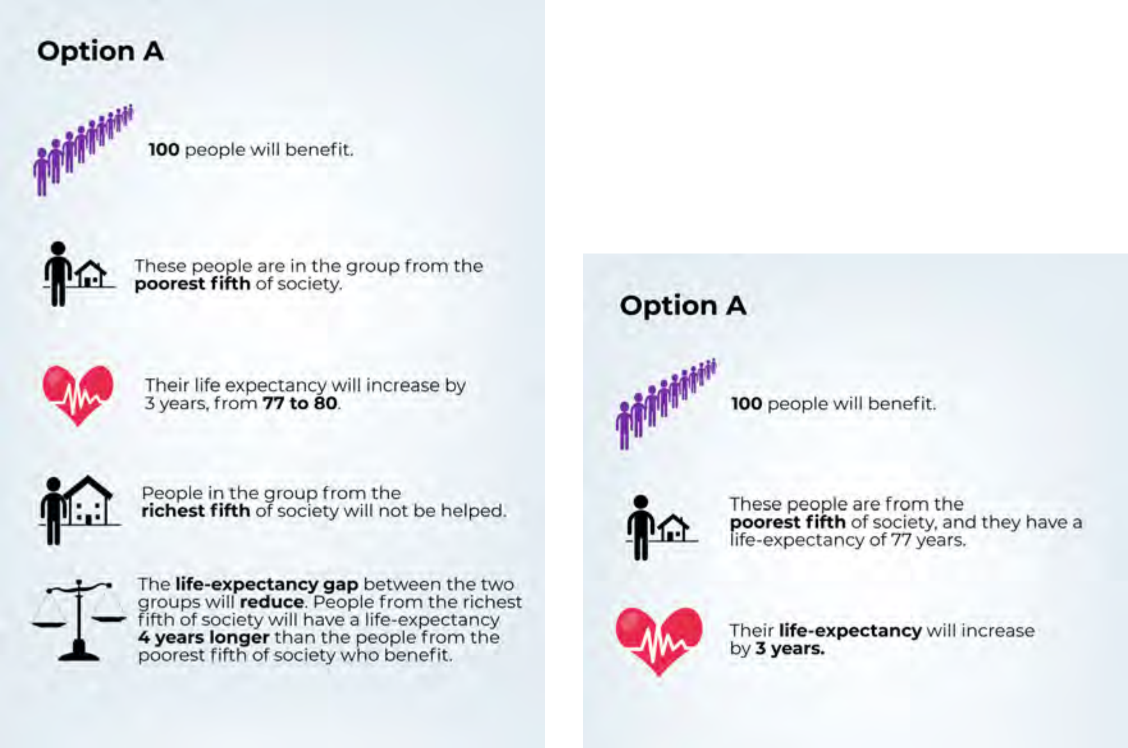
[1] Note this decision was made prior to receiving Social Science and Medicine peer reviewer comments on an earlier version of the manuscript detailed in Chapter 5. The limitations identified by the reviewers reduced my confidence in the strength of this evidence. If I had been aware of these issues when deciding how to design the study detailed in this chapter, I may have considered testing Hypothesis A (group types) further in this study. These limitations are discussed in Chapter 5.

The PTO design detailed in this chapter differs from that applied in Chapter 5 in four ways. First, there was no "neutral" arm. This is because Hypothesis B is restricted to socioeconomic groups, and Hypothesis A was not designed to be tested in the study. Subsequently, a neutral arm was not required. Second, nine quality-of-life types were tested, rather than two. This was designed to provide insight into whether Hypothesis B (group types) holds across a broader range of quality-of-life types. Third, two magnitudes of QALY gain were tested: a 3 QALY gain and a 0.5 QALY gain. This was designed to test Hypothesis B using two different QALY-gain sizes. Fourth, the information presented to participants in the choices sets was simplified. This was done in an attempt to maintain participant engagement when they were responding online. Figure 6.1, below, compares an "Option A" (pro-poor intervention) from Chapter 5 (*left*) to the equivalent one from this chapter (*right*).

Figure 6.1: *A comparison of a Chapter 5 socioeconomic group "Option A" (left) and one used in Chapter 6 (right)*



Option A

100 people will benefit.

These people are in the group from the **poorest fifth** of society.

Their life expectancy will increase by 3 years, from **77 to 80**.

People in the group from the **richest fifth** of society will not be helped.

The **life-expectancy gap** between the two groups will **reduce**. People from the richest fifth of society will have a life-expectancy **4 years longer** than the people from the poorest fifth of society who benefit.

Option A

100 people will benefit.

These people are from the **poorest fifth** of society, and they have a life-expectancy of 77 years.

Their **life-expectancy** will increase by **3 years.**

As per the studies detailed in Chapters 4, and 5, respondents were told about an inequality in life-expectancy between the two socioeconomic groups. They were not informed about any inequalities in lifetime quality-of-life. Following analysis of the studies detailed in the prior two chapters, I initially planned to brief participants in this study about inequalities in quality-of-life. However, I opted to restrict the briefing to inequalities in life-expectancy, and instead leave exploring the impact of providing information on inequalities in quality-of-life for future studies. The implications of this decision are discussed further in McNamara et al. (2020c), Appendix 6.2. and Chapter 7.

Authorship statement

The McNamara et al. (2020c) paper was written with two co-authors: Aki Tsuchiya and John Holmes. A “CRediT” author statement (Elsevier, 2020) for this paper is provided below:

Simon McNamara: Conceptualization, Methodology, Software, Investigation, Formal analysis, Data curation, Writing - Original draft preparation, Project administration, Funding acquisition. **Aki Tsuchiya**: Supervision, Writing - Reviewing and Editing, Funding acquisition. **John Holmes**: Supervision, Writing - Reviewing and Editing.

I am the sole author of the second and third appendices.

6.1. McNamara et al. (2020c)

RESEARCH ARTICLE
Chapter 6

Does the UK-public's willingness to prioritise disadvantaged socioeconomic groups differ by type of health-gain? A person-trade-off study.

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Funding information
This work was supported by the EuroQol Research Foundation [2010840], the Wellcome Trust Doctoral Training Centre in Public Health Economics and Decision Science [108903/Z/19/Z], and the University of Sheffield.

Abstract
Distributional cost-effectiveness analysis (DCEA) is a new form of CEA which enables economists to capture the impacts of interventions on inequalities in health between social groups. Existing QALY-based variants of DCEA treat all incremental QALYs in the same way, irrespective of whether they are made up of life-expectancy gains or quality-of-life gains. We conducted an online choice-experiment to test whether this approach is consistent with the preferences of the public. We hypothesised that the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health if an intervention improves life-expectancy rather than if it improves quality-of-life. Just over 1,500 members of the UK-public participated. Respondents were randomised to pairwise person-trade-off questions about hypothetical interventions that would provide one of ten health-gain-types, including life-expectancy or different quality-of-life dimensions. The sample were willing to prioritise disadvantaged groups with lower lifetime health for all tested health-gain types; however, they were more willing to do so for interventions that improve life-expectancy rather than quality-of-life. The preferences of the UK-public may not be consistent with DCEAs that treat all types of QALY gains equally.

1 | INTRODUCTION

Socioeconomic status is a predictor of lifetime health. If you are poor, on average, you can expect to live a shorter life than if you were rich [1]. You can also expect to experience more health problems in your life [2], and to report lower self-assessed health [3]. In many countries, these "socioeconomic inequalities in health" are significant [1]. For example, people who live in the most deprived fifth of neighbourhoods in England have a quality-adjusted life-expectancy 11.87 quality-adjusted-life-years (QALYs) lower than people who live in the least deprived fifth of neighbourhoods [4]. Health policy-makers in the UK have stated that they want to reduce socioeconomic inequalities in health [5, 6, 7, 8]. In contrast, economic evaluations in the UK do not, typically, model or value the distributional consequences of health-related interventions [9].

Distributional Cost-Effectiveness Analysis (DCEA) [10] is a form of cost-effectiveness analysis that allows economists to formally capture the impact of interventions upon inequalities in health. It does this by: (1) modelling the net impact of interventions on the quality-adjusted life-expectancy of different social groups; and (2) explicitly and transparently aggregating the outcomes achieved by those groups using a health-related social welfare function (HRSWF) [11] [12]. Whilst conventional CEA applies an additive HRSWF founded on the normative judgement that our social aim is QALY-maximisation, DCEAs can use alternative HRSWFs. For example, those that reflect the public's aversion to inequalities in health [13].

To date, two QALY-based forms of HRSWF have been applied in DCEA [14, 10, 15]: one based on the Atkinson social welfare function [16], and one based on the Kolm social welfare function [17]. These QALY-based HRSWFs are "naïve" to the type of health-gain an intervention provides: they assume society gives equal priority to health gains provided to groups with lower lifetime health independently of whether that gain takes the form of an increase in life-expectancy or relief of quality-of-life problems. Whilst stated preference studies from the UK [13, 18], Spain [19, 20], Australia [21] and Canada [22] provide evidence that the public in these countries are averse to socioeconomic inequalities in health, these studies have, primarily, utilised choice-experiments in which participants were asked to make choices between hypothetical scenarios that varied the life-expectancy[1] of different socioeconomic groups. Relatively little attention has been paid to quality-of-life [18]. In particular, no study has explored whether the public's preferences regarding the prioritisation of different socioeconomic groups are consistent with use of a HRSWF that is naïve to the type of health-gain an intervention provides.

This is potentially an important omission, as evidence suggests that, independently of any concern for inequality, the public may value QALYs provided to others differently depending on how they are composed. For example, Shah, Tsuchiya Wailoo [26] conducted a discrete choice experiment (DCE), and found evidence that, for both people at the end-of-life and otherwise, the UK-public may prefer QALY-gains that are attributable to improvements in quality-of-life, rather than life-expectancy. Most recently, Lancsar et al. [27] conducted a DCE in a sample of the Australian public, and found no statistically significant differences between respondents' valuations of QALYs that were the result of gains in solely life-expectancy or quality-of-life; although QALY gains that were the product of a combination of the two were valued more highly than both in isolation. While these findings are mixed, they suggest that the preferences of the public may not be consistent with the use of the QALY-based additive HRSWF applied in traditional CEA. This issue has yet to be explored in the context of socioeconomic inequalities in health, and the QALY-based HRSWFs applied in DCEA.

We hypothesise that the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health for interventions that improve life-expectancy, rather than for those that improve quality-of-life problems. In contrast to the idea that all QALY-types are the same, we think that decisions about interventions that have potential to relieve suffering are likely to prompt the public to experience stronger instinctive negative emotional reactions to the idea of favouring poorer people over richer people than questions about interventions that would increase life-expectancy. Subsequently, following Haidt's [28] intuitionist model of moral judgement[2], we anticipate that these instinctive reactions are likely to lead to the pub-

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[1] Or variants thereupon. For example, "years in full health (YFH) over the average person's life" [23, 24, 25].

[2] Haidt argues that intuitive reactions to moral problems drive moral judgements. Subsequently, if the public feel a stronger intuitive aversion to the idea of failing to relieve suffering than of failing to increase life-expectancy they are likely to make more efficiency-focused judgements when considering interventions that relieve quality-of-life problems than those that improve life-expectancy.

lic responding in a more “gain-egalitarian” way (gains to all valued equally) [29] for decisions about quality-of-life improving interventions than life-expectancy increasing ones. If preferences were found to differ by health-gain type, this would raise concerns about the democratic legitimacy of DCEAs conducted using existing HRSWFs, and motivate the development of new HRSWFs, and/or alternative forms of distributionally sensitive economic evaluation that can incorporate these preference variations.

In a recent paper, McNamara et al. [18] field a face-to-face pairwise person-trade-off (PTO) choice experiment in a convenience sample of the UK-public (n=80). Participants were asked to make prioritisation decisions about hypothetical interventions that would benefit either: [Option A] a defined number of people from the poorest fifth of society who have a life-expectancy of 77 years, or [Option B] a defined number of people from the richest fifth of society who have a life-expectancy of 84 years. The number of people in the richest fifth of society who would benefit from Option B was systematically varied in response to participant choices, in order to provide a quantitative estimate of their relative willingness to prioritise the two groups. The study involved PTO questions about three health-gain types: gains in life-expectancy, relief of severe pain, and relief of severe mobility problems. Each intervention provided a 3 QALY gain. Participant responses to the life-expectancy questions were compared to those for the two quality-of-life types. The results are consistent with the idea that the UK-public are more willing to prioritise disadvantaged socioeconomic groups over advantaged socioeconomic groups for an intervention that provides a 3-QALY gain via an improvement in life-expectancy, rather than relief of severe pain or severe mobility problems. However, McNamara et al. did not explore whether this finding holds for other quality-of-life types, or whether it holds for other QALY-gain magnitudes. If DCEAs are to reflect the preferences of the public across a broader range of health-gain types, and magnitudes, it would be valuable to know whether or not or not this is the case. In this paper, we report a choice experiment that features a substantially larger number of participants (n=1,502 vs n=80), nine quality-of-life health-benefit types, and two QALY gain magnitudes.

2 | METHODS

2.1 | Study overview

We fielded an online, cross-sectional, pairwise PTO study to test our hypothesis. Figure 1, below, gives an overview of the study design. We randomised respondents evenly to one of ten arms, each focusing on a different health-gain type: improvements in life-expectancy (Type 1); improvements in one of the five dimensions of the EQ-5D descriptive system (mobility, self-care, usual-activities, pain/discomfort, or anxiety/depression; Types 2-6); or improvements in one of the individual elements of the two composite dimensions of the EQ-5D (pain, discomfort, anxiety, or depression; Types 7-10) [30]. Participants completed two PTO exercises about interventions that would provide the health-benefit type they had been randomised to. One was about an intervention that would provide a 3 QALY gain to each person who benefited from it. In the quality-of-life arms this was the result of relief of severe quality-of-life problems, and in the life-expectancy arm it was the results of a 3-year increase in life-expectancy. The other was about an intervention that would provide a 0.5 QALY gain to each person who benefited from it. This was the result of relief of slight quality-of-life problems, or a 0.5-year increase in life-expectancy. We tested two different QALY-gain magnitudes in order to explore whether our hypothesis held independently of whether the intervention provided a small (0.5 QALY) or moderate (3 QALY) gain. The order of the two exercises was randomised.

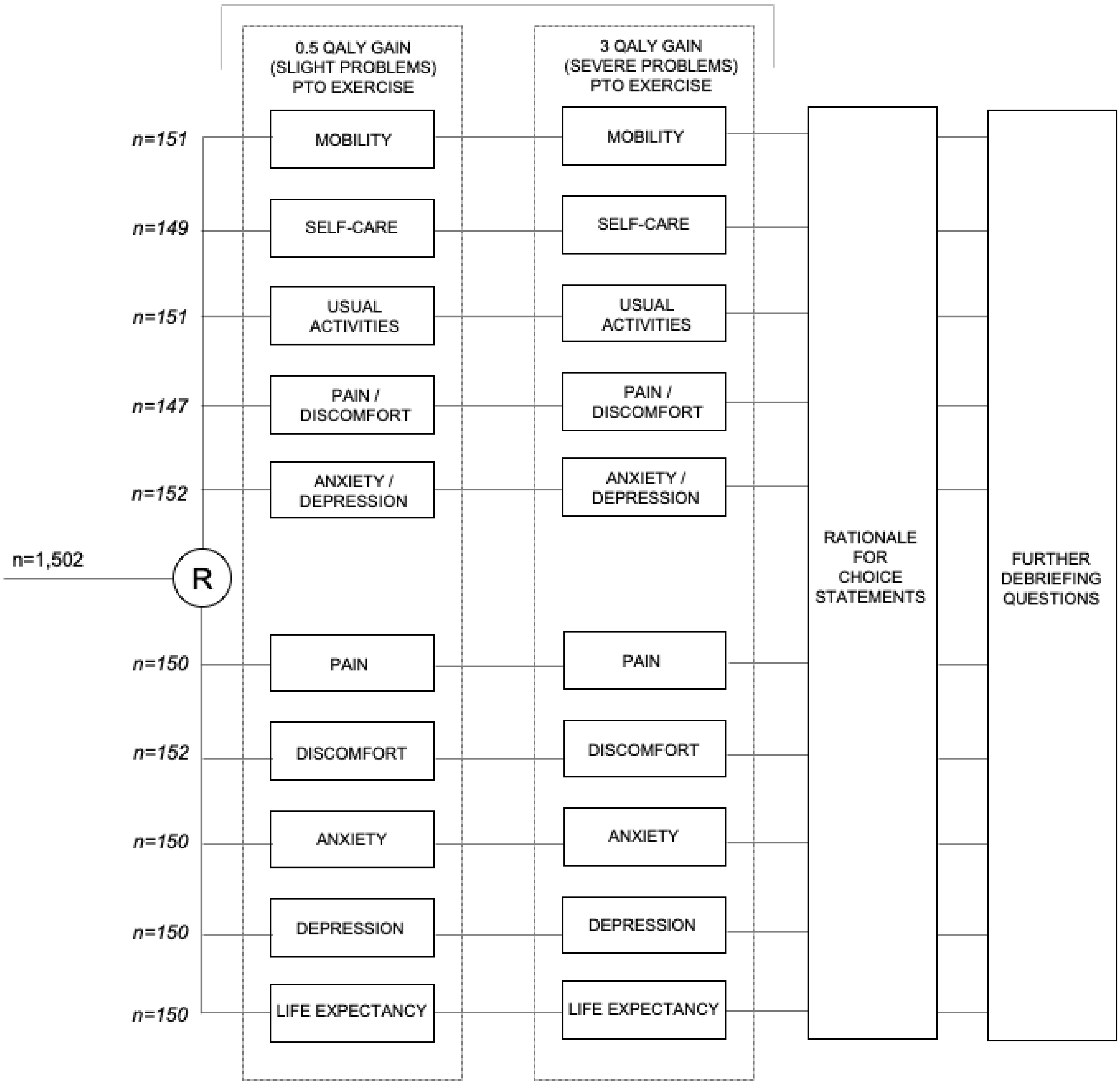

FIGURE 1 Study design.

In all exercises, we asked participants to make choices between pairs of policy options that benefited either people from the poorest fifth of society who have a life-expectancy of 77 years; or, people from the richest fifth of society who have a life-expectancy of 84 years. We tested our hypothesis by comparing PTO results in the life-expectancy arm with those in the nine quality-of-life arms (a between-persons comparison). This was done discretely for each of the nine quality-of-life types and the two QALY-gain magnitudes, giving 18 comparisons in total. The PTO briefing, choices, and protocol were extensively piloted. Further information on the PTO exercises and testing procedure is provided in Section 2.3 below.

Following their second PTO exercise, participants were asked to indicate the rationale for their choices in that second exercise. This was done through eight "rationale for choice statements". Respondents were asked to select those statements that explained why they made the choices they did. We then compared the selected statements across study arms in order to provide insight into why the public's preference may differ by health-gain type. Further detail on the rationale for choice statements is provided in Section 2.6 below. Subsequently, participants were asked two further sets of debriefing questions, the results of which will be reported elsewhere. The study was programmed in, and hosted online by, Qualtrics. Study graphics were developed in Piktochart.

2.2 | Pairwise PTO exercises

Participants were informed that on average, poorer people in the UK live shorter lives than richer people and that people from the poorest fifth of society can expect to live until they are 77 years old, while people from the richest fifth can expect to live until they are 84 years old [4]. They were then told to imagine that they were a minister in the government, and that they had been asked to make choices between pairs of policy options that would impact the health of different people in society. Below, we explain the PTO protocol for the 3 QALY gain using the pain arm as an example. We then detail how this task differed in the remaining eight quality-of-life arms and in the life-expectancy arm. Subsequently, we explain how the 0.5 QALY gain exercises differed.

The policy options that provided a 3-QALY gain via relief of severe pain.

Participants were informed the people who would benefit from the intervention are 70 years old, and that they have a health condition. As a result of this health condition they are in severe pain. The people with the pain rate their quality-of-life as being a 40 on a scale from 0-100, with 100 being perfect health, and 0 being as bad as dead. Without the intervention, they will experience this severe pain for the next 5 years, at which point it will go away, whereas the intervention provides complete relief from this pain for the next 5 years leaving them in perfect health (100 out of 100). This amounts to a 3 QALY benefit (a 0.6 utility gain for 5 years), although participants were not told this.

We stated that some of the people with the health problem were from the poorest fifth of society with a life-expectancy of 77 years, while some were from the richest fifth of society with a life-expectancy of 84 years. The government could fund one of the two policy options presented for each question, but not both; however, if the participant felt both options were equally as good and did not mind which the government chose they could express this. We clarified that there was no other way the people could get relief from their severe pain.

The first question in each PTO exercise presented a choice between an intervention that would benefit 100 people from the richest fifth of society of 100 people from the poorest fifth of society, and asked "which option should the government choose?". Figure 2, below, demonstrates how this initial choice was presented.

If a respondent said they were indifferent between the options, they continued to the next part of the study. If they chose one of the two, the number of people from the richest fifth of society who would benefit was changed. If a participant chose Option A (the option that benefited the people from the poorest fifth of society), we increased the number of people in the richer group who would benefit from Option B by 100 (e.g. to 200 following the initial question). If a participant chose the option that benefited Option B (the people from the richest fifth of society), we reduced the number of people in the richer group who would benefit from this option by 50 (e.g. to 50 following the initial question). Respondents were then asked to choose between the revised interventions.

We continued this systematic variation until a participant either: expressed indifference between two options; went beyond the range tested in the study (more than 1000 people, or less than 50 people, in the richer group); or could be inferred as being indifferent between two of the options presented because they reached the lowest level of resolution tested in the study[3]. If a participant gave an “off the scale” response, their PTO indifference point was recorded as >1000 or <50 depending on whether they were off the scale pro-poor (>1000) or pro-rich (<50). Throughout the choice sets, we fixed the number of people who would benefit from Option A (the intervention that helped people from the poorest fifth of society) at 100.

The policy options that provided a 3 QALY gain via relief of other severe quality-of-life problems

The remaining eight quality-of-life arms were as described above, except pain was substituted for the quality-of-life type the participant had been randomised to. Throughout, we described the beneficiaries’ health using text from the relevant dimensions of the EQ-5D-5L instrument (e.g. people in the self-care arm were described as experiencing “severe problems in washing and dressing themselves”) [31]. Examples of the different graphics used for each arm are provided in the Supplementary Online Appendix.

The policy options that provided a 3 QALY gain via an increase in life-expectancy

The life-expectancy policy options improved life-expectancy by 3 years. Respondents were informed that in the extra 3 years provided by the intervention the people who benefited from it would say they were in perfect health (100 out of 100). This equates to a 3 QALY gain (3 additional years of life in perfect health). Figure 3, below, provides an example PTO question for this intervention.

The policy options that provided a 0.5 QALY gain

In the 0.5 QALY gain exercise, we informed participants in the quality-of-life arms that the people with the health condition were experiencing slight quality-of-life problems (e.g. slight pain). As in the 3 QALY gain exercise, these problems were expected to last 5 years. Respondents were told that in these 5 years the people will rate their health as 90 out of 100. The policy option provided complete relief from these slight problems. The people who benefited would report being in perfect health (100) for this period: a 0.5 QALY gain (a 0.1 increase in utility for 5 years). The life-expectancy intervention increased life-expectancy by 6 months. In this period, the people who benefited would say there were in perfect health (100): a 0.5 QALY gain (0.5 additional years of life in perfect health)

2.3 | Quantifying participants’ willingness to prioritise people from the poorest fifth of society over people from the richest fifth of society.

The number of people in the poorer group was fixed at 100 throughout. As a result, the higher the number of people in the richer group when a respondent declares indifference between the two options, the higher their implied willingness to prioritise improvements in the health of poorer people over richer people. Subsequently, we quantified this willingness for each participant using the number of people who selected Option B (the intervention that benefited people from the richer group) when they expressed indifference between two policy options (their “PTO indifference point”). This was done separately for each of the two QALY-gain exercises a participant completed.

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[3] For example, someone who chose an Option B that benefited 400 people from the richest fifth of society over an Option A that benefited 100 people from the poorest fifth of society, and then chose an Option A that benefited 100 people from the poorest fifth of society over a revised Option B that helped 350 people from the richest fifth of society was assumed to have an indifference point of 375 (the midpoint of the two prior values).

Option A

100 people will benefit.

These people are from the **poorest fifth** of society, and they have a life-expectancy of 77 years.

They will receive complete relief from their **severe pain** for **5 years**.

Option B

100 people will benefit.

These people are from the **richest fifth** of society, and they have a life-expectancy of 84 years.

They will receive complete relief from their **severe pain** for **5 years**.

FIGURE 2 The initial PTO question for the 3 QALY gain intervention in the pain arm; which option should the government choose?

Option A

100 people will benefit.

These people are from the **poorest fifth** of society, and they have a life-expectancy of 77 years.

Their **life-expectancy** will increase by **3 years.**

Option B

300 people will benefit.

These people are from the **richest fifth** of society, and they have a life-expectancy of 84 years.

Their **life-expectancy** will increase by **3 years.**

FIGURE 3 An example PTO question for the 3 QALY gain intervention in the life-expectancy arm; which option should the government choose?

2.4 | Comparing across health-gain types

If the public are more willing to prioritise disadvantaged socioeconomic groups over advantaged socioeconomic groups for interventions that improve life-expectancy rather than improve quality-of-life, then for a given QALY-gain magnitude, we would expect participants in the life-expectancy arm to express higher PTO indifference points than participants in the quality-of-life arms. We tested this discretely for each quality-of-life type and QALY-gain magnitude (i.e. we did not pool across quality-of-life types or QALY-gain magnitudes). This was done this using Mann-Whitney U-Tests (non-parametric rank based) for each comparison.

2.5 | Rationale for choice statements

Participants in the quality-of-life arms were shown eight rationale for choice statements. The statements were the same in each arm while the order of the statements was randomised. The eight rationales were: (R1) “It is better to help the poorer people, because on average, poorer people live shorter lives than richer people”; (R2) “It is better to help the poorer people, because the richer people could improve their health through private healthcare”; (R3) “It is better to help the poorer people, because poorer people are disadvantaged in many other ways in life”; (R4) “It is better to help the poorer people, because richer people could use their money to adapt to their health problems”; (R5) “It is better to help the poorer people, because they have less money than richer people”; (R6) “It is better to help the richer people, because richer people contribute more to the economy”; (R7) “When it comes to health, it is equally as good to help poorer people or richer people”; and (R8) “It is better to help the group with more people in it”. R7 was worded to be consistent with “gain-egalitarianism” in health. Participants in the life-expectancy arm were shown seven of the eight rationales: R4 was not presented as it was not applicable. In all arms, we asked respondents to indicate all the statements that explained what they were thinking when they answered their second PTO exercise.

We compared the frequency at which people in the life-expectancy arm and the quality-of-life arms selected the rationales in order to provide insight into why preferences may, or may not, differ by health-gain type.

2.6 | Fielding

We fielded the study between 23rd January 2020 and 25th January 2020. We aimed to recruit a quota sample of 1,500 members of the UK-public using “Prolific”: an online platform that connects researchers with a standing panel of members of the general public who have registered to take part in research studies [32]. Sample quotas were stratified by age, gender, and ethnicity based upon 2011 census data for England and Wales. Respondents were paid £2.50 in return for their participation. At an anticipated completion time of 15 minutes, this equated to an expected payment of £10/hour.

2.7 | Ethics

Ethics approval for the study was granted by the Research Ethics Committee of the School of Health and Related Research at the University of Sheffield (ID: 022496).

3 | RESULTS

3.1 | Participants

In total, 1502 members of the UK-public completed the survey. Participants were representative of the population of England/Wales in 2011 in terms of gender and ethnicity. The sample had a higher mean age (45 compared to 42 in the population) and were more educated (57% had a degree compared to 27% in the population) [33]. Respondents were more likely to intend to vote for a left-of-centre political party (38% for the Labour Party compared to 29% of the population; and 8% for the Green Party compared to 4), and were less likely to intend to vote for a right-of-centre political party (32% for the Conservative Party compared to 49%) [34]. When asked about their subjective richness ("If the number 100 was the richest person in the UK, and the number 0 was the poorest person in the UK, how rich do you think you are?"), only 2% of the sample gave a response that placed themselves in the richest fifth of society. Participants were randomised relatively evenly across the 10 health-gain types. Sample size ranged from 147 of 152 per arm. Further detail on participant characteristics by study arm is provided in the Online Appendix.

3.2 | Person-trade-off results

Figures 4 and 5, below, show the median PTO indifference points by arm for the 3-QALY gain and 0.5 QALY gains exercises. In these graphs, the y-axis shows the proportion of participants that had an indifference point equal to, or larger than, that displayed on the x-axis, and the x-axis shows the number of people from the richest fifth of society who would benefit from the option that favoured this group. As the number of people from the poorest fifth of society was fixed at 100 throughout all the exercises, the x-axis shows the respondents' relative willingness to prioritise the poorer group over the richer group in that exercise. In both exercises the median PTO indifference points in the life-expectancy arm are higher than those in the nine quality-of-life arms. This is consistent with our hypothesis that the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health for interventions that improve life-expectancy, rather than for those that improve quality-of-life.

Table 1, below, details the relative weight the median respondent in each exercise and arm placed on a health-gain provided to a person in the poorest fifth of society compared to a person from the richest fifth of society and the p-values for each Mann-Whitney U-test. For both the 3 QALY and 0.5 QALY exercises, the median respondents in the life-expectancy arm placed a 3:1 weight on improving the health of people from the poorer group relative to improving the health of people from the richer group. In contrast, the median respondents in the nine quality-of-life arms placed weights of >1.25:1 and ≤ 2:1 in favour of the poorer group. The p-values for each Mann Whitney U-test were statistically significant at commonly used α levels (range: <0.001 to 0.036).

3.3 | Rationale for choice responses

The average number of statements selected was 2.4 per participant. This figure was similar across the ten study arms (range: 2.2-2.7).

Comparing rationales across the life-expectancy and quality-of-life arms

Figure 6, below, shows the frequency participants in the life-expectancy and nine quality-of-life arms chose each rationale. In this figure, the purple diagonally striped circles show participant responses in the life-expectancy arm, and the solid grey circles show participant responses in the nine quality-of-life arms. The percentage of respondents in the individual quality-of-life arms who selected each rationale is provided in the Online Appendix.

Participants in the life-expectancy arm were more likely to justify their choice by referring to R1 ("It is better to help the poorer people, because on average, poorer people live shorter lives than richer people"). In total, 59% of respondents in the life-expectancy arm selected this rationale, whilst only 26% to 37% did so in the quality-of-life arms. The p-values for Chi-square tests comparing the frequency this rationale was selected in the life-expectancy arm to each of the quality-of-life arms were all <0.001.

Participants in the quality-of-life arms were more likely to select the gain-egalitarian rationale (R7 "When it comes to health, it is equally as good to help poorer people or richer people") than participants in the life-expectancy arm. In the life-expectancy arm 35% of respondents selected this statement compared to 43% to 57% in the quality-of-life arms. P-values for Chi-square tests comparing the frequency at which this statement was selected in the life-expectancy arm to each quality-of-life arm were <0.01 for mobility, self-care, pain/discomfort, anxiety/depression and pain; 0.01 for discomfort; 0.03 for usual activities; 0.10 for anxiety; and 0.16 for depression. R4 ("It is better to help the poorer people, because richer people could use their money to adapt to their health problems") was not applicable in the life-expectancy arm, but was selected by 30-45% of participants in each of the quality-of-life arms. There were no other substantial differences between the life-expectancy and quality-of-life arms.

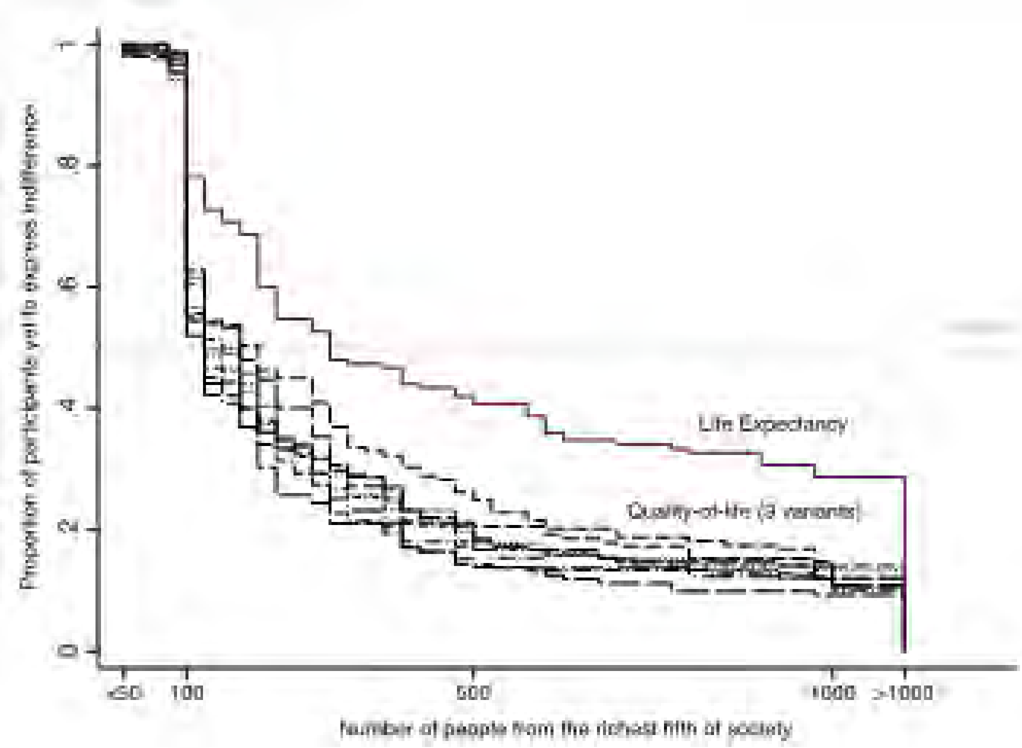

FIGURE 4 PTO indifference points: 3 QALY gain exercise

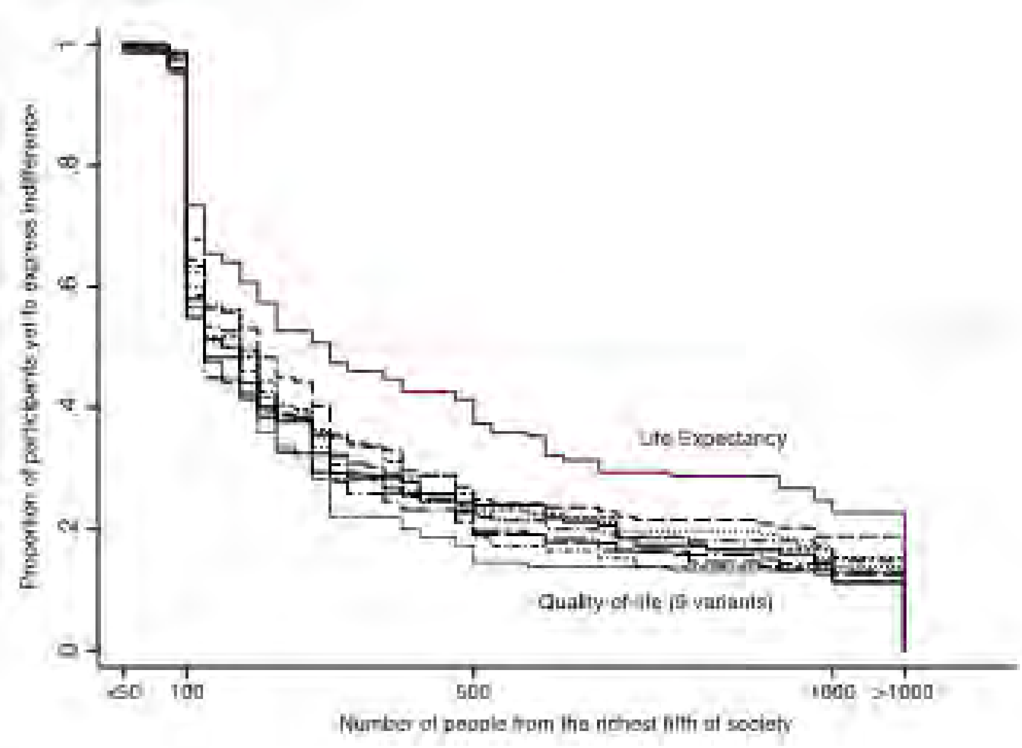

FIGURE 5 PTO indifference points: 0.5 QALY gain exercise

TABLE 1 Relative weight median respondent placed on a health-gain to a person in the poorest fifth of society compared to someone from the richest fifth of society

	3 QALY gain exercise		0.5 QALY gain exercise	
Health-gain type	Relative weight median respondent gave to a gain to poorer vs richer group	p-value vs life-expectancy†	Relative weight median respondent gave to a gain to poorer vs richer group	p-value vs life-expectancy†
Life-Expectancy	3.00	-	3.00	-
Mobility	1.25	<0.001	1.25	<0.001
Self-Care	2.00	0.001	2.00	0.036
Usual Activities	1.25	<0.001	1.75	0.006
Pain/Discomfort	1.25	<0.001	1.25	<0.001
Anxiety/Depression	1.25	<0.001	1.63	0.001
Pain	1.25	<0.001	1.75	0.005
Discomfort	1.75	<0.001	1.63	0.001
Anxiety	1.63	<0.001	1.75	0.006
Depression	1.75	<0.001	1.25	<0.001

† p-values for Mann-Whitney U-tests of hypothesis (the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health if an intervention improves life-expectancy rather than if it improves quality-of-life).

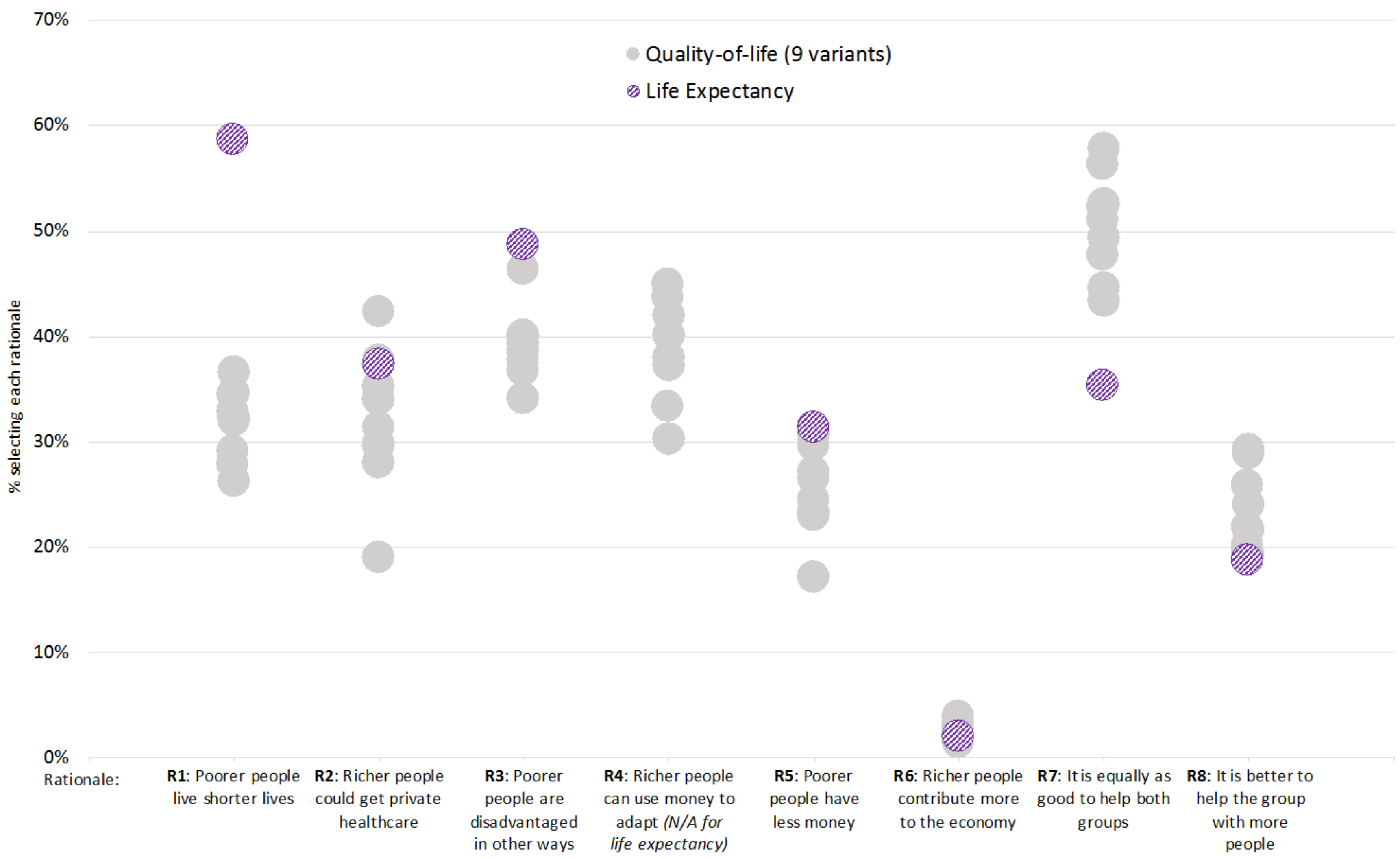

FIGURE 6 Rationale for choice responses in the life-expectancy arm and quality-of-life arms

4 | DISCUSSION

We fielded a large online choice experiment in order to explore the UK-public's willingness to prioritise different socioeconomic groups for a variety of health-improving interventions. Our PTO results are consistent with the idea that the UK-public are willing to prioritise disadvantaged socioeconomic groups with lower life-expectancy over advantaged socioeconomic groups with higher life-expectancy for interventions that improve life-expectancy. This finding was observed for both a 3 QALY and a 0.5 QALY life-expectancy gain, and is consistent with prior stated preference studies conducted in the UK [13], Spain [19, 20], Australia [21] and Canada [22].

We also find evidence that suggests the UK-public are willing to prioritise disadvantaged socioeconomic groups with lower life-expectancy over advantaged socioeconomic groups with higher life-expectancy for interventions that improve quality-of-life. In each of the nine quality-of-life arms, and for both QALY-gain magnitudes, the majority of respondents made PTO choices consistent with placing a relative weight >1 on QALY gains to people from the poorest fifth of society compared to people from the richest fifth of society. However, we find evidence that UK-public may be more willing to prioritise disadvantaged socioeconomic groups with lower life-expectancy for interventions that improve life-expectancy, rather than those that relieve quality-of-life problems. This was observed for both QALY-gain magnitudes tested and all nine quality-of-life variants (mobility, self-care, usual activities, pain/discomfort, anxiety/depression, pain, discomfort, anxiety, and depression). This finding is aligned to that of McNamara et al.[13]; albeit extended to seven new quality-of-life types and two, rather than one, QALY-gain magnitudes[4]. These results indicate that the UK-public's aversion to inequalities in health may not be consistent with the QALY-based HRWSFs applied in DCEAs to date.

Following the PTO exercises, we asked participants to explain the reason for their choices. Compared to the life-expectancy arm, a lower proportion of respondents in the quality-of-life arms selected the rationale that referred to the inequality in life-expectancy between the two groups (R1: "It is better to help the poorer people, because on average, poorer people live shorter lives than richer people"). Conversely, a higher proportion of participants in the quality-of-life arms selected the gain-egalitarian rationale (R7: "When it comes to health, it is equally as good to help poorer people or richer people"). This variation is consistent with the PTO results observed, and provides insight into why participant preferences may not be consistent with QALY-based HRSWFs. The discrepancy in selection of statement R1 suggests that participants in the life-expectancy arm considered the stated inequality in life-expectancy as being more relevant to their prioritisation decisions than participants in the quality-of-life arms did. If participants' aversion to inequalities in health were consistent with the QALY-model, we would expect this proportion to be the same across arms: an inequality of given QALY-magnitude should be equally relevant to a prioritisation decision about an intervention that provides a gain of a set QALY-magnitude, independently of the health-type that the inequality, or gain, are a function of. Instead, we observe results that suggest aversion to inequalities in health may be "health domain-specific", with an inequality in a given domain of health perceived as only being relevant, or as being more relevant, to a prioritisation decision about that domain of health, rather than in another. Furthermore, the variation in frequency in selection of the latter statement (R7) is consistent with the idea that questions about quality-of-life improving interventions prompt the public to experience stronger instinctive gain egalitarian reactions to decisions about prioritising different socioeconomic groups than decisions about life-expectancy increasing interventions. Testing this logic was not a primary aim of this study, and whilst our findings are consistent with this idea they are not sufficient to determine whether or not this was, or was not, the case. It would be interesting to explore this idea further in future qualitative

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[4] For quality-of-life, McNamara et al. [13] asked participants questions about interventions that provided a 3-QALY gain via relief of pain, or relief of mobility problems.

studies.

The primary strength of this study its size and scope. This is the largest study that has explored the UK-public's aversion to inequalities in health between socioeconomic groups, and the first to elicit inequality aversion across a wide range of health-types. Other strengths include the collection of rationale for choice data, and the testing of a novel, policy-relevant, hypothesis. This study also has limitations. For example, we told participants about inequalities in life-expectancy, but not quality-of-life. This is potentially important, because rationale for choice data suggests that health inequality aversion may be health-type specific. If we had provided this information, respondents may have been more willing to prioritise the socioeconomically disadvantaged group for the quality-of-life interventions. In addition, whilst we attempted to standardise the QALY gain provide by each intervention, we did not explicitly state what the QALY gain was. Instead, we provided respondents with information that equated to a set QALY-gain magnitude. If we had stated the QALY-gain this may have impacted our results. Moreover, as noted in the introduction to this paper, evidence suggests the public may value QALYs provided to others differently depending on how those QALYs are composed, independently of any stated inequality [27, 26]. Similarly, a systematic review of willingness-to-pay studies [35] provides evidence the public place higher monetary valuations on own-health QALY gains that are the result of improvements in life-expectancy rather than those that are the result of quality-of-life. As result, it is possible that the differences we observe across health-gain types may, at least in part, be the result of participants placing different values on these different types of QALY gain.

It should also be noted that the two different "QALY-gain magnitude" quality-of-life exercises applied two different levels of baseline quality-of-life severity: a starting utility value of 0.4 for the 3 QALY gain exercises, and 0.9 for the 0.5 QALY gain exercises. As a result, they could equally be referred to as two "baseline quality-of-life severity" exercises. This conflation exists because it was not possible to modify the QALY gain provided by the intervention without changing either the pre-intervention utility value, the post-intervention utility value, or the duration of benefit. We opted to modify the pre-intervention utility value, and fix the others. We could have opted to change the QALY-gain magnitude by modifying one of the other parameters, but this would inevitably have resulted in another form of conflation (i.e. modifying the duration of benefit would have conflated this and QALY-gain magnitude). Given this, differences in PTO responses across the two exercises should be considered to be the result of differences both QALY-gain magnitude and baseline severity.

Time preference may also have influenced our results. In the quality-of-life exercises, respondents were asked to consider an intervention that would have an immediate impact of the beneficiaries quality-of-life. In contrast, participants in the life-expectancy arm may have perceived the benefits of the intervention as coming between 7 and 14 years in the future for the richer and poorer groups respectively[5]. As a result, some of the differences observed between arms may be attributable to participants placing different present values on the health gains provided by the quality-of-life and life-expectancy interventions. It should also be noted that our PTO exercise had limited resolution. In the choice scenarios we varied the number of people in the richer group by a factor of 50, and then inferred indifference points when required. For example, a participant who chose to help 100 poorer people over 100 richer people, but then chose to help 150 richer people was inferred as being indifferent between helping 100 poorer people and 125 richer people: a 1.25:1 weight on helping the poorer group. If we had presented these questions at a higher resolution, it is possible that we may have observed different point estimates of participants preferences. Other limitations include the use of a sample that was more educated, and more politically left-wing, than the general population; and the lack of deliberation and participant discussion inherent in an online fielding.

We would be interested in conducting future stud-

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[5] Beneficiaries were stated as being 70-years old, with a life-expectancy of 77-years if they were from the poorest fifth of society and 84-years if they were from the richest fifth.

ies on this topic that feature broader, more extensive, briefings on socioeconomic inequalities in quality-of-life, samples that are more representative of the public, and opportunity for participants to discuss and debate their prioritisation decisions with other. We also think it would be interesting to present the findings of this study, and other inequality aversion elicitation studies, to a panel of the public (e.g. the NICE's Citizens Council) and to ask them to debate whether or not government should prioritise health gains to poorer people over richer people, and whether or not the strength of that prioritisation should differ by type of health gain. This could then inform the development of a reference-case for distributionally sensitive economic evaluation, which economists could then use to generate standardised evaluations that better reflect policy-makers stated objective to reduce inequalities in health [5, 6, 7, 8].

This study, and its findings, are relevant to both academics and policy-makers interested in developing, conducting and commissioning distributionally sensitive forms of economic evaluation in the UK and beyond. This is primarily because our findings suggest the public's aversion to socioeconomic inequalities in health may not consistent with QALY-based HRWSFs that have been employed in DCEAs to date [14, 10, 15]. If this is the case, then DCEAs that apply these HRWSFs may miss-represent the views of the public. For example, if the public are more willing to prioritise disadvantaged socioeconomic groups over advantaged socioeconomic groups for interventions that improve life-expectancy rather than relieve quality-of-life problems, then use of a HRSWF that has been parameterised based on the public's view on life-expectancy will over-state the public's willingness to favour the socioeconomically disadvantaged for quality-of-life interventions. This is not a trivial outcome. If our results reflect the UK-public's preferences, DCEAs conducted in this way could result in resource allocation decisions that cause advantaged socioeconomic groups to experience more avoidable pain, anxiety, depression, and/or other forms of suffering than the public would support. For example, if we were to apply the relative weight the median respondent in the 3-QALY life-expectancy exercise placed on a gain to a person from the poorest fifth of society (3:1), to a DCEA about an intervention that provided a 3-QALY gain via relief of severe pain (1.25:1 median response in this study), our results suggest that DCEA would over-estimate the public's willingness to prioritise the poorer group for this intervention by a factor of 2.4 (3/1.25). Given the potential human consequences of this over-estimation, it is important that those conducting and commissioning distributionally sensitive forms of economic evaluation think carefully about the source of the HRSWFs they apply, and the consistency of these HRSWFs with the preferences of the public.

In conclusion, we find our sample are willing to prioritise disadvantaged socioeconomic groups with lower life-expectancy over advantaged socioeconomic groups with higher life-expectancy for interventions that improve life-expectancy. We also find evidence consistent with the idea that the UK-public are willing to prioritise disadvantaged socioeconomic groups with lower life-expectancy over advantaged socioeconomic groups with higher life-expectancy for interventions that improve quality-of-life. This supports the use of distributionally-sensitive forms of economic evaluation, such as DCEA. However, we find evidence that suggests the preferences of the UK-public may not be consistent with the QALY-based HRSWFs used in recent DCEAs [14, 15]. Our results indicate that the UK-public may be more willing to prioritise disadvantaged socioeconomic groups with lower life-expectancy over advantaged socioeconomic with higher life-expectancy for interventions that improve life-expectancy, rather than those that relieve quality-of-life problems. These findings motivate the development of new forms of HRWSF, and/or distributionally sensitive economic evaluation, that can capture potential variations in the public's attitudes towards prioritising disadvantaged groups depending on the type of health-gain an intervention provides.

Acknowledgements

This work was supported by the EuroQol Research Foundation [2010840], the Wellcome Trust Doctoral Training Centre in Public Health Economics and Decision Science

[108903/Z/19/Z], and the University of Sheffield. The authors would like to thank Paul Schneider for his comments on an earlier draft of this manuscript. This document was formatted using the Wiley and Overleaf "Wiley Journal Template" LaTeX template. This template was developed by the two parties during 2017/2018, and is available for use under Creative Commons CC BY 4.0. We thank Wiley and Overleaf for developing this LaTeX template, and making it freely available.

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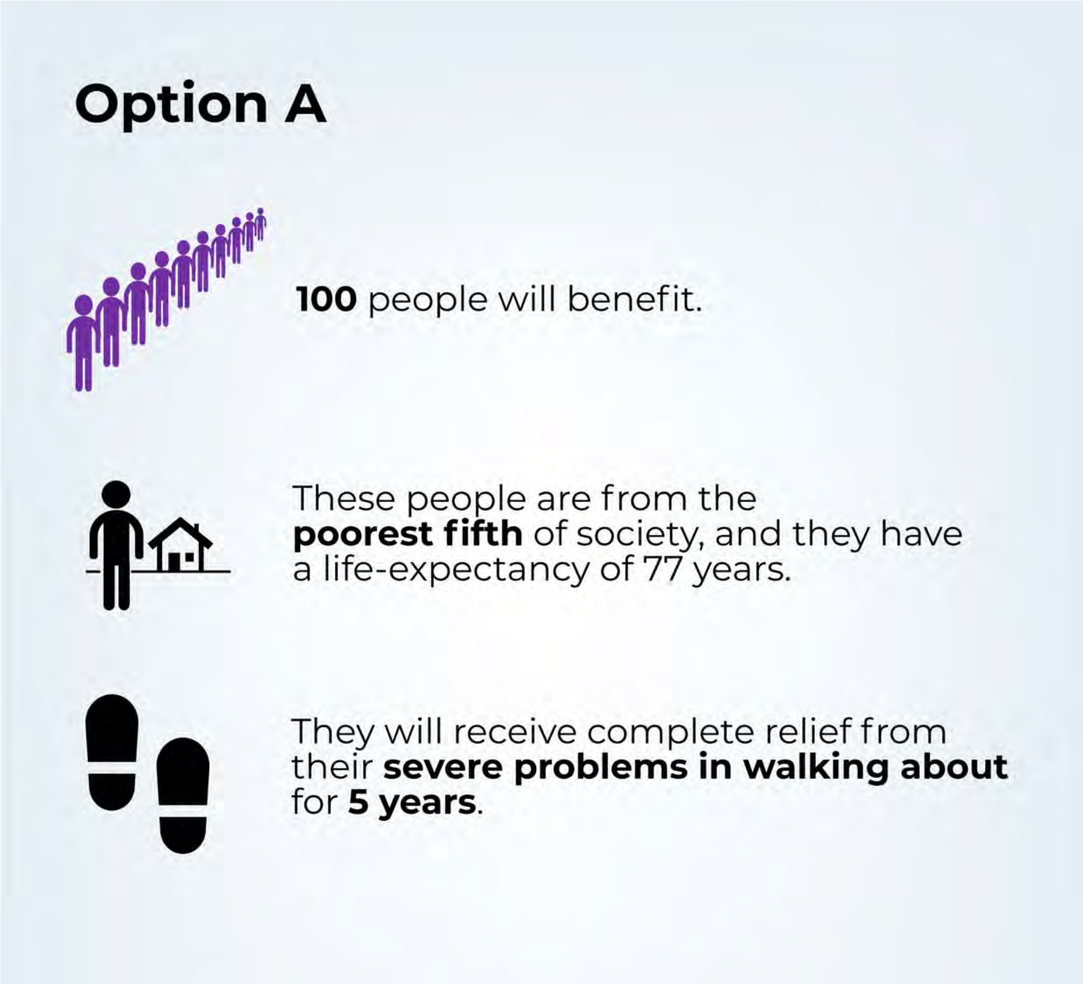
[34] YouGov, Voting Intention tracker (24th-26th January 2020); 2020. Retrieved from: `https://d25d2506sfb94s.cloudfront.net/cumulus_uploads/document/pvy6e0njjl/TheTimes_VI_Results_200127_w.pdf` (accessed 07/07/2020).

[35] Ryen L, Svensson M. The willingness to pay for a quality adjusted life year: a review of the empirical literature. Health economics 2015;24(10):1289–1301.

APPENDIX A6.1. The McNamara et al. (2020c) online appendices

Online Appendices for McNamara et al. (2020c)

Figure 1. An example of the graphics used in the mobility arm



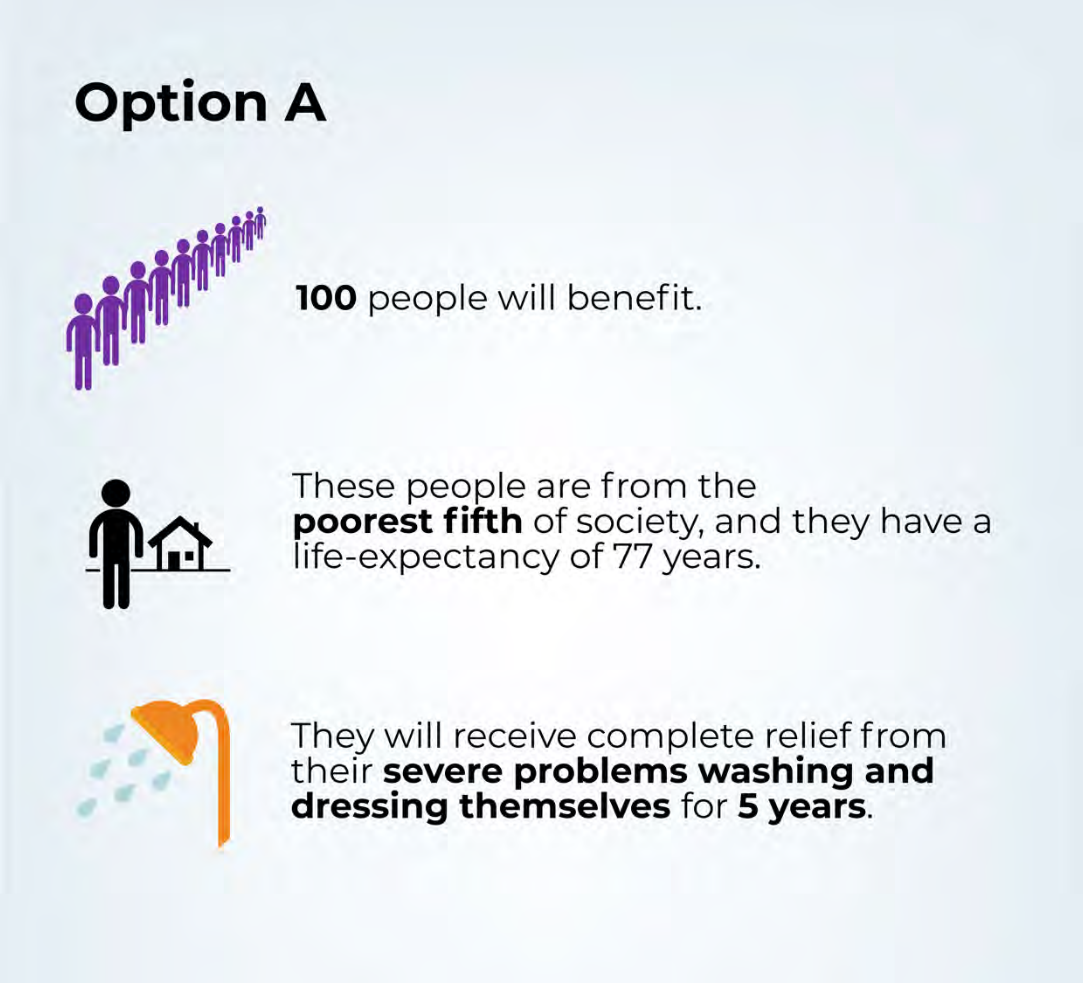
Option A

100 people will benefit.

These people are from the **poorest fifth** of society, and they have a life-expectancy of 77 years.

They will receive complete relief from their **severe problems in walking about** for **5 years**.

Figure 2. An example of the graphics used in the self-care arm



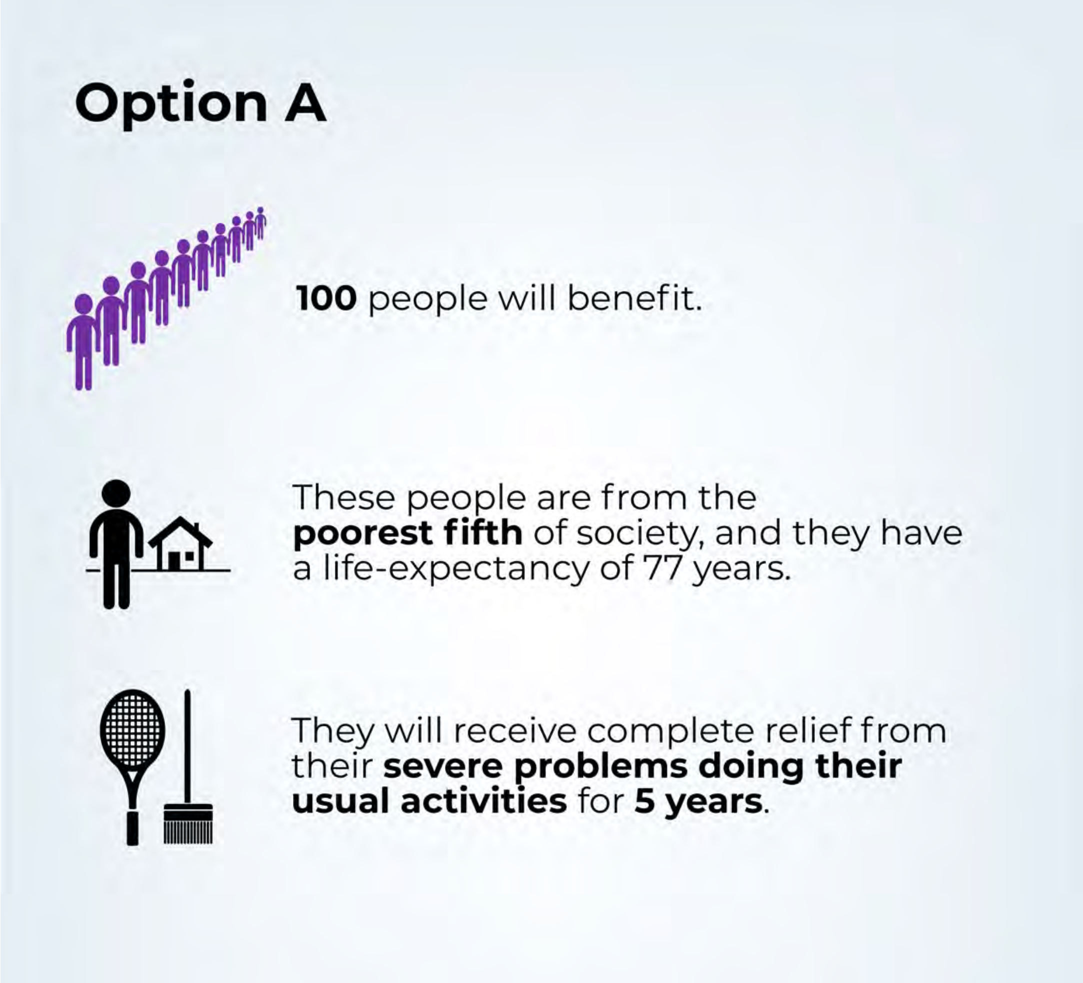
Option A

100 people will benefit.

These people are from the **poorest fifth** of society, and they have a life-expectancy of 77 years.

They will receive complete relief from their **severe problems washing and dressing themselves** for **5 years**.

Figure 3. An example of the graphics used in the usual activities arm



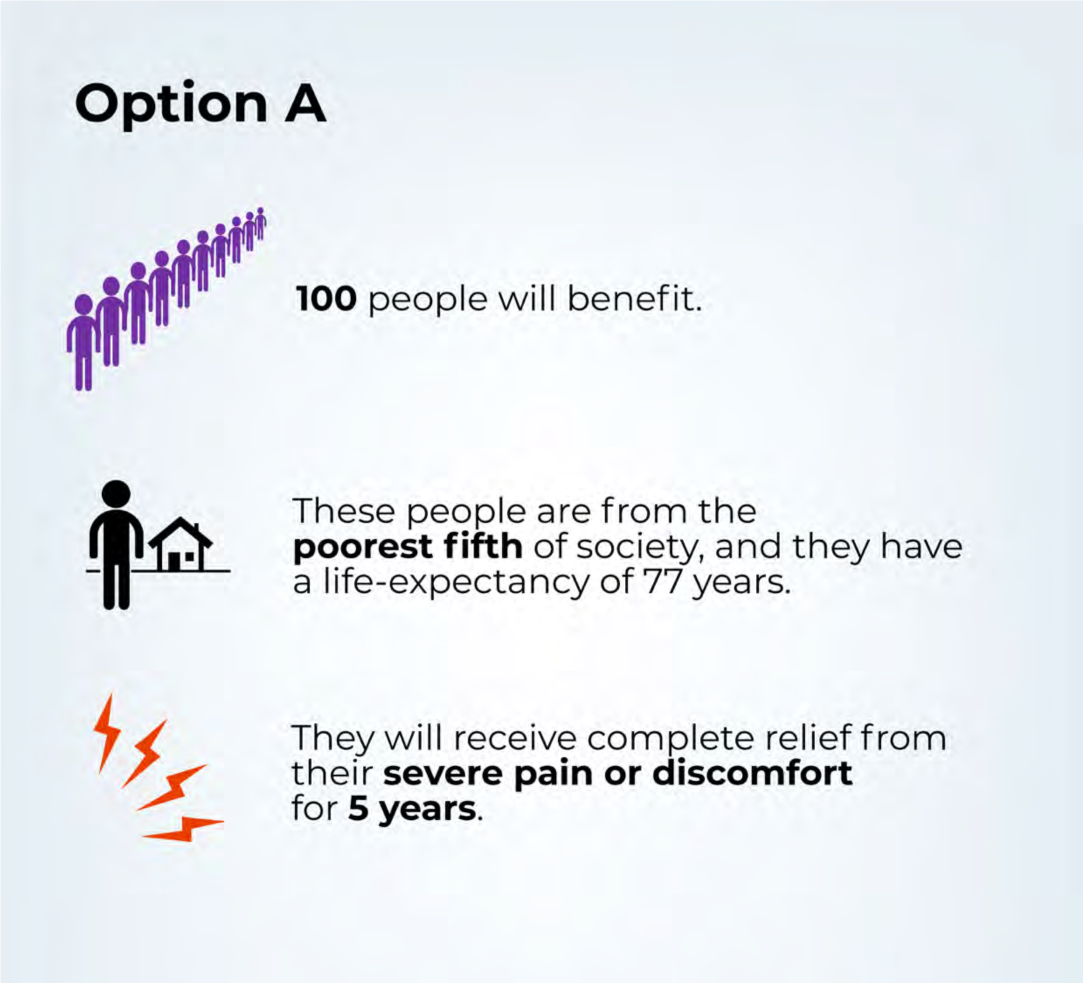
Option A

100 people will benefit.

These people are from the **poorest fifth** of society, and they have a life-expectancy of 77 years.

They will receive complete relief from their **severe problems doing their usual activities** for **5 years**.

Figure 4. An example of the graphics used in the pain/discomfort arm (wording modified for pain alone and discomfort alone arms)



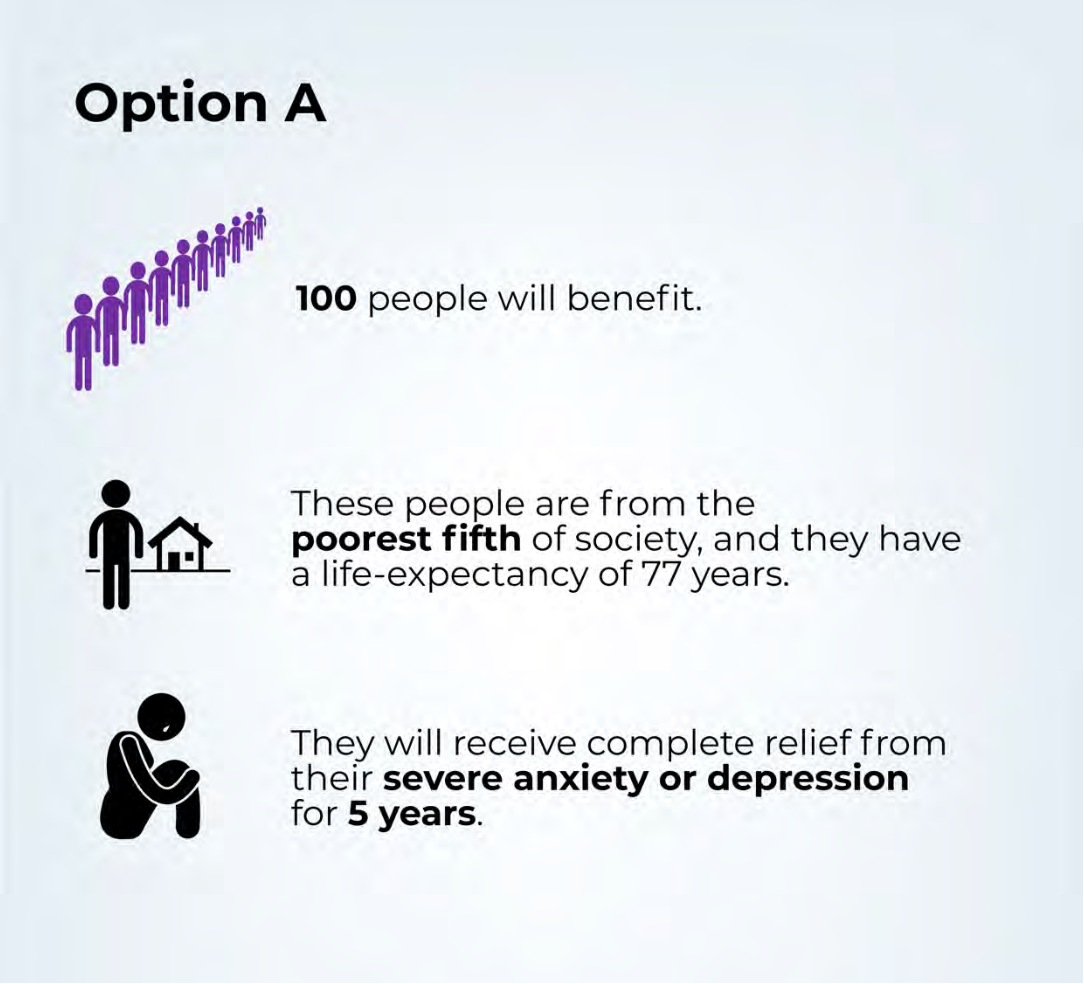
Option A

100 people will benefit.

These people are from the **poorest fifth** of society, and they have a life-expectancy of 77 years.

They will receive complete relief from their **severe pain or discomfort** for **5 years**.

Figure 5. An example of the graphics used in the anxiety/depression arm (wording modified for anxiety alone and depression alone arms)



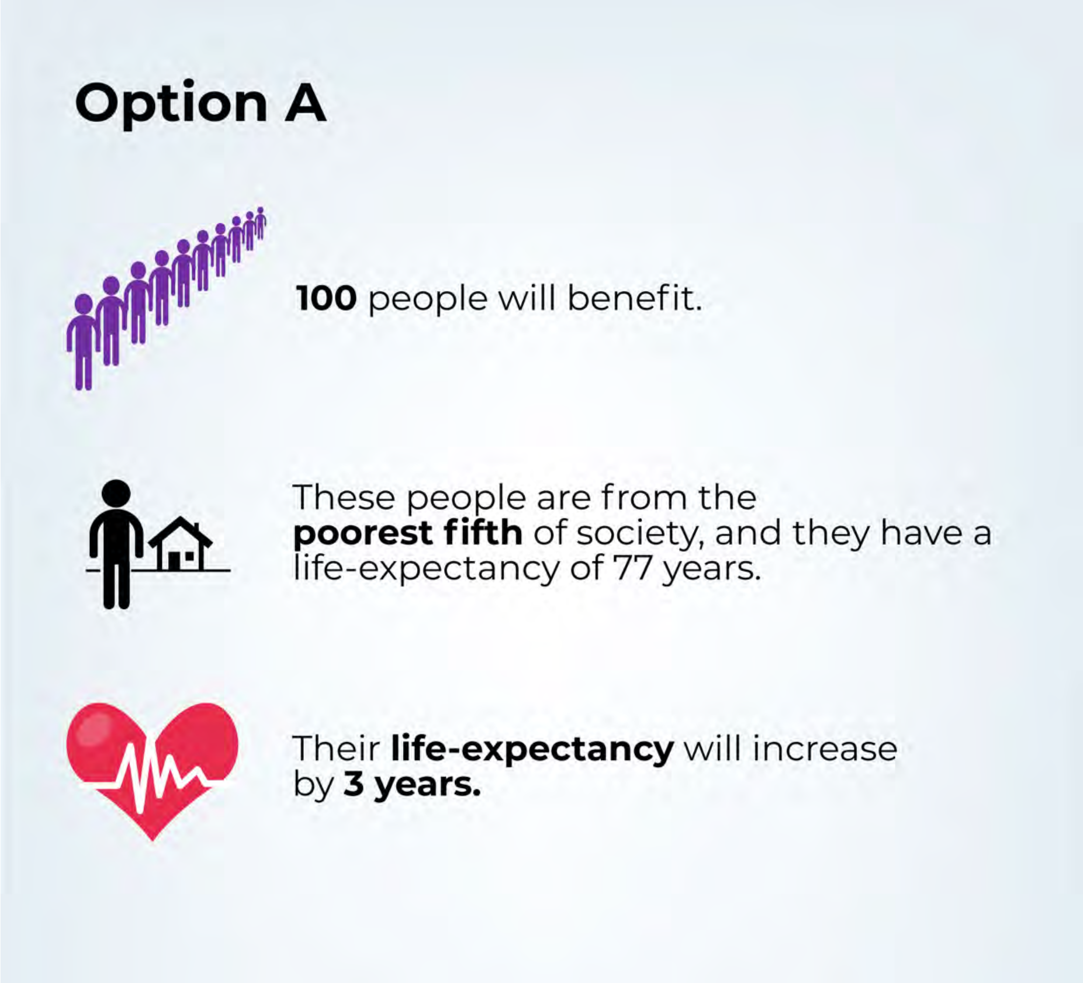
Option A

100 people will benefit.

These people are from the **poorest fifth** of society, and they have a life-expectancy of 77 years.

They will receive complete relief from their **severe anxiety or depression** for **5 years**.

Figure 6. An example of the graphics used in the life expectancy arm



Option A

100 people will benefit.

These people are from the **poorest fifth** of society, and they have a life-expectancy of 77 years.

Their **life-expectancy** will increase by **3 years.**

Table1. Participant characteristics by arm

		Mobility (n=151)	**Self-care** (n=149)	**Usual Activities** (n=151)	**Pain/ Discomfort** (n=147)	**Anxiety/ Depression** (n=152)	**Pain** (n=150)	**Discomfort** (n=152)	**Anxiety** (n=150)	**Depression** (n=150)	**Life-Expectancy** (n=150)
Male		42%	49%	46%	50%	45%	49%	51%	55%	49%	49%
Age (mean)		45	45	45	47	46	44	44	45	46	43
Education Level	Degree	55%	56%	59%	57%	62%	63%	48%	52%	59%	53%
	A-levels (or equivalent)	21%	28%	21%	26%	20%	17%	25%	27%	20%	27%
	GCSEs (or equivalent)	21%	13%	14%	15%	12%	15%	24%	17%	19%	19%
	Other qualifications	1%	1%	5%	2%	5%	3%	1%	2%	1%	1%
	No qualifications	1%	1%	1%	0%	1%	2%	3%	2%	1%	1%
	Don’t know	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%
Ethnicity	White	87%	86%	81%	89%	86%	85%	83%	84%	87%	85%
	Black/African/Caribbean/Black British	1%	2%	5%	3%	3%	5%	5%	2%	5%	4%
	Asian/Asian British	5%	9%	10%	7%	6%	7%	7%	9%	7%	9%
	Mixed/Multiple ethnic groups	6%	2%	2%	0%	3%	1%	3%	4%	1%	3%
	Other ethnic group	1%	1%	1%	1%	3%	1%	1%	1%	0%	0%
Voting Intention[φ]	Conservative	28%	33%	33%	29%	31%	29%	26%	29%	28%	27%
	Labour	37%	32%	37%	34%	28%	41%	33%	37%	29%	31%
	Liberal Democrat	7%	12%	9%	12%	13%	7%	16%	12%	12%	9%
	Scottish National Party	5%	3%	5%	3%	5%	3%	5%	1%	4%	3%
	Plaid Cymru	1%	1%	1%	1%	1%	0%	0%	1%	1%	1%
	Brexit Party	2%	2%	1%	1%	4%	1%	3%	4%	3%	2%
	Green	6%	8%	5%	10%	5%	7%	6%	5%	9%	9%
	Other	3%	3%	1%	3%	5%	2%	3%	3%	3%	2%
	None	9%	4%	9%	7%	6%	7%	7%	7%	10%	11%
	Not eligible to vote	3%	2%	1%	0%	2%	3%	1%	1%	1%	5%
Subjective Richness[Ω]	5 (richest fifth)	2%	1%	3%	4%	2%	1%	1%	1%	1%	2%
	4	13%	13%	16%	14%	15%	13%	13%	15%	13%	14%
	3	27%	26%	27%	24%	32%	24%	24%	28%	27%	32%
	2	33%	37%	35%	35%	28%	41%	38%	31%	37%	32%
	1 (poorest fifth)	26%	25%	19%	22%	23%	21%	25%	25%	22%	20%

* 2011 census data used for sex, age, education level and ethnicity. Voting intention data from 26th January 2020 YouGov Westminster voting intention tracker. Note, for voting intention our survey included options for “none” and ”not eligible to vote”. The voting intentions figures we provide are the percentage of the 90% of respondents who did not select one of these two options. Raw percentages are provided in the Online Supplementary Appendix.

[φ] “If there were a general election held tomorrow, which party would you vote for?”

[Ω] “If the number 100 was the richest person in the UK, and the number 0 was the poorest person in the UK, how rich do you think you are?”

APPENDIX A6.2. How this chapter contributes to this thesis as a whole

This chapter: (1) provides further evidence consistent with Hypothesis B of this thesis (the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health if an intervention improves life-expectancy than they are if it improves quality-of-life). Furthermore, it (2) provides additional evidence that participants asked questions about prioritising the health of different socioeconomic groups are influenced by non-health factors. This is consistent with the logic underlying Hypothesis A of this thesis (group types). This study also (3) provides further evidence consistent with the idea of domain-specific health inequality aversion, with an inequality in life-expectancy seemingly perceived to be more important to a decision about an intervention that improves life-expectancy, rather than one that improves quality-of-life. This is consistent with Chapters 4 and 5.

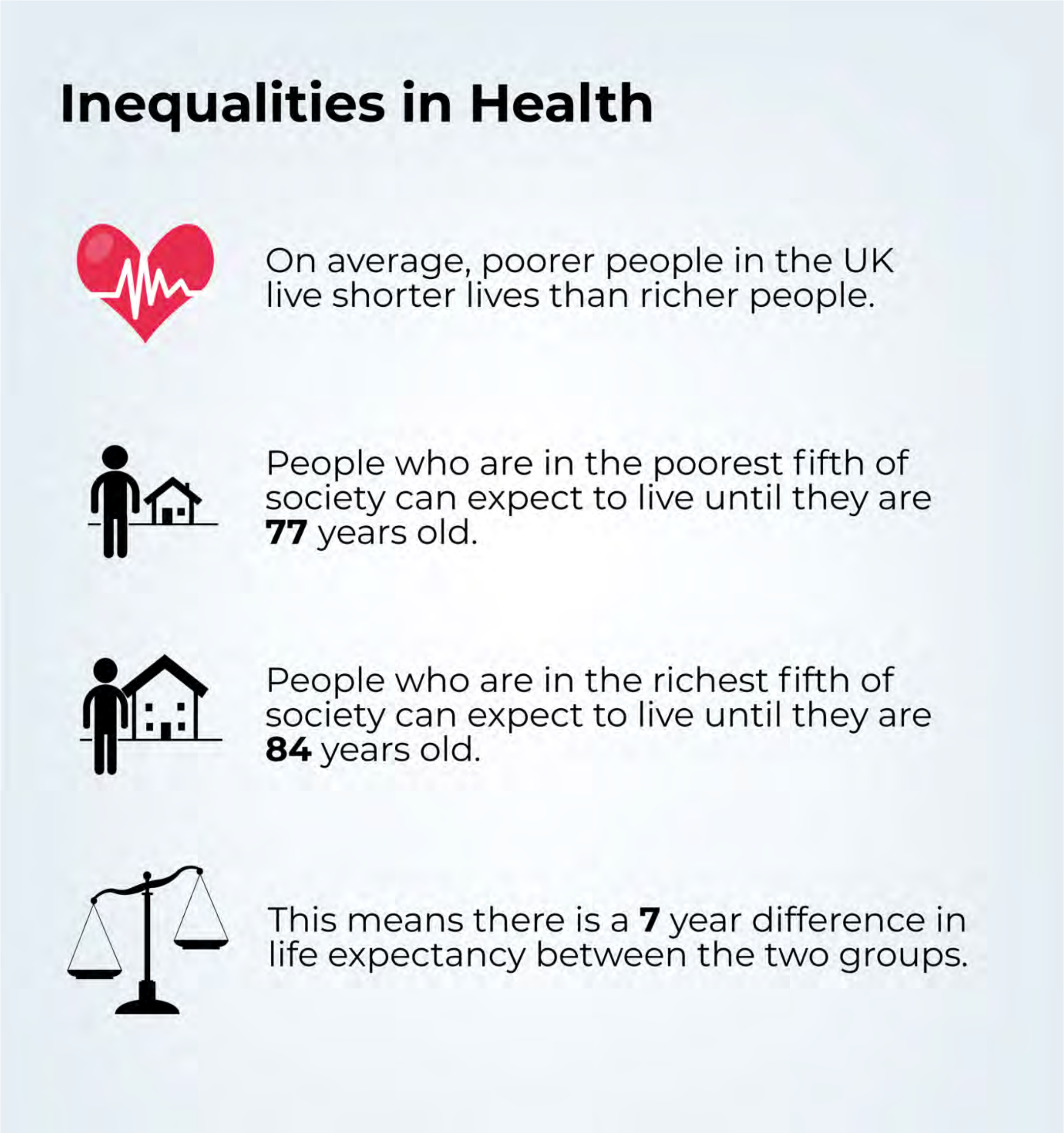
As a result of (3), and the fact that respondents were told about inequalities in life-expectancy, but not lifetime quality-of-life, is is uncertain whether this study is applicable to a hypothesis about inequalities in "lifetime health" more generally. Given this, this chapter should be regarded as providing (4) further evidence consistent with Hypothesis B, but not strong evidence in support of it; and, (5) additional evidence that the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower *life-expectancy* over advantaged socioeconomic groups with higher *life-expectancy* if an intervention improves life-expectancy than they are if it improves quality-of-life.

As discussed in Chapters 4 and 5, it should be noted that icons and phrases used to convey information to participants in the PTO materials may have influenced them to respond in a more inequality averse manner than might otherwise have been the case had objective alterantives been used. As a consequence, this study may over-estimate the public's willingness to prioritise disadvantaged socioeconomic groups over advantaged groups.

APPENDIX A6.3. Online study participant briefings

Chapter 6 – Study materials

Introduction 1



Inequalities in Health

On average, poorer people in the UK live shorter lives than richer people.

People who are in the poorest fifth of society can expect to live until they are **77** years old.

People who are in the richest fifth of society can expect to live until they are **84** years old.

This means there is a **7** year difference in life expectancy between the two groups.

Note that this briefing reverted to use of the term “inequalities in health” used in Chapter 4, rather than use the title “Poorer and richer people” used in Chapter 5. In retrospect, “differences in health” may have been a more objective title to use here.

Introduction 2

What we are researching

Every day, the government has to make difficult decisions that will impact people's health.

They could choose to focus on improving the health of everyone equally.

They could choose to focus on improving the health of poorer people.

They could choose to focus on improving the health of richer people.

We are interested in what you think the government should do when making these difficult decisions.

Note that, in comparison to Chapter 5, this briefing was more explicit in explaining to participants that government could choose to focus on one group or the other, or both. This information was emphasised in this study, as participants were not completing the exercises in the presence of an interviewer. Subsequently, I wanted to minimise the chance that they could be confused by the task, and not be able to clarify with an interviewer.

Introduction 3

What we would like you to do

Imagine you are a minister in the government.

You have been asked to make some choices about policies that will change people's health.

Think carefully about your choices - these are imaginary situations, but the government does use the results of surveys like this to make real policy decisions.

Life-expectancy exercise briefing 1 (3-QALY gain)

The Policy Options

The policy options you will be choosing between will improve the life-expectancy of people by **3 years**.

The people are currently 70 years old, and they have no health problems.

Note the introduction of the female icon in this study. The study materials used in Chapter 5 featured solely a male figure.

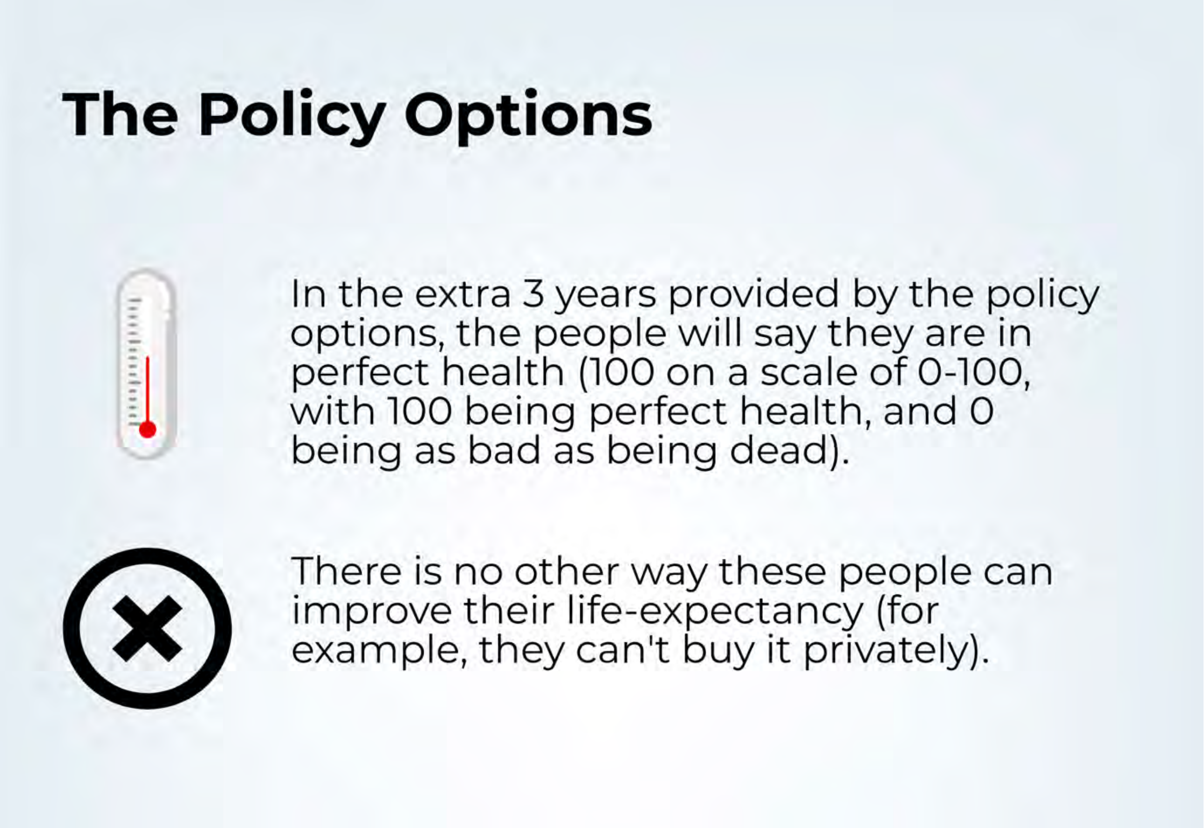
Life-expectancy exercise briefing 2 (3-QALY gain)

The Policy Options

Some of the people are from the poorest fifth of society, and they have a life-expectancy of 77 years.

Some of the people are from the richest fifth of society, and they have a life-expectancy of 84 years.

Life-expectancy exercise briefing 3 (3-QALY gain)



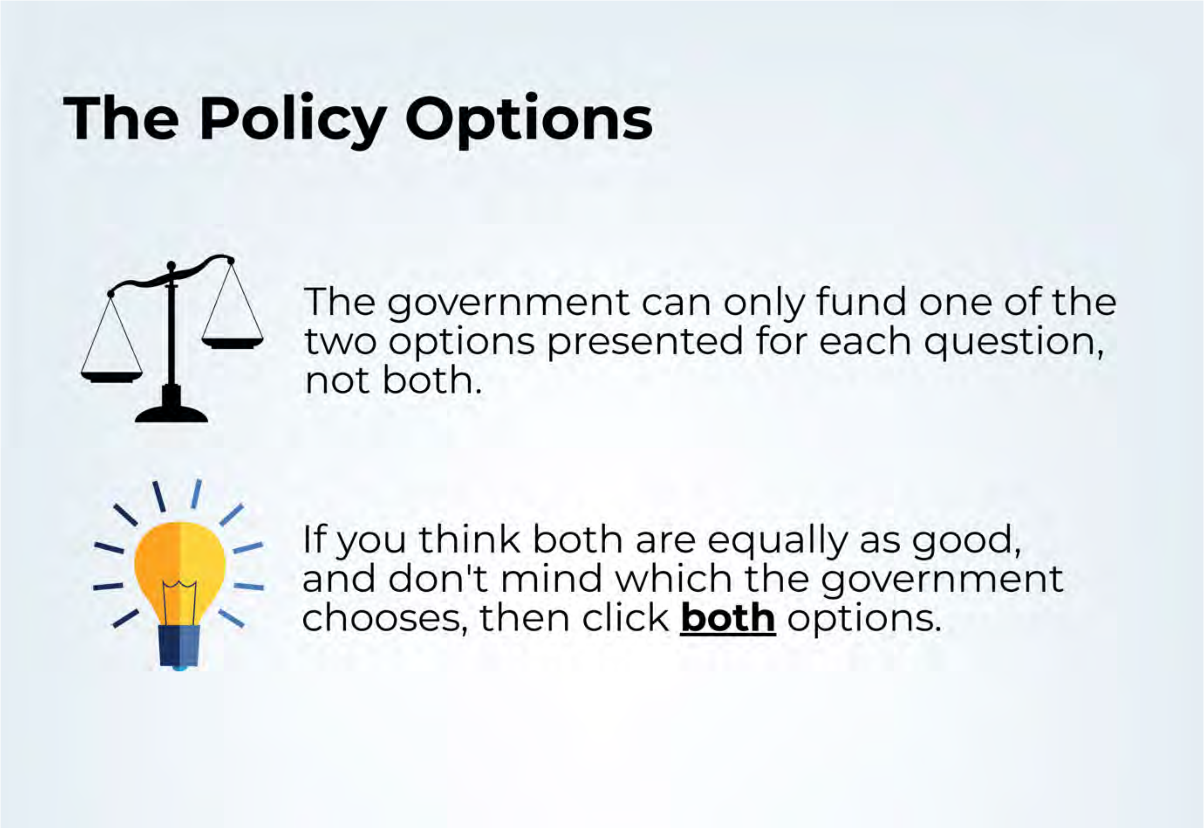
The Policy Options

In the extra 3 years provided by the policy options, the people will say they are in perfect health (100 on a scale of 0-100, with 100 being perfect health, and 0 being as bad as being dead).

There is no other way these people can improve their life-expectancy (for example, they can't buy it privately).

Note this briefing now explicitly mentions that the intervention is not available privately. In this prior chapter, respondents were provided with the first part of this sentence, but not the later.

Life-expectancy exercise briefing 4 (3-QALY gain)



The Policy Options

The government can only fund one of the two options presented for each question, not both.

If you think both are equally as good, and don't mind which the government chooses, then click **both** options.

Self-care exercise briefing 1 (0.5-QALY gain)

The Policy Options

The policy options you will be choosing between will help people who have a health condition.

Because of this health condition, these people have **slight** problems in washing and dressing themselves.

Without the policy options, these peoples' problems in washing and dressing themselves are expected to last for the next 5-years.

The people are currently 70 years old, and they have no other health problems.

Briefings for other quality-of-life types were comparable to these presented here, albeit modified with different text regarding the health problems, and different graphics designed to represent the different health problems (see Appendix A6.1. for examples of these). It is possible that my choice of icons may have influenced participant responses. For example, in the above graphic the use of a shower icon to represent problems in washing and dressing may have prompted participants to focus solely on washing problems, and neglect dressing problems. It is unclear what impact this might have had on their responses.

Self-care exercise briefing 2 (0.5-QALY gain)

The Policy Options

Some of the people are from the poorest fifth of society, and they have a life-expectancy of 77 years.

Some of the people are from the richest fifth of society, and they have a life-expectancy of 84 years.

Self-care exercise briefing 3 (0.5-QALY gain)

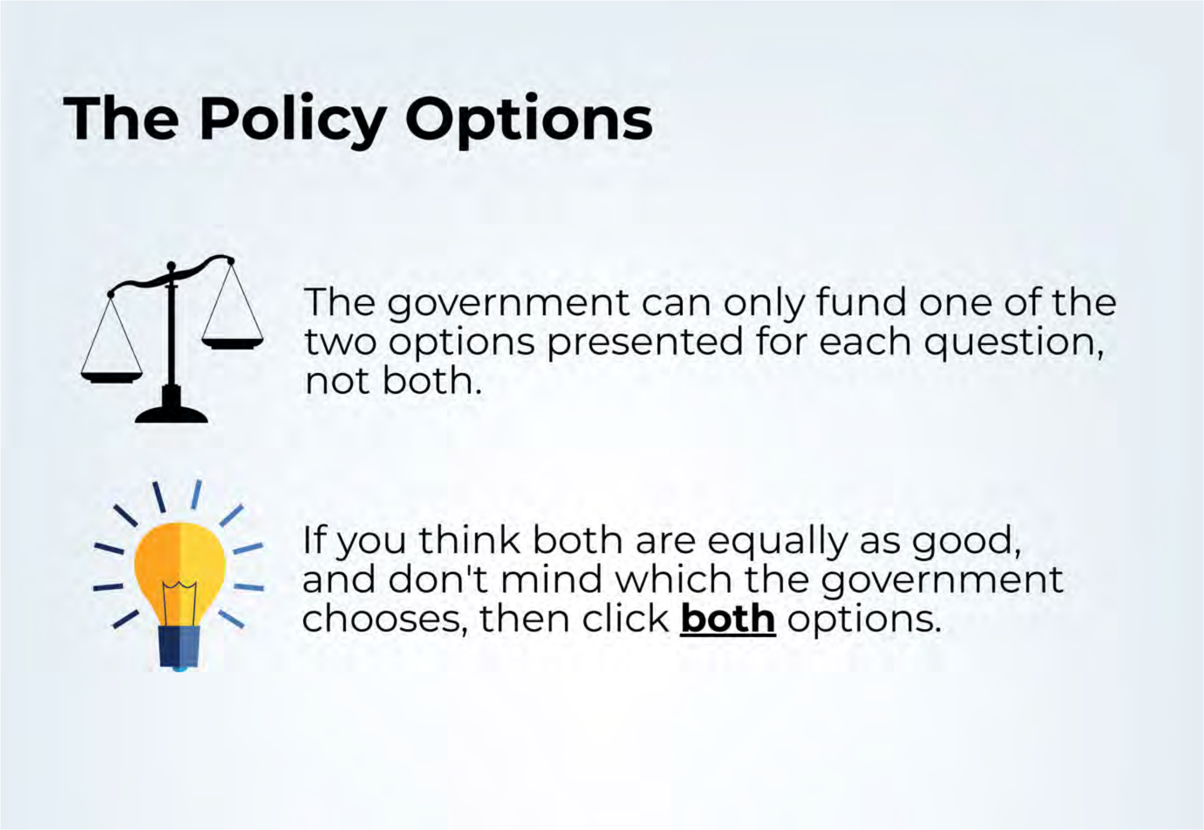
The Policy Options

The people with the problems in washing and dressing themselves say that on a scale of 0-100, with 100 being perfect health, and 0 being as bad as being dead, they are a **90**.

The policy options will provide complete relief from these slight problems in washing and dressing themselves for **5-years**. In this time, the people will say they are in perfect health (100).

There is no other way these people can get relief from their slight problems in washing and dressing themselves (for example, they can't buy it privately).

Self-care exercise briefing 4 (0.5-QALY gain)



The Policy Options

The government can only fund one of the two options presented for each question, not both.

If you think both are equally as good, and don't mind which the government chooses, then click **both** options.

Chapter 7: Discussion

Chapter 1 introduced the two central hypotheses of this thesis. Hypothesis A: the UK-public are more averse to inequalities in lifetime health between socioeconomic groups than they are to inequalities in lifetime health between neutrally labelled groups. Hypothesis B: the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health if an intervention improves life-expectancy than they are if it improves quality-of-life. Chapter 2 detailed a systematic review of evidence relevant to these hypotheses. Chapter 3 then explained how the two hypotheses could be tested; considered how they should be tested; and briefly explained how they would be tested in this thesis. Following this, Chapter 4 reported a quantitative/qualitative pilot of a PTO study designed to test the hypotheses. Subsequently, Chapter 5 reported a face-to-face fielding of a PTO study designed to test both the hypotheses. After this, Chapter 6 detailed an online fielding of a PTO study designed to test Hypothesis B (health gain types) alone.

This chapter discusses the thesis as a whole. It features seven sections[1]: [7.1] reviews the two hypotheses, and the extent to which the evidence presented is consistent with them; [7.2] outlines the limitations of the thesis; [7.3] discusses implications for policy-makers and researchers; [7.4] outlines future research ideas motivated by the work undertaken; [7.5] explains my views on what policy-makers interested in implementing distributionally sensitive forms of economic evaluation should do; [7.6] clarifies the original contributions made. Finally, [7.7] reflects on the thesis as whole, and concludes.

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[1] Note that this chapter does not include a section in which I explicitly compare and contrast the work undertaken to existing literature. This is because this is done in each of individual chapters where relevant.

7.1. Is the evidence available consistent with the two hypotheses?

When considering the findings reported in this section, it should be noted that the graphics and text used to convey information to participants in the three studies may have prompted them to respond in a more inequality averse manner than might have been the case had more objective alterantives been used (see Section 4.2.1. for further detail). It is uncertain what impact this effect may have had on the tests of the two hypotheses.

7.1.1. Hypothesis A: the UK-public are more averse to inequalities in lifetime health between socioeconomic groups than they are to inequalities in lifetime health between neutrally labelled groups

7.1.1.1. Motivation

In Chapter 1, I argued that it is not obvious whether the health-related social welfare function/s (HR-SWFs) applied in distributionally sensitive economic evaluations should be parameterised using estimates of aversion to inequalities in health between socioeconomic groups, or neutrally labelled groups. I then made the case this distinction is only of practical significance if inequality aversion differs between the socioeconomic groups and neutrally labelled groups. I argued that aversion is likely to differ between these two contexts, because the public are likely to be influenced by non-health factors that differ between socioeconomic groups (e.g. inequalities in income). Subsequently, I made the case these non-health factors are likely to motivate prioritisation of disadvantaged socioeconomic groups. This led to Hypothesis A: the UK-public are more averse to inequalities in lifetime health between socioeconomic groups than they are to inequalities in lifetime health between neutrally labelled groups.

7.1.1.2. Is the evidence presented consistent with Hypothesis A?

The systematic review (detailed in Chapter 2) identified eight studies that elicited the UK-public's aversion to inequalities in health between socioeconomic groups, and nine that elicited their aversion between neutrally labelled groups. The review found no direct tests of Hypothesis A. Estimates of aversion from studies in which participants were asked about socioeconomic groups tended to be higher than those in which respondents were asked about neutrally labelled groups. This is consistent with Hypothesis A; however, the methods used across these studies differed. Given this, it is possible that the differences observed across studies are a result of variation in methods, rather than differences in aversion by group-type.

In the pilot study (detailed in Chapter 4) the PTO indifference points of participants asked questions about socioeconomic groups (n=10) were, generally speaking, higher than those of participants asked about neutrally labelled groups (n=10). This trend is broadly consistent with Hypothesis A, albeit based on small numbers.

Participants randomised to questions about socioeconomic groups stated that they were influenced by non-health factors. These included: (1) the broader non-health inequalities between poorer and richer people; (2) the potential for differential productivity impacts of ill health between poorer and richer people; (3) the potential for differential downstream costs associated with ill health for poorer and richer people; and (4) the potential for richer people to obtain private healthcare. No respondent asked about neutrally labelled groups explained their choices by making reference to non-health factors. This is consistent with the thinking underlying Hypothesis A.

In the face-to-face PTO study (Chapter 5), half the participants (n=40) were randomised to PTO questions about socioeconomic groups, and half (n=40) were randomised to questions about neutrally labelled groups. Each completed three PTO tasks: one about improved life-expectancy, one about relief of severe pain, and one about relief of severe mobility problems. Respondents in the socioeconomic arm were more willing to prioritise the disadvantaged socioeconomic group over the advantaged socioeconomic group than the participants asked questions about neutrally labelled groups were willing to prioritise people with Disease A over Disease B. The p-values for statistical tests of this hypothesis were below 0.05 for all three health-gain types. This is consistent with Hypothesis A, however there were a number of differences between the socioeconomic arm and neutral arm of this study, which mean the two are not directly comparable. These are outlined in detail in Chapter 5. Given the potential confounding introduced by these differences, the PTO results presented in this chapter should be regarded as being consistent with

Hypothesis A, rather than strong evidence in support of it.

Following the PTO tasks, participants were asked to explain the reasons for their choices. Respondents asked questions about socioeconomic groups stated they were influenced by non-health factors. At least 20% selected each of the following rationales for one of the three exercises: (1) poorer people have less money than richer people; (2) poorer people are disadvantaged in many other ways in life; (3) richer people could use their money to find other ways of getting around; and (4) richer people could improve their health through private health-care. In contrast, less than 10% selected non-health rationales that would motivate pro-advantaged group decisions: “richer people contribute more to the economy” and “poorer people cost the government lots of money”. This response pattern is consistent with the thinking underlying Hypothesis A.

In the online PTO study (Chapter 6), just over 1,500 members of the UK-public were asked questions about interventions that would improve the health of one of two socioeconomic groups. The reasons participants gave for their choices are consistent with the thinking underlying Hypothesis A: that members of the public asked questions about socioeconomic groups are influenced by factors other than the health of those groups. Non-health factors cited included: (1) the inequality in income between poorer and richer people; (2) the potential for richer people to obtain private healthcare; (3) the potential for richer people to use their money to adapt to health problems; and (4) the broader disadvantage faced by poorer people.

The thesis as a whole

This thesis provides strong evidence that, when asked to make decisions about prioritising gains in the health of different socioeconomic groups, the UK-public state they are influenced by factors other than the health of those groups. This is consistent with the thinking underlying Hypothesis A. Chapter 2 (systematic review) provides evidence consistent with Hypothesis A. Similarly, Chapter 4 (pilot) and Chapter 5 (face-to-face fielding) provide evidence consistent with Hypothesis A. In combination, this evidence suggests (1) the UK-public are more averse to inequalities in lifetime health between socioeconomic groups than they are to inequalities in lifetime health between neutrally labelled groups; and (2) this difference is, at least in part, a function of non-health differences between socioeconomic groups.

7.1.2. Hypothesis B: the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health if an intervention improves life-expectancy than they are if it improves quality-of-life

7.1.2.1. Motivation

In the first chapter of this thesis, I noted that the UK public's aversion to socioeconomic inequalities in lifetime health has, typically, been elicited by asking respondents to make choices between scenarios that would improve the life-expectancy[2] of different socioeconomic groups. I then stated that relatively little attention has been paid to quality-of-life, and in particular, that no prior study has explored whether the UK-public are as willing to prioritise disadvantaged groups for interventions that improve quality-of-life as they are for interventions that improve life-expectancy.

This is potentially an important omission, as current QALY-based "distributionally-sensitive" HRSWFs treat QALYs that are the result of gains in life-expectancy equally to those that are the result of gains in quality-of-life. As a result, if decision-makers wish to reflect the views of the public in health economic evaluation, it would be valuable to know whether or not their preferences are consistent with this position.

In Chapter 1, I suggested this may not be the case, because the public may experience stronger negative instinctive reactions to the idea of prioritising poorer people over richer people for interventions that relieve quality-of-life problems, rather than those that improve life-expectancy. This logic lead to Hypothesis B: the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health if an intervention improves life-expectancy than they are if it improves quality-of-life.

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[2] Or variants thereupon.

7.1.2.2. Is the evidence available consistent with Hypothesis B?

The systematic review detailed in Chapter 2 identified no direct tests of Hypothesis B, and no indirect evidence to support, or refute it.

The pilot study reported in Chapter 4 provides evidence broadly consistent with Hypothesis B; albeit based on a very small number of respondents. Of the ten participants asked questions about socioeconomic groups, eight were more willing to prioritise the poorer group over the richer groups for the gain in life-expectancy rather than relief of severe pain, and two were equally willing to prioritise the poorer group for both interventions.

The face-to-face PTO study detailed in Chapter 5 provides evidence consistent with Hypothesis B. Forty participants answered questions about socioeconomic groups. Each completed three PTO exercises: one about an intervention that increased life-expectancy, one that relieved severe pain, and one that improved mobility problems. Respondents were more willing to prioritise the socioeconomically disadvantaged group with lower life-expectancy over the advantaged group with higher life-expectancy for interventions that improved life-expectancy, rather than relieved severe pain ($p=0.10$), or relieved severe mobility problems ($p=0.05$). There are a number of limitations associated with these comparisons, and these are detailed in Chapter 5.

The online PTO study presented in Chapter 6 similarly provides evidence consistent with Hypothesis B. In this study, all respondents answered questions about socioeconomic groups. Participants were randomised to one of ten health-gain-types: life-expectancy improvement, or one of nine quality-of-life variants. They each completed two PTO exercises for their randomised health gain type: one for a 3 QALY, and one for a 0.5 QALY gain. For both QALY-gain magnitudes, respondents in the life-expectancy arm were more willing to prioritise the disadvantaged socioeconomic group over the advantaged socioeconomic group than respondents in each of nine quality-of-life arms were. The p-values for statistical tests of these comparison range from <0.001 to 0.036. As per the face-to-face study, there are caveats associated with these comparisons. Further information on these is provided in Chapter 6.

The evidence as a whole

In totality, the evidence available is *consistent* with Hypothesis B: the UK-public may be more willing to prioritise disadvantaged socioeconomic groups with lower lifetime health over advantaged socioeconomic groups with higher lifetime health if an intervention improves life-expectancy than they are if it improves quality-of-life

However, as discussed in Chapters 5 and 6, the studies presented should not be regarded as providing strong evidence *in support* of Hypothesis B. This is because this hypothesis includes the term “lifetime health”, whilst all three studies presented participants with information about socioeconomic inequalities in life-expectancy, not “lifetime health” more generally. Notably, none of the three studies provided participants with information on socioeconomic inequalities in quality-of-life. This omission is potentially problematic, because the reasons participants gave for their choices across the three studies suggest that health inequality aversion may be “health domain specific”, with an inequality in life-expectancy perceived as being more relevant to a decision about an intervention that would improve life-expectancy, rather than one that improves quality-of-life. For example, in the pilot study reported in Chapter 4, nine of the ten participants asked questions about socioeconomic groups explained their decision about the intervention that improved life-expectancy by referring to the inequality in life-expectancy between the two groups, whilst none did so when explaining their decision about pain-relief. Similarly, in the face-to-face study detailed in Chapter 5, 56% of participants cited the inequality in life-expectancy between the two groups when explaining their decisions about the intervention that would improve life-expectancy, whilst only 26% and 31% did so for their choices about the interventions that relieved pain and improved mobility respectively. Furthermore, in the online study detailed in Chapter 6, 59% of respondents asked questions about the intervention that would improved life-expectancy cited the inequality in life-expectancy between the groups, whilst 26%-37% did so in the nine quality-of-life arms.

In combination, these rationales suggest that providing respondents with information on inequalities in quality-of-life may have increased their willingness to prioritise the disadvantaged socioeconomic group for interventions that improve quality-of-life. In turn, this may have eroded, eliminated, or even reversed, the observed differences in the public’s willingness to prioritise the socioeconomically disadvantaged for gains in life-expectancy compared to gains in quality-of-life.

As a result, whilst the three studies provide relatively strong evidence that UK-public are willing to prioritise disadvantaged socioeconomic groups with lower *life-expectancy* over advantaged socioeconomic groups with higher *life-expectancy* if an intervention improves life-expectancy than they are if it improves quality-of-life, it is uncertain whether this conclusion can be extrapolated to Hypothesis B: the UK-public are willing to prioritise disadvantaged socioeconomic groups with lower *lifetime health* over advantaged socioeconomic groups with higher *lifetime health* if an intervention improves life-expectancy than they are if it improves quality-of-life.

7.2. Limitations

The section discusses the key limitations of this thesis as whole. Issues specific to each study are discussed in the relevant chapters. Given the above discussion regarding the conflation of “life-expectancy” and “lifetime health”, this issue is not discussed again in this section, although it is clearly a limitation of the thesis.

7.2.1. Limitation 1: the lack of decision-maker consultation

In Chapter 1, I explained that this thesis was motivated by the fact that decision-makers have often sought out, and sometimes implemented, the views of the public when determining which social value judgements to implement in economic evaluation. Subsequently, I stated I was interested in eliciting the UK-public’s aversion to socioeconomic inequalities in health because decision-makers may wish to take into the views of the public when deciding which HR-SWFs to apply in health economic evaluation.

Given this motivation, it would have been preferable to have consulted with decision-makers throughout the course of developing this thesis. For example, they could have been consulted when designing the studies, or recruited to a steering group. Whilst I was practically limited in the scope of what I could achieve given the time and budget available, I feel that I could have done more to engage with decision-makers on these topics, even if only in a limited capacity.

When considering this issue, it is important to note that I am not proposing that I would have required decision-maker *endorsement* of my research questions before pursuing them. This is because there are a number of reasons why policy-makers may be unwilling to endorse a legitimate and socially valuable research agenda. For example, they may face political pressure to present a positive impression of an incumbent government. Given this, they may be reluctant to endorse, or even actively attempt to suppress research into politically sensitive issues, including inequality. This is not a hypothetical scenario: the Conservative government of Margret Thatcher actively suppressed the publication of "The Black Report" into inequalities in health in 1980 (Richmond, 2002). Given this possibility, if researchers require policy-makers endorse their research agendas, there is a risk that issues that are politically sensitive but important to the public will not be addressed. Equally, it may be the case that policy-makers themselves hold views that are unrepresentative of the public, or even discriminatory. Subsequently, they may not support research into important issues that they deem to be unimportant, or that are counter to their own views (e.g. research into ethnic inequalities in health if they are racist, or research into inequalities in health between people of different sexualities if they are homophobic).

Similarly, I am not suggesting I would have required policy-makers endorse my methodological choices. These individuals are, typically, not methodological experts. As a result, they may knowingly or otherwise favour methods that are not scientifically robust, or that are inefficient. As a result, I believe it is preferable for researchers to develop methodological proposals, and then consult with policy-makers to gain their views on how they might be adapted to be more policy-relevant.

If I had consulted with policy-makers, it is possible that they may not have supported my research questions for good reasons. These reasons could have helped shape my thinking, and guided my in a different direction. Equally, the policy-makers may have supported my proposals, but suggest that I modify my study designs in order to add questions they would be of particular interest to them. For example, if I had consulted with NICE at an early stage of this thesis, they may have informed me that they were considering introducing a QALY-modifier based on inequalities in health: as set out in their recent methods consultation (NICE, 2020b). Subsequently, I could have modified my studies to be more specific to the ideas they consulted on. Equally, if I had shared my proposal with them this may have shaped their thinking. In retrospect, this feels like a missed opportunity to adapt my research to a live policy agenda. Given this, in future I plan to consult with policy-makers when developing, and executing, research ideas.

7.2.2. Limitation 2: the lack of diversity in methods/implementation approaches

The three core chapters of this thesis (4, 5 and 6) applied one choice-experiment methodology (PTO), and a limited set of implementation approaches. These studies represent a small subset of the methods/ approaches that could reasonably have used.

This thesis did not explore whether the hypotheses held using BTO, budget/pie-splitting, or DCE. Equally, it did not test whether the hypotheses held if differing groups labels were used; if the age of the potential beneficiaries were varied; if participants were asked to respond to the questions in groups; if they were asked to deliberate on the issues prior to answering the PTO questions; or, if any number of combinations of implementation approaches detailed in Chapter 3 were applied.

If different methods and implementation approaches (different "choice architectures[3]") had been used, it is entirely possible that different results may have been observed. For example, if respondents had been asked to make choices about interventions that would harm the health of different socioeconomic groups, loss aversion (Tversky & Kahneman, 1991) may have prompted them to be less willing to prioritise the poorer group over the richer group. Equally, if a budget/pie-splitting design had been implemented, naive diversification (Benartzi & Thaler, 2001) may have prompted respondents to appear to be more gain egalitarian than in the "either/or" closed pairwise PTO design used[4].

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[3] This term originates from "Nudges": the idea of making changes to the way a choice is presented in order to influence how people respond to it (Thaler & Sunstein, 2008). Whilst this term "choice architecture" is sometimes used in the context of designing an environment in order to influence behaviour in a specific way (e.g. putting fruit before chocolate bars in a school cafeteria in an attempt to prompt healthier eating), it applies equally to the design of studies intended to impartially elicit the views of the public (Thaler, 2020) (i.e. health economics preference elicitation studies).

[4] When presented with the option of allocating a finite pool of resources over a given number of alternatives, evidence suggest people have a tendency to spread those resources over the available options (Benartzi & Thaler, 2001). Subsequently, a budget/pie splitting design may result in a more even spread of resources across the alternatives than might be implied by the PTO design used in this study - a design in which respondents faced a choice between helping one group or another, but could not choose to benefit both groups to some degree.

In the context of this thesis, I find the "architectural conditionally"[5] of my conclusions discomforting. This is because, when designing the my studies, I chose to use specific methods and implementation approaches when I could reasonably have chosen alternatives. For example, I could reasonably have chosen to budget/pie-splitting or DCE rather than PTO. These alternatives may have produced different findings. As a result, if the apparent "preferences" presented in this thesis were used in policy-making, my choice of methods may result in people dying, and suffering, who may otherwise not have died or suffered, had I made alternative reasonable decisions.

Given this, it would have been preferable to have fielded a wider-range of the set of reasonable alternatives, and explored whether the results observed were robust to the approach taken (i.e. conduct sensitivity analysis). Whilst the lack of methodological diversity is a limitation of this thesis, it is equally a limitation of virtually every health economics preference elicitation study. No research program can test every potential approach. We must all decide which of the many reasonable approaches to implement given the resources available, and the consequences of those decisions may be measured in the blood of those who lose out as a result. I find this deeply unsettling. It would be interesting to explore this issue in future work - both in positive[6] and normative[7] terms.

7.2.3. Limitation 3: The conflation of socioeconomic and economic status

Chapter 1, Section 1.4, noted that prior literature that purports to be about the UK-public's aversion to socioeconomic inequalities health operationalised this concept via use of experimental labels based solely on economic status: being from the "richest" and "poorest" fifth of society. Subsequently, it stated this thesis would "carry-forward the convention set by these prior authors, and regard studies that apply economic status

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[5] My findings are conditional upon the way they were generated: the "architecture" used.

[6] What impact do different choice architectures have on the results of health economics preference elicitation studies? Which aspects of study design have a large impact, and which have a small impact? Note that I am not suggesting this issue has not been explored before. There is existing literature on the impact of framing and administration effects in health economics choice experiments (e.g. Rowen et al. 2016). I am simply interested in conducting future research of this kind, and, in particular, identifying which design factors have the largest impact of the apparent preferences elicited, and which have relatively minor impacts.

[7] Which choice architecture/s should be used? Who should decide which choice architecture/s should be used? How should architectural-sensitivity be accounted for when integrating the apparent preferences of the public in health economic evaluation? Does choice architectural sensitivity mean preferences should not be used in health economic evaluation? (Oliver, 2006; Oliver & Sunstein, 2019).

focused labels as capturing the public's aversion to socioeconomic inequalities in health".

In retrospect, this is an unnecessary conflation, particularly in the context of a thesis titled "The UK-public's aversion to inequalities in health between socioeconomic groups". In my *de novo* studies I could have used experimental labels that better represented socioeconomic status. Equally, I could have tested whether the use of socioeconomic or purely economic-focused experimental labels influenced participant responses. However, I did not do this, and simply assumed estimates of aversion to inequalities between groups defined in terms of economic status could be extrapolated to aversion to inequalities in health between socioeconomic groups. This decision is a key limitation of this thesis, and means I cannot be sure that my *de novo* studies reflect the public's aversion to socioeconomic inequalities in health, rather than simply the aversion to inequalities in health between groups of differing economic status.

7.2.4. Limitation 4: The lack of consideration of the potential to elicit aversion to inequalities in health between people who live in more and less deprived areas

In Chapter 1, I noted that prior authors have used the index of multiple deprivation (IMD: an area-based index of deprivation) as an operational substitute for an individual's socioeconomic group: both in choice experiments, and in each of the DCEAs conducted to date. I then stated that "Given this precedent, in this thesis, I will similarly regard inequalities in health between neighbourhoods of differing deprivation levels as being a reasonable, albeit imperfect, substitute for inequalities in health between socioeconomic groups.". In retrospect, when beginning work on this thesis, I should have thought more carefully about why each of the DCEAs conducted to data has used IMD-based data. With hindsight, this is because quality-adjusted life-expectancy (QALE) data stratified by IMD is readily available (Love-Koh et al., 2015), whilst this is not the case for an individual-level measure of socioeconomic status. As a result, whilst it is possible to conduct a DCEA based on IMD, it not currently possible to conduct an equivalent analysis based on an individual level measure of socioeconomic status. Looking back, I should have explored this issue earlier, and reconsidered the fundamental premise of this thesis: that I wanted to understand the UK-public's aversion to inequalities in health between socioeconomic groups in order to inform the conduct of DCEAs. In retrospect, if DCEAs are only possible if the population is stratified using IMD, the HR-SWFs used in these analyses should be informed by the UK-public's aversion to inequalities in health between people who live in more and less deprived areas, rather than their aversion to inequalities in health between socioeconomic groups. I did not consider this issue when developing this thesis, and this is a limitation of my work. In future, I would be interested to explore the UK-public's aversion to inequalities in health between groups identified using area-level deprivation.

7.3. Implications for policy-makers and researchers

This section reviews two key implications of this thesis for policy-makers and researchers. These are not the only implications of the work undertaken. These are simply the two most closely aligned to the two hypotheses at the heart of this thesis. Additional implications are discussed in Chapters 2, 5, and 6, above.

7.3.1. The need for a normative debate: should HR-SWFs be parameterised using estimates of inequality aversion between socioeconomic groups or neutrally labelled groups?

This evidence presented in this thesis is consistent with Hypothesis A: the UK-public are more averse to inequalities in lifetime health between socioeconomic groups than they are to inequalities in lifetime health between neutrally labelled groups. From a practical perspective, this difference is significant because it means that use of these two alternatives may results in different interventions being considered to be "cost-effective", and subsequently, different resource allocation decisions.

An example

Imagine you are a decision-maker tasked with implementing a bowel cancer screening strategy for the United Kingdom. Fortunately, Asaria et al. (2016) have conducted a DCEA on this topic. As part of this paper, the authors have conducted a threshold analysis. This analysis explores the impact of varying the Atkinson inequality aversion parameter[8] (ε) on the results of their evaluation. The authors identify ε=8 as the decision-critical threshold: above this level, a bowel cancer screening strategy targeted at the socioeconomically disadvantaged is the most cost-effective; below this level, a universal strategy is the most cost-effective.

Now, imagine you find McNamara et al. (2020b): the face-to-face PTO study reported in Chapter 5. This paper reports an ε value of 12.63 between socioeconomic groups, and a ε of 6.43 between neutrally labelled groups. Which of these two parameters will you implement?

The human consequences of this choice, and the need for a debate

This example clearly demonstrates the potential human implications of this thesis. In this case, use of the socioeconomic group parameter is likely to result in more people experiencing, and dying from, bowel cancer than may be the case if the neutral parameter were used. Conversely, use of the socioeconomic group parameter is likely to reduce socioeconomic inequalities in health more than if the neutrally labelled parameter were used, but fail to improve overall population health to the same degree. When applied across a whole country, and over a significant period of time, these alternatives are likely to impact the lives of a substantial number of people in profound ways. If one of the two alternatives is implemented over the other, many will suffer and die who would not otherwise have suffered and died, and many will lose loved ones that they would not otherwise have lost.

From a normative perspective, it is not immediately obvious whether the HR-SWFs applied in DCEA *should* be parameterised using estimates of aversion between socioeconomic groups, or neutrally labelled groups. Given this, and the human costs discussed above, this motivates a normative debate on this issue.

A set of reasonable positions

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[8] See Appendix A1.1 for the functional form associated with this parameter. In addition, note that higher ε numbers equate to higher levels of inequality aversion.

If our aim is represent the views of the public, it *could* be argued that DCEAs should use estimates of aversion to inequalities between neutrally labelled groups, because (1) a number of studies suggest the UK-public think the government should not consider someone's income or socioeconomic status when making decisions about their health, and (2) the rationale for choice responses across Chapters 4, 5 and 6, demonstrate that participants in these studies were influenced by these factors.

With regards to (1), Baker et al. (2010) conducted focus groups to inform the selection of attributes that would be applied in a discrete choice experiment and rejected use of socioeconomic class as an attribute on the basis of participant responses. Notably the authors state "several respondents were appalled at the suggestion that health care might be prejudiced against people with higher socioeconomic status". Similarly, Anand & Wailoo (2000) found that 88% of their respondents agreed that "the incomes of people affected by a disease should not be taken into account when determining which disease to treat". This finding is aligned to that of Dolan, Cookson, & Ferguson (1999). In their focus group based study, the authors found that 86% of respondents rejected the idea of giving lower priority to improving a person's health because they were "rich"; and similarly, that 94% rejected the idea of giving a higher priority to someone because they were "poor".

Whilst some of the studies are now dated, and they were not conducted with the aim of informing DCEA, they do suggest that the UK-public would reject the idea that the health of a richer person should be given a lower weight in decision making *because they are richer*, rather than simply *because they have higher lifetime health.* This would motivate use of estimates of aversion between neutrally labelled groups, rather than socioeconomic groups.

Putting democracy aside, it could equally be argued that it is simply unfair for the health of a richer person be given a lower weight in decision making *because they are a richer person* (Brock, 2003; Herlitz, 2017). For example, if someone is materially wealthy but suffering extreme pain, it may be argued that it is inequitable to deprioritise that person's pain relief because of their wealth.

Alternatively, it could be argued that DCEAs should apply estimates of aversion to inequalities between socioeconomic groups, because socioeconomic circumstance itself *is* relevant to decision-making. These individuals are not from "neutral" groups, and their relative advantage/disadvantage is not a matter of chance, nor it is it limited to health alone (as might be inferred from use of neutral labels). Instead, this advantage/disadvantage is a function of deep-rooted structural inequality which permeates across a wide-range of domains of well-being and opportunity (Marmot et al. 2010). Given this, use of estimates of aversion between neutrally labelled groups risks "whitewashing" the issue, both in terms of erasing concerns regarding the inequity of socioeconomic inequalities in health, and removing factual non-health differences from consideration. As a result, application of estimates of aversion between neutrally labelled groups may under-represent societies willingness to prioritise health gains provided to the socioeconomically disadvantaged.

Conversely, it could be argued that estimates of aversion between neutrally labelled groups should be used, because estimates of aversion between socioeconomic groups are influenced by factors that may be better reflected elsewhere in economic evaluation. For example, in the *de novo* studies conducted participants stated they were influenced by factors including: (1) productivity impacts; (2) downstream non-health costs (e.g. pensions); and (3) the potential for richer people to obtain private healthcare. *If* we did want to consider these factors in an economic evaluation[9], it appears normatively preferable to implement these as formal aspects of a model, rather than in a *health* inequality aversion parameter. Furthermore, if we did want to consider these factors, it appears normatively desirable to do so on the basis of evidence, rather than simply the *assertions* of members of the public taking part in a choice experiment. Alternatively, if these factors are not deemed relevant to decision-making, then DCEA should implement estimates of aversion not influenced by them.

In summary, this thesis motivates a normative debate on whether the HR-SWFs applied in DCEA should use of estimates of aversion between socioeconomic groups, or neutrally labelled groups. There are logical reasons to favour either. Given this, and the human consequences outlined above, it would be valuable for researchers, policy-makers, and the public, to discuss this issue, and debate which alternative[10], as a society, we should practically implement.

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[9] And there are good reasons why each of these might be rejected.

[10] If either. This issue will be explored further in Seciton 7.4.2, below.

My position

Personally, I am deeply uncomfortable with the idea of valuing improvements in someone's health at a lower level than someone else's *because of their socioeconomic circumstance itself.* In all honesty, I find the idea that the value of preventing, or relieving, an individual's extreme pain, severe depression, blindness, physical disability *etc*, should differ depending on their socioeconomic circumstance *itself* absolutely abhorrent; both in terms of favouring the socioeconomically advantaged, or disadvantaged. In my view, socioeconomic circumstance itself should not be considered in health decision making.

If society were to agree with this position, but still want to prioritise people with lower lifetime health[11] independently of their socioeconomic status, this could be achieved via "health-exclusive" DCEA: a DCEA in which society is stratified based on health alone (e.g. using solely the health components of IMD), rather than socioeconomic status/area based deprivation[12]. A HR-SWF parameterised using an estimate of the public's aversion to inequalities between neutrally labelled groups could then be applied to this stratification, in order to weight QALY gains based solely on the lifetime health of those individuals.

7.3.2. Implication 2: Hypothesis B (health gain types) warrants further research

As discussed in Section 7.1.2.2, above, the studies reported in Chapters 4, 5 and 6, effectively explored a restricted variant of Hypothesis B of this thesis: "the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower *life-expectancy* over advantaged socioeconomic groups with higher *life-expectancy* if an intervention improves life-expectancy than they are if it improves quality-of-life", rather than an otherwise equivalent hypothesis including the term *lifetime health.* Given this, and the evidence of "health domain specific inequality aversion" outlined previously, it is not clear whether the results observed in these studies can be extrapolated to Hypothesis B of the thesis.

As a result, the evidence currently available is not sufficient to motivate, or enable, im-

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[11] I do not necessarily support this position.

[12] As has been the case in DCEAs conducted to date (Asaria et al., 2016, 2015; Griffin, Walker, & Sculpher, 2020; Yang et al., 2020).

plementation of forms of distributionally sensitive economic evaluation that reflect health-gain type specific preferences. Consequently, further research on this topic is warranted. For example, by fielding a study comparable to that reported in Chapter 6, but with participants receiving information on socioeconomic inequalities in life-expectancy *and* quality-of-life.

In the interim, forms of economic evaluation that are capable of accounting for differences in preferences by health gain type could be developed. In practice, this would require economic models that track the dimension-level health states of individuals (i.e. not simply utility values), and then disaggregate the QALY-gain provided by an intervention into it's constituent parts. Dimension-specific distributional weights could then be applied to these different types of QALY gain in order to better represent the views of the public.

In theory, this could be done by using micro-simulation to model the EQ-5D responses of individuals in a cohort over time with, and without, an intervention[13]. The incremental QALY gain provided by that intervention could then be decomposed into that attributable to life-extension, and to each of the dimensions of the EQ-5D[14]. A health-type specific distributional tariff derived from a choice experiment could then be used to weight the different types of QALY gain in accordance with the preferences of the public.

Whilst these "health-type dissagregative" forms of cost-effectiveness analysis would be necessary to implement dimension specific differences in willingness to prioritise disadvantaged groups, they could also be used in non-distributional economic evaluation. For example, health-type dissagregative cost-effectiveness analysis could be used to generate a better understanding of the source of the QALY gains provided by an intervention[15]. It would be interesting to explore the practical feasibility, and potential applications, of health-type dissagregative forms of cost-effectiveness analysis in future work.

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[13] I accept this would be relatively data intensive compared to current methods.

[14] Note that disaggregating a QALY-gain by EQ-5D dimension would require some consideration of: (1) how to split the EQ-5D tariff constant across dimensions; and (2) how to split the multi-severe level dummy variable across dimensions (Dolan, 1997). This could conceivably be done by spreading the constant across all dimensions reporting any problems, and by splitting the severe problems dummy variable across all dimensions reporting severe problems.

[15] e.g. Drug X produces a net 3 QALY gain over Drug Y. This is a result of a 1 QALY loss attributable to increased pain/discomfort, a 2 QALY gain attributable to a reduction of anxiety/depression, and a 2 QALY gain attributable to life-extension.

7.4. Future research ideas

When discussing the limitations, and implications, of this thesis above, I introduced a number of issues and methods that I think it would be interesting to conduct future research on. In this section, I outline two further ideas motivated by the work undertaken, and the thinking underlying it.

7.4.1. Exploring aversion to inequalities in health between other social groups

This thesis is focused on socioeconomic inequalities in health. I have not explored the public's aversion to inequalities in health between other social groups. For example, between people from different geographic areas; of different ethnicities; of different migrational status; of varying sexualities; and of intersectional combinations of these attributes. To my knowledge, no study has explored the UK-public's aversion to these inequalities, or considered how they might be considered in distributionally sensitive economic evaluation.

This is potentially an important omission, because socioeconomic inequalities in health are not the only inequalities of interest to policy-makers: inequalities between these other "social cleavages" are also considered to be important (e.g. Public Health England, 2018). It would be interesting to explore these issues in future work.

This could plausibly be done using variants of the PTO studies used in Chapters 4, 5, and 6, or a Shaw-based BTO design, with group-labels varied in order to explore how the UK-public's preferences differ by group-type. Given the evidence of ethnic inequalities in death due to COVID-19 (Public Health England, 2020a), it would be particularly interesting to use this real-world situation as a basis for an inequality aversion elicitation choice-experiment focused on ethnicity.

I suspect research into the public's aversion to inequalities in health between other group-types may provide further motivation for use of health-exclusive DCEA. For example, if the public were found to be less averse to inequalities in health if the disadvantaged group were from a specific protected group[16] (e.g. an ethnic minority) (Equality Act 2010), use of an inequality aversion parameter from a study of this kind would likely

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[16] Consciously or otherwise.

violate decision-makers legal obligations regarding discrimination (Ibid.).

In contrast, use of health exclusive DCEA would remove this concern, and allow policy-makers to grant additional weights to people with lower lifetime health on the *sole basis of their lower lifetime health*, not *because* they are from an ethnic minority/majority, a migrant/domestically born, of different sexuality *etc*. Putting legal concerns to the side, I also suspect this would be more aligned to the *principles* (Van Exel et al., 2015) the public think should be applied in public decision making, even if, in the context of a choice-experiment, providing them with information about these characteristics influences their responses.

7.4.2. Exploring the democratic foundations of DCEA

Over the course of this PhD, it has become apparent that the democratic foundations of DCEA are relatively weak. Whilst many studies have asked members of the UK-public to make choices between interventions that would benefit different socioeconomic groups, and then inferred their inequality aversion on the basis of those choices, no study has explicitly asked the public whether government *should* use DCEA to inform decision-making.

This is concerning, because it is entirely possible that, if asked to choose between helping people from two socioeconomic groups in a choice-experiment, a respondent may favour helping a poorer person over a richer person, but reject the idea that, *as a point of principle*, the government should systematically prioritise the health of poorer people over richer people in decision-making.

Given this, it would be interesting to explore whether the public do support DCEA, and if so, what type of DCEA they think should be implemented (e.g. socioeconomic group based DCEA or health-exclusive DCEA). As these issues are relatively complex, this may best be done via a NICE Citizens' Council on DCEA, or an equivalent intensive Citizens' Jury/Assembly format supported by another decision-maker/public body (e.g. Public Health England). It is entirely possible that this research may result in the public rejecting DCEA entirely, and instead favouring distributionally naive approaches.

In addition to the fact that no study has asked the public whether or not they support use of DCEA, it should also be noted that the two HR-SWFs applied in DCEA to date[17] have absolutely *no* democratic foundation. No study has explored whether the preferences of the UK-public are consistent with these specific functional forms, no study has asked the public whether they support use of these functions, and no study has asked policy-makers whether they support their use. This is deeply concerning because these two functions are only two possibilities amongst a potentially enormous set (Adler, 2019). Given this, and the human implications of the choice of HR-SWF applied in DCEA, I am deeply uncomfortable with economists simply picking one, or two, of these functions and implementing them (Asaria et al., 2016, 2015; Griffin, Walker, & Sculpher, 2020; Yang et al., 2020). The choice of HR-SWF is fundamentally *an issue of judgement.* Given this, the democratic legitimacy of DCEA could be strengthened significantly by exploring whether the public's preferences are consistent with specific HR-SWFs, and whether the public and policy-makers support the use of specific HR-SWF. This could, in theory, be done using choice experiments supplemented with a Citizens' Council, as discussed above, and/or a decision-maker focused equivalent.

7.5. What I think policy-makers should do

In the first chapter of this thesis, I explained how estimates of health inequality aversion might be used to inform distributionally sensitive economic evaluations, and some of the potential implications of these uses. In this section, I explain my views on what I think policy-makers should do. Throughout, I assume the policy-maker has decided they wish to consider socioeconomic inequalities in heath in economic evaluation.

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[17] One based on the Atkinson SWF (Atkinson, 1970), and the other based on the Kolm HR-SWF (Kolm, 1976).

Distributionally sensitive economic evaluations which: (1) formally integrate across groups, or (2) take a non-integrative approach?

If policy-makers wish to pursue a distributionally sensitive economic evaluation of a given set of interventions[18], I suggest they should do so using an approach that includes integrative, non-integrative, and deliberative elements.

At first, I propose they request a conventional distributionally naive cost-effectiveness analysis of the interventions. This would give the policy-maker insight into the efficiency of the intervention at a population level. In addition, it would give them a benchmark against which to compare the results of distributionally sensitive methods.

Subsequently, I recommend the policy-maker request discrete cost-effectiveness analyses be conducted for each socioeconomic group, or operational substitute thereof (e.g. IMD quintles). This information will allow the policy-maker to better understand how interventions are expected to function in those different groups. In addition, it would provide insight into how the different groups are likely to influence the results of an integrative analysis (e.g. whether the intervention is more/less efficient in different groups).

Following this, I recommend the decision-maker request estimates of the population net health benefit associated with each intervention: both at an aggregate level, and for each group. This would provide a quantitative understanding of the human implications of each alternative, and in particular, the net health cost associated with deviating from the strategy which would maximise population health.

Subsequently, I propose the policy-maker should require formal integration across groups. In the first instance, I suggest this be done using a reference case HR-SWF and inequality aversion parameter. I recommend the policy-maker define the reference case function/parameter, and that this should be informed by a combination of evidence of the public's aversion to inequality[19], deliberation within a Citizens' Council setting[20], and discussion with stakeholders (e.g. politicians, other policy-makers, public health professionals, health service leaders, clinicians, charities, patient organisations, academics etc).

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[18] Later in this section, I will discuss which intervention types I think these methods should, and should not, be applied to.

[19] This could include consideration of estimates of aversion to inequality between socioeconomic groups and neutrally labelled groups.

[20] As proposed in the previous section.

I suggest this reference case be subject to a public consultation prior to implementation, so that the broader public can express their views. This process would allow the policy-maker to ensure they take into account the view of different stakeholders, and consider modifying their proposals in response to comments.

In addition to a reference case analysis, I propose the policy-maker should require sensitivity analyses using a broader set of pre-defined HR-SWFs and associated inequality aversion parameters. This could be used in order to identify whether the choice of HR-SWF and inequality aversion parameter is a first order issue: a factor that would change the conclusion as to which intervention strategy is the most cost-effective. If this is the case, I recommend threshold analyses be conducted in order to identify the combinations of HR-SWFs and parameters that would be required to make different strategies the most cost-effective. In order to make this easier for the decision-maker and public to interpret, I suggest this information be converted into estimates of the relative weights that would have to be placed on the lives of different social groups for specific interventions to become cost-effective (e.g. A is most cost-effective if we are willing to place a >5 weight on QALY gains provided to people from the most deprived fifth of society relative to people from the least deprived fifth of society, but otherwise B is the most cost-effective).

Once all required analyses are available, I propose the policy-maker should deliberate on which of the interventions should be implemented. At a minimum, I believe this should include a discussion on the robustness of the evaluation conducted, consideration of the base case and sensitivity analyses (both in terms of the model as a whole and the HR-SWF aggregation procedures), and a debate about whether there are good reasons to deviate from the reference case HR-SWF and inequality aversion parameter (e.g. are there factors that mean it is more appropriate to a apply higher/lower/no distributional weightings in the case of these interventions?). As part of this deliberation, I recommend the policy-maker explicitly consider the net health and distributional impacts of each intervention. In addition, I propose they should debate the acceptability of the relative weights that would have to be placed on the lives of different social groups in order to make each intervention the most cost-effective. Furthermore, I recommend they consider whether there are other aspects of the interventions that warrant QALY-weighting on other grounds: for example, relating to innovation, or other potential prioritisation criteria. Subsequently, I suggest the policy-maker should recommend/fund the intervention, or set of interventions, that in totality they feel represents the best use of public money. I then propose the policy-maker should publish the logic underlying their decision, and provide the public with an explicit population health impact assessment associated with the chosen intervention/s[21].

In my view, this approach would enable the policy-maker to be transparent and explicit in their consideration of inequality, but enable them to be flexible and adapt to the nuance of a given situation where warranted.

When considering this proposal, it should be noted that, during consultation, the public may reject the use of a distributionally sensitive HR-SWF at all. If this is the case, I believe the policy-maker should reflect on the social legitimacy, and political implications, of introducing an aggregation procedure and methodology the public do not support. In this case, the policy maker could reasonably decide to introduce a distributionally sensitive HR-SWF anyway. For example, they may believe inequalities in health are fundamentally unfair and require resolution irrespective of whether the public support this. However, I would caution against this in the context of the UK: a country that has a tradition of democracy, and of implementing the views of the public in health-related decision making.

Distributionally sensitive economic evaluations of interventions: (1) restricted to specific social strata or (2) available to all?

The NHS was founded on the idea of treatment according to need, irrespective of socioeconomic circumstance. Given this, I believe it would be politically untenable for a UK decision-maker to consider restricting a “downstream” NHS medical treatment or procedure to specific socioeconomic groups. As a result, I do not recommend policy-makers conduct or commission economic evaluations of treatments restricted to specific socioeconomic groups. Conversely, targeting of public health interventions is relatively commonplace (Bull et al., 2014). Given this, I believe it would be appropriate to conduct distributionally sensitive economic evaluations of these restricted interventions.

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[21] e.g. A is associated with an expected net loss of 5,000 QALYs compared to B. However, A was selected because it will reduce inequalities more than B. A provides a net benefit of 3,000 QALYs over B to people from the most deprived fifth of society, and a net loss of 8,000 QALYs to people from the least deprived fifth of society.

Distributionally sensitive economic evaluations of: (1) preventative & screening public health interventions, or (2) treatments for ill health?

Subject to consultation with stakeholders and the general public, I believe policy-makers (e.g. Public Health England) should implement distributionally sensitive economic evaluations for "upstream" public health interventions. Furthermore, I suggest this be done using the approach outlined earlier in this section. I hold this view, because the reduction of inequality is a key objective of public health decision-makers (PHE, 2020b), and I believe the proposal above provides a sensible, evidence-based, way for this objective to be considered in decision-making.

In addition, I suggest policy-makers (e.g. NICE) should consult on using this same approach for medical interventions, where they deem it appropriate in order to capture the benefits/costs of the intervention. For example, if a medical intervention is expected to have a significant impact on inequalities in health (e.g. a new medicine that substantially lowers the risk of mortality from cardiovascular disease[22]), NICE could require, or give manufacturers the opportunity to provide, a full distributionally sensitive economic evaluation[23]. Alternatively, if inequalities in health are not expected to be relevant (e.g. appraisals of end-of-life cancer medicines that provide minor survival benefits), NICE could maintain their current distributionally naive methods. In the interest of efficiency, I suggest NICE specify whether distributionally sensitive methods should be used during scoping of an appraisal/guideline.

In my view, this approach, combined with the proposal set out earlier in this section, would give policy-makers the flexibility to consider inequalities in health where relevant, and to do so in a structured, evidence-based, transparent, and nuanced manner. Furthermore, it would allow them to demonstrate they are properly and seriously taking account of the distributional impacts of their decisions: a legal obligation for the NHS in England (NHS England, 2015).

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[22] Note there is a strong socioeconomic gradient of mortality due to cardiovascular disease (Marmot et al., 2020)

[23] This opportunity could equally be provided to guideline development groups. Similarly, NICE could request academic groups conduct distributionally sensitive economic evaluations in support of their Multiple Technology Appraisal program.

7.6. Clarifying original contributions to knowledge

This thesis is the first work: (1) to introduce, and explore, the two hypotheses discussed; (2) to find evidence that the UK-public are more averse to inequalities in health between socioeconomic groups, than between neutrally labelled groups; (3) to provide evidence that the UK-public are more willing to prioritise disadvantaged socioeconomic groups with lower life-expectancy over advantaged socioeconomic groups with higher life-expectancy, if an intervention improves life-expectancy, rather than if it improves quality-of-life; (4) to report participant explanations of their choices in a socioeconomic health inequality aversion elicitation study; (5) to find evidence that participants choices between socioeconomic groups in these studies are influenced by non-health factors; (6) to argue that it may *not* be normatively desirable for DCEAs to apply HR-SWFs populated with estimates of the public's aversion to inequalities between socioeconomic groups; and (7) to find evidence that suggests the UK-public's aversion to socioeconomic inequalities in health may be health dimension-specific. In addition, this thesis (8) is the first to report use of PTO to explore aversion to socioeconomic inequalities in health.

7.7. Reflecting on this thesis as a whole

In this thesis, I have hopefully demonstrated my ability to think, and act, in a systematic manner; to make original contributions to knowledge; to relate my findings to existing research; to explain the implications of my work for policy-makers; and to write to a publishable standard. Whilst, as discussed above, there are things I would do differently if I were asked to test the two hypotheses again, I have learned a lot through doing what I have, and have found this to be a very valuable, and enjoyable experience.

I suspect the most significant contribution of this entire thesis is simply pointing out that existing DCEAs may have, intentionally or otherwise, effectively deprioritised the health of people *because of their socioeconomic circumstance itself*, rather than simply *because they have higher lifetime health.* I firmly believe this is inappropriate, and suspect that much of the public, media, and government are likely to agree with me. Given this, I hope this issue is considered seriously by those conducting and commissioning DCEAs, and those considering implementing interventions on the basis of these analyses.

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