When is health inequality acceptable?

Appraisals of inevitability, complexity and causal explanations

Bridger, Emma K [1]

Tufte-Hewett, Angela [2]

Comerford, David [3]

Nettle, Daniel [4, 5]

1. School of Psychology and Vision Sciences, University of Leicester, Leicester, UK
2. Department of Psychology, Birmingham City University, Birmingham, UK
3. Behavioural Science Centre, University of Stirling, Stirling, UK
4. Institut Jean Nicod, Département d'études cognitives, Ecole Normale Supérieure, Université PSL, EHESS, CNRS, Paris, France
5. Department of Social Work, Education and Community Wellbeing, Northumbria University, Newcastle upon Tyne, UK

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Correspondence concerning this article should be addressed to Emma K Bridger, School of Psychology and Vision Sciences, University of Leicester, Leicester, UK.

Email: eb441@leicester.ac.uk

Abstract

Health inequalities are typically presented with respect to separate groupings or *bases of categorization*, such as income-related health inequality or life expectancy by education. We sought to characterize the cognitive consequences of presenting health inequality by bases of categorization. Across two studies (N = 1,321), UK and US participants made a number of judgments about life expectancy differences (including how acceptable they are and whether they should be addressed) attributed to distinct bases of categorization: income, education, social class, neighbourhood, lifestyle choices and genetics. Health inequality was perceived as least acceptable when attributed to the four socioeconomic bases, and most acceptable for lifestyle choices and genetics. Six appraisal dimensions – complexity, malleability, inevitability, extent driven by biological, psychological and sociocultural causes - varied with basis of categorization *and* predicted views on health inequality. These dimensions could explain the majority (47-57%) of the drop in acceptability for health inequality attributed to neighbourhood, social class and education differences relative to a condition with no categorization. These findings illustrate for the first time some of the causal explanations and affiliated inferences that underpin views on health inequality, and the corresponding consequences for communicating about health and health inequalities.

Keywords: Health inequalities; Lay perceptions; Categorizations; Conceptions of inequality; Appraisals; Causal explanations

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Appraisals of inevitability, complexity and causal explanations

Securing public support and engagement is key for the success of interventions designed to reduce health inequalities (Marmot, 2010; Smith et al., 2022). Accordingly, researchers from a growing number of social science disciplines are studying lay perspectives on health inequalities. Building on sociological research on lay conceptions of illness (Helman, 2007; Pitt & Stott, 1985), one robust strand of this work employs qualitative methods to document lay views and experiences of inequality and health (Blaxter, 1997; Smith et al., 2022; Smith & Anderson, 2018). Elsewhere, health economists ask respondents to make choices between different health distributions in order to calculate inequality aversion preferences (Comerford et al., forthcoming; Costa-Font & Cowell, 2019; McNamara et al., 2020). Others use simpler survey designs to ask about acceptable levels of health or income inequality in society (Howarth et al., 2019; Macchia & Ariely, 2021; Bridger et al., 2023). One feature common to these distinct approaches is that preferences, views or attitudes are typically elicited in a *bivariate* manner (Costa-Font & Cowell, 2019; Howarth et al., 2019). By this we refer to the fact that health inequalities are presented as a function of another grouping or domain, which we call different *bases of categorization* (or *categorizations* for brevity) hereafter.

One commonly examined basis of categorization is income, as in studies of income-related health inequality aversion (Hardadottir et al., 2022), ideal health distributions across income quintiles (Macchia & Ariely, 2021) or views on life expectancy differences between the rich and the poor (Bridger et al., 2023). These provide valuable insights, but they do not reflect the diversity of categorizations actually employed in health inequality research. In their mapping analysis of health equity research, Collyer & Smith (2020) identified at least eight different clusters of leading international researchers working in the area. These clusters differentiated along geographical, historical, and disciplinary lines but also by their emphasis on particular bases of categorization. For instance, one cluster, primarily in the Netherlands, UK and US, focused on income-based health inequality, whilst another UK-based cluster represented those who study geographical and place-based approaches to health. The largest cluster was the US-based field of "*health disparities*", which examined health outcomes for different ethnic groups, arising from efforts to understand health gaps between ethnic minority and majority populations. Even within the discipline of social epidemiology, there have been debates about how and which socioeconomic status (SES) indicators should be used to operationalize social gradients of health. Some have argued that different indicators, such as education or occupation, can be taken as transposable elements of the same underlying fundamental cause (Phelan et al., 2010), but others contend that SES indicators should not be used interchangeably because SES-health associations vary according to which indicator is employed (Macintyre et al., 2003). In one critique of this kind, Geyer et al. (2006) argue that, despite arranging health outcomes in similar distributions, education, income and occupational class each independently relate to health after mutual adjustment suggesting that they "tap into different causal mechanisms" (pp. 804). They posit, for example, that net effects of education might reflect the role of greater health awareness or increased control, whilst income-related effects might capture easier access to material resources that boost health.

It is feasible that, even without awareness of these epidemiological patterns, non-experts might make distinct causal inferences about health inequality as a function of different categorizations, and this may have consequences for their views about inequality. Our view on this is informed first by the claim that causal models are key construals that people automatically use to make sense of their worlds (Sloman, 2005), and more specifically by work showing that, when people are presented with causal explanations for certain behaviours, they make a number of corresponding inferences. Nettle and colleagues (2023) presented participants with a series of explanations (e.g., “Young men in town of XXXX have a genetic propensity to kill”) for behaviours such as homicide or teenage parenthood and asked them to make a number of ratings for each explanation. Responses indicated that participants grouped these framings into broader clusters of explanations that were compatible with biological (e.g., genetics, hormones), psychological (e.g., motivation, choices and traits) and sociocultural (e.g., culture, social roles) superordinate categories. These clusters encompass attributional dichotomies reported elsewhere such as individual-situational (Piff et al., 2020) and biogenetic-psychological judgments (Haslam & Kvaale, 2015) including in lay views of health and illness causation (MacFarlane & Kelleher, 2002; Helman, 2007). The three causal clusters also correspond well with separate domains of intuitive biology (Medin & Atran, 2004), intuitive psychology (Kamps et al., 2017) and intuitive sociology (Shutts & Khalish, 2021), each of which produce characteristic types of reasoning (Spelke & Kinzler, 2007). Accordingly, these causal explanations synchronised with judgments about whether these behaviours could be changed and what kinds of interventions were appropriate to change them. Presenting participants with psychological explanations for behaviours led them to rate the behaviour as simpler and more malleable; socioculturally-caused behaviours were seen as more complex; and biological explanations led to lower malleability ratings. These patterns are consistent with the logic that biological explanations cue operating features of intuitive biology, which is that the world is immutable, natural and predetermined (Heine et al., 2017) and less easily subject to change, personal choice or agency (Dar-Nimrod & Lisandrelli, 2012). In contrast, psychological explanations may induce greater perceived malleability if intuitive psychology principles explain behaviour as a function of “transient and reversible inner states” (Nettle et al., 2023).

We view it as plausible that similar effects arise when people are presented with health inequality by different bases of categorization. For instance, if work on income inequality attributions in US samples (Piff et al., 2020; Kraus et al., 2009) also applies to health, respondents would be expected to endorse sociocultural explanations to a greater extent than psychological ones to explain income-related health inequality. Other categorisations such as education or lifestyle differences, however, might lead to greater endorsement of psychological explanations and thus be viewed as more malleable and less complex. An important component of our proposition here is that these causal explanations and associated inferences about complexity and malleability have consequences for global views on the acceptability of health inequality. Whilst we propose to empirically test this for the first time here, there are already indications that opposition to health inequality varies depending on whether this is differentiated by income or education. In a recent UK Health Foundation report (Kane et al., 2022), 75% of a nationally representative survey (n = 2,102) stated that addressing differences in health by income was important, whilst only 69% indicated differences in health by education level were important to address. In the present studies, we set out to examine whether such differences in acceptability of different kinds of inequality arise because of the intuitive causal judgments people make for different categorization bases. We also examine a wider range of categorization bases than have previously been studied (cf. Booske et al., 2011).

Methods

In two studies, we asked participants from the UK and USA their views about differences in life expectancies for distinct bases of categorization. There is already considerable study of the UK public's view of health inequality (e.g., Howarth et al., 2019;

Smith et al., 2022) and we wished to include respondents from another English-speaking country with high levels of inequality. In line with previous work (e.g., Bridger et al., 2023; Kane et al., 2022; Smith et al., 2022), we asked participants to indicate the priority with which these life expectancy differences should be addressed (Study 1) and agreement that something should be done about them (Study 2), as well as about the overall acceptability of life expectancy inequality (Studies 1 and 2). We present participants with one of six bases of categorization: genetics, lifestyle choices, income, education, neighbourhood and social class. The latter four categorizations were selected to capture a broad range of SES indicators employed in epidemiologic literatures of socioeconomic health inequalities. We also examined views on health inequalities by lifestyle choices following evidence that health behaviours explain a considerable proportion of social gradients in health and mortality (Whitley et al., 2014), as well as concerns that health inequality policy often focuses on tackling social gradients in lifestyle choices and behaviours at the expense of upstream interventions that might address socioeconomic inequalities themselves (Baum & Fisher, 2014). Whilst the genetic basis of socioeconomic health inequality is unclear and controversial (Mackenbach, 2005), we included this as a basis because people view genes as a key determinant of ill-health (Schnittker, 2015) and because we wanted to examine responses for a category likely to invoke biological explanations.

Studies 1 and 2 were conducted separately and sequentially but are reported together in the interests of brevity and in order to clarify the motivating logic for key changes between the two studies. Although primarily exploratory, we pre-registered both study designs and analysis protocols prior to data collection: https://osf.io/4cez8/?view_only=886245f44632487fbb152a5c47ba142b (Study 1) and https://osf.io/nbvc7/?view_only=6c8f0f9c6b17483ab5b4cdfc7559ee70 (Study 2). Divergence from planned analyses is acknowledged where relevant. Both studies received ethical approval from the ethics committee at Birmingham City University (/#11312/sub2/R(A)/2022/Dec/BLSSFAEC).

Participants (Study 1 and 2)

The data reported here are from 602 participants in Study 1 and 719 in Study 2. Samples in both studies were recruited through the UK and US Prolific panels (1: UK = 301, US = 301; 2: UK = 364, US = 355). Use of platforms like Prolific is widespread in experimental psychology. They can rapidly produce large datasets, are more socioeconomically diverse than student participant pools and have been shown to replicate the results of in-person studies (Peer et al., 2022). A priori power analysis was precluded by the exploratory nature of the study design; nonetheless we sought to obtain a minimum of 100 participants in each of the categorization conditions.

Mean age was comparable in the two studies (1 = 38.35, SD = 13.76, range = 18-83; 2 = 39.93, SD = 13.89, 18-83), however, gender distribution was less balanced in Study 1 than 2. 61.96% (n = 373) of participants in Study 1 identified as female, 37.54% as male (n = 226) and the remainder (n = 3) as non-binary, compared to 48.95% (n = 352) identifying as female in the Study 2. The remainder of Study 2 respondents identified as male (n = 355; 49.37%), as genderfluid (n = 1), non-binary (n = 6) or preferred not to say (n = 6). Participants from Study 1 were not able to take part in Study 2. During recruitment, participants with missing data on more than two of the key study questions were dropped and replaced.

Design and Materials

Study 1

Participants were randomly allocated to one of six categorization bases (income, neighbourhood, education, social class, genetics, lifestyle choices). All participants were presented with an initial text stating that *In Britain/the USA today, people in the longest-lived* *percentile live 15 years longer than those in the 1st percentile*, accompanied by a graphical depiction of life expectancy by percentile (adapted from Chetty et al., 2016). Participants were then informed that these differences in life expectancy are mainly due to differences in the corresponding categorization condition. Figure S1 presents a screenshot of how this information and ancillary questions appeared to participants in the social class condition.

Participants were next presented with four questions in the following order. First, they were asked how acceptable these differences in life expectancy are (on a 0 to 100 slider, where 0 = *not at all acceptable* and 100 = *entirely acceptable*). Second, they were asked how much of a priority they thought addressing these differences should be (where 0 = *not at all a priority* and 100 = *a very high priority*). The final two questions of this section asked how easy they thought it would be to address these differences in life expectancy due to the basis of inequality (where 0 = *not at all easy* and 100 = *very easy*) and how inevitable they thought these differences in life expectancy are (where 0 = *not at all inevitable* and 100 = *entirely inevitable*).

Participants were then asked to rate four causal explanations (biological, psychological, sociocultural and chance factors) for differences in life expectancy. Full description and analysis of these items can be found in Supplemental Materials. We do not report further on these responses here because aspects of the analysis indicated that participants had difficulty interpreting these items. For instance, the genetics category was rated higher for psychological than biological explanations. It was also the category rated lowest on chance factors, which was counter to our expectations. To help address these concerns, in Study 2 we reverted to the approach employed in the study that motivated the inclusion of these causal explanation items in the first place (Nettle et al., 2023). This meant that we asked participants to rate more specific causal explanations, i.e., hormones (as in

Nettle et al. 2023) rather than superordinate categories (i.e., biological explanations) which may be harder to interpret. This is described in further detail below.

Demographic questions at the end of the survey were restricted to gender and age. Along with standard information on study details, withdrawal, contact and data storage, at the point of debrief we took care to ensure that participants were informed that it is not the case that differences in health and life expectancy are driven by any one factor and that in reality, health and life expectancy are influenced by many different determinants at the same time. Participants were invited to learn more at an international webpage on the determinants of health.

Study 2

This study was designed to replicate and address some limitations of Study 1. There were a number of changes to the design and materials. Firstly, we included a seventh “no-basis” condition, intended to serve as a neutral reference category. In this condition, we asked participants to make acceptability ratings of inequality where inequality was presented without any basis of categorization. This condition allows us to compare the influence of specific bases of categorization against a condition with no category.

We were also cognizant that in Study 2 we could not differentiate participants’ judgments about the basis of categorization itself (e.g., social class) from life expectancy differences related to that basis (e.g., life expectancy differences by social class). It may be, for example, that social class is viewed as a more intractable issue than life expectancy by social class (or vice versa), or that some participants interpreted the question as asking about the former whilst others answered about the latter. To determine whether this mattered, we manipulated whether participants were asked to rate the basis of categorization per se or life expectancy by that basis of categorization (we henceforth refer to this variable as *explanation target*). Table S3 presents an overview of the study design and the final sample size per cell.

The initial text and question on acceptability were as in Study 1. As it may have assessed ratings of the urgency of the issue as opposed to general support for intervention, and in order to more directly compare with previous studies (Bridger et al., 2023; Smith et al., 2022), the question on how much of a priority intervening should be was replaced with a question asking about support for intervention: *How much do you agree that something needs to be done to address these differences in life expectancy* [by [category]]? on a scale from -50 (*strongly disagree*) to +50 (*strongly agree*). The response scale was changed from 0-100 to -50 to +50, to help participants differentiate agreement vs. disagreement.

Participants were next asked four questions (in a randomized order) designed to gauge perceptions of inevitability, malleability and complexity. As these are relatively abstract concepts to rate and participants may have struggled with this in Study 1, we reverted to asking participants to agree or disagree with simpler statements as in Nettle et al. (2023). Accordingly, we asked the extent to which participants agreed or disagreed (on a 100-point slider where -50 = *strongly disagree* and 50 = *strongly agree*), that differences: can be easily changed; are inevitable; have a simple cause; and are complex. Participants in the categorization as explanation target condition were asked to make these ratings about the basis of categorization (e.g., *differences in social class have a simple cause*), whilst participants in the life expectancy by categorization condition were asked about life expectancy by the basis of categorization (e.g., *differences in life expectancy by social class have a simple cause).*

Subsequently, participants were asked to rate the contribution of 12 causal factors (in a randomized order) on a scale from 0 (*not at all driven by*) to 100 (*strongly driven by*). The response scale and phrasing of nine of these causal explanation items were adapted from

Nettle et al. (2023) where ratings of explanations that relate to genetics, hormones and evolutionary advantage were found to cluster together ('biological' cluster), ratings of choice, motivation and psychological traits clustered together ('psychological' cluster), as did ratings of culture, social role, childhood experiences ('sociocultural' cluster). Items were rephrased to fit the current paradigm (e.g., rate the extent to which *differences are driven by factors related to childhood experiences*). A further three items were added to capture features of what might be understood to be the case if something is driven by chance: factors that cannot be known, factors that cannot be controlled, factors that cannot be predicted. These were included to determine whether these differentiated from biological causes, that are often conflated with chance attributions (e.g., Pill & Stott, 1985) and because views on chance and luck are known to be determinative in people's judgments about fair health outcomes (Tinghög et al., 2017). Due to an error, all participants were presented with two identically-worded items relating to social roles (instead of the 13th pre-registered item) and so responses to these two identical items were averaged. We therefore collected data on 12 causes rather than the pre-registered 13.

On the final page, participants were asked analogous questions about the extent to which differences should be driven by each of the 12 causes. Henceforth, these items are referred to as measures of *ideal causation* in order to differentiate them from measures of *perceived causation* described above and reported below. Full reporting and analysis of ideal causation responses can be found in Supplemental Materials.

Results

All data and code for both studies are available at https://osf.io/jk7p5/?view_only=435bbff197954e66ba5640cada51b7d1.

Study 1

Acceptability. A one-way between-subjects ANOVA on acceptability ratings for participants in the six categorization conditions revealed a main effect of categorization basis ($F(5,593) = 39.96$, $p < .001$, $\eta^2 = 0.252$). To characterize this effect, Bonferroni-corrected post-hoc contrasts (corrected for a family of 6 contrasts) indicated that acceptability was significantly higher for genetics and lifestyle choices than all other bases (*p*s < .001). Acceptability ratings did not differ between genetics and lifestyle choices, or between neighbourhood, education, social class and income (see Figure 1).

Priority. On average, ratings for all six categorization bases were closer to a very high priority than not at all a priority (see Figure 1). A one-way ANOVA on priority ratings showed a main effect of categorization ($F(5,594) = 6.88$, $p < .001$, $\eta^2 = 0.055$). Life expectancy differences as a function of genetics were a significantly lower priority than all other bases of categorization, significantly so (*p*s < .005) in all cases except for lifestyle ($p = .057$).

Malleability. Ratings of how easy to address (hereafter, *malleability*) and how inevitable these differences in life expectancy are (hereafter, *inevitability*) were only weakly negatively correlated ($r = -.091$, $p = .027$; see Table S1) and so these variables were analysed separately. On average, malleability ratings were closer to not at all easy than very easy to change (see Figure 1). A one-way ANOVA showed a main effect of categorization ($F(5,590) = 4.150$, $p = .001$, $\eta^2 = 0.034$) and Bonferroni-corrected post-hoc contrasts revealed that education-related differences in life expectancy were viewed as easier to address than social class differences ($p = .018$). All other differences were non-significant (*p*s > .05).

Inevitability. Ratings of inevitability were on average closer to entirely inevitable than not at all inevitable (see Figure 1). The one-way ANOVA on these ratings again indicated a main effect of categorization (F(5,592) = 3.688, $p = .003$, $\eta^2 = 0.030$). Bonferroni-corrected post-hoc contrasts showed that life expectancy differences related to genetics were viewed as significantly more inevitable than those relating to education ($p = .014$) and neighbourhood ($p = .004$). No other differences were significant (ps > .05).

Supplemental Analysis. Additional analyses reported in the Supplemental Materials examined whether effects of categorization interacted with country. Inevitability ratings were higher in the UK than US respondents, but there were no other main effects or interactions with country.

Study 2

Acceptability. The one-way between-subjects ANOVA on acceptability ratings showed a main effect of categorization (F(6,711) = 35.969, $p < .001$, $\eta^2 = 0.233$) and Bonferroni-corrected contrasts indicated that acceptability differed for the condition with no basis relative to all other categories (ps < .001) and that acceptability for the no-basis condition lay in between those for specific bases of categorization (see Figure 2). Acceptability ratings were significantly higher for lifestyle choices and genetics compared to all other bases (all ps < .005). There were no significant differences between ratings of acceptability for neighbourhood, social class, income and education, or between lifestyle choices and genetics. The pattern from Study 1 was therefore replicated, with the addition that acceptability of life expectancy inequality per se lay at an intermediate level: more acceptable than differences by neighbourhood, social class, income and education, but less acceptable than differences by lifestyle choice and genetics.

Support for intervention. There was also a significant main effect of categorization for responses to this item (F(6,710) = 13.542, $p < .001$, $\eta^2 = 0.103$). Support for intervention was significantly lower for genetics than the no-basis condition ($p = .016$), neighbourhood (p

$< .001$), social class ($p < .001$), education ($p < .007$) and income ($p < .001$). Support for intervention was also significantly lower for lifestyle choices than for education ($p < .001$), income ($p = .001$), neighbourhood ($p < .001$) and social class ($p = .004$). Support for intervention on neighbourhood was significantly higher than for no basis ($p = .007$). Responses did not differ significantly between genetics and lifestyle choices ($p = .803$).

Malleability, Inevitability and Complexity. To enable comparisons with Study 1, responses to items on how easily differences can be changed (malleability) and how inevitable (inevitability), which correlated negatively ($r = -.216$, $p < .001$) were analysed separately. Agreement that differences have a simple cause and are complex were more strongly negatively correlated ($r = -.507$, $p < .001$) and so, in line with Nettle et al. (2023), responses to having a simple cause were reverse coded and the mean of the two items was calculated to capture an overall measure of complexity.

Figures 2 and S2 show ratings of inevitability, complexity and malleability (Fig S2) for the seven bases of categorization. Main effects of categorization were significant for all three dimensions ($F(6,709/711) > 5.62$, $p < .001$, $\eta^2 > 0.045$). Genetics was rated as significantly less malleable than all other categories (ps $< .001$; except for no basis). Inevitability judgments were higher for the no-basis condition than for education ($p = .043$), neighbourhood ($p < .001$) and social class ($p = .007$). They were also higher for genetics than all other categories (ps $< .001$) except lifestyle choices and no basis. Differences by lifestyle choices were viewed as more inevitable than by neighbourhood ($p < .001$) and social class ($p = .003$). Finally, differences without a basis and attributed to genetics did not differ in complexity from one another and were rated as more complex than income (ps $< .001$), neighbourhood (ps $< .05$). Genetics was also rated as more complex than education ($p = .031$) and lifestyle choices ($p = .031$). Complexity ratings did not differ between other bases of categorization.

Although not planned, for completeness we examined whether ratings on these dimensions were influenced by explanation target (life expectancy by categorization basis vs. categorization basis). These analyses are reported in full in Supplemental Materials. Whilst there were no interactions with explanation target for judgments of malleability or complexity there were for inevitability ratings. Overall, participants viewed life expectancy differences by bases of categorization (e.g., life expectancy by education differences) to be less inevitable than the bases of categorization themselves (e.g., education differences). The exceptions to this were lifestyle choices (where inevitability ratings were comparable across explanation target) and social class (where life expectancy differences by social class were seen as more inevitable than social class differences per se; see Figure S4).

Causal Explanations. A Kaiser-Mayer-Olkin test on the ratings of the 12 causal explanations showed good sampling adequacy for perceived (overall MSA = .83; lowest MSA was .73 for social roles) and ideal explanations (overall MSA = .83; lowest MSA was .66 for motivation). Initial scree plots conducted separately for the perceived and ideal causation items indicated that between 2 and 4 components should be extracted for perceived explanations and 4 components for ideal explanations. As a four-component solution was anticipated and most consistent across the two sets of causal explanation items we conducted PCA analysis to extract four components applying oblique (promax) rotation. The four-component solution was broadly comparable across perceived and ideal items. The first factor (biological explanations) included evolution (perceived factor loading = .83; ideal factor loading = .93), genetics (perceived = .88; ideal = .90) and hormones (perceived = .81; ideal = .83), whilst a second factor captured uncontrollable or chance causes: factors that can't be predicted (perceived = .88; ideal = .93), known (perceived = .87; ideal = .91) or controlled (perceived = .74; ideal = .90). A third factor related to sociocultural factors: social roles (perceived = .90.; ideal = .95), childhood experiences (perceived = .80; ideal = .87) and culture (perceived = .64; ideal = .86) and a fourth component related to psychological factors: choices (perceived = .92; ideal = .94) and motivations (perceived = .92; ideal = .91). The principal difference in component solutions for the two sets of items was that dispositional traits loaded on to the biological factor for perceived items (.56) but did not load onto any factors for ideal explanations. This item was removed from further analysis. Table S4 shows the correlations between the four components which were highest for the chance and biological components (perceived = .55, ideal = .51) and sociocultural and psychological components (perceived = .48, ideal = .36). Together the four components explained 70% of variance in responses to perceived causal explanations and 77% of ideal causal explanations. Measures for the four components were created by averaging ratings for the corresponding items. Figure 3 shows mean perceived causal explanation ratings for each categorization basis. Planned analyses of causal explanations by categorization, explanation target and perceived vs. ideal causation are reported fully in Supplemental Materials.

Categorical Mediation. In order to determine whether differences between each basis of categorization and the no-basis condition were mediated by the appraisal dimensions and causal explanations we conducted a planned multi-categorical mediation analysis, using Hayes' (2013) PROCESS macro for regression-based approaches to mediation. The macro allows for simple quantification of the indirect pathway from predictor (in this case, each categorization basis relative to no-basis) to the dependent variable (acceptability/agreement something should be done) via each mediator. The six categorization bases were thus dummy coded with no-basis as the reference category, with malleability, inevitability and complexity ratings as well as the four causal explanation dimensions included as parallel mediators. Age, being in the UK (vs. US) and being male (vs. all other genders) were included as covariates. Standard errors were robust to heteroscedasticity (Cribari-Neto) and 10,000 bootstraps were drawn to obtain confidence intervals for indirect effects. Comparable analyses for Study 1, with education as the reference category are reported in Supplemental Materials.

Table 1 reports the total and indirect effects for models predicting ratings of acceptability and agreement that something should be done. Acceptability was higher and support for interventions lower for male participants than participants of other genders. UK and younger respondents were also more supportive of intervention on this issue. Table 1 shows that there were significant indirect effects on acceptability through most of the included mediators except for chance and malleability judgments, however, the exact pattern of mediation differed across bases of categorization (see Figures 4 & 5). For instance, relative to life expectancy differences not attributed to any category, differences by education, income, neighbourhood and social class were less acceptable partially because they were viewed as less inevitable and less driven by biological explanations (hormones, genes, evolution). Neighbourhood and social class categorizations were less acceptable due to a decrease in the perceived role of psychological explanations (choices and motivations). Life expectancy attributions by genetics, however, were comparatively more acceptable as they were seen as more inevitable, more biologically-based and less psychologically-based. Lifestyle choices were viewed as more acceptable because they were also viewed as less complex, as well as more psychologically-driven. Complexity ratings as well as sociocultural causes negatively predicted acceptability and therefore often acted as suppressors such that they operated against the prevailing direct and remaining indirect effects of categorization on acceptability. For example, income-related life expectancy differences were seen as less complex than the no-basis condition, slightly offsetting the other effects that overall reduced acceptability for this category. Similarly, lifestyle choices were viewed as more socioculturally-driven than the neutral condition, which counteracted effects of reduced complexity and increased psychological drivers.

Table 1 also depicts the corresponding pattern for support for intervention on health inequality. Again, there were significant indirect effects for sociocultural (education, genetics, lifestyle) and psychological (genetics, lifestyle, neighbourhood, social class) explanations as well as inevitability and complexity ratings. However, in contrast to acceptability judgments, there were no significant indirect effects through biological explanations, whilst malleability ratings did mediate effects of education, genetics and lifestyle choices relative to no-basis.

Supplemental Analysis. The remaining planned analyses are reported in the Supplemental Materials, alongside examination of effects of categorization and sample. As in Study 1, there was little evidence of interactions with country, with the following exceptions: support for intervention and inevitability judgments were higher in the UK sample and US respondents rated sociocultural explanations lower than UK respondents in the genetics condition. Unplanned moderated mediation analyses examined whether country influenced any of the direct and indirect pathways tested above. Psychological explanations were predictive of acceptability ratings in the UK sample only. There were no other significant interactions with country.

Results Summary

Differences in the acceptability of life expectancy differences according to basis of categorization were consistent across both studies: acceptability was lowest for life expectancy by income, social class, neighbourhood and education, and highest for life expectancy by lifestyle choices and genetics. In Study 2, acceptability for life expectancy variation without a categorization basis lay in the middle. An inverse pattern was observed for judgments of priority to intervene (Study 1) and support for intervention (Study 2). In Study 2, the twelve causal explanations reduced to the four anticipated superordinate categories: biological, chance, sociocultural and psychological explanations. These causal dimensions behaved as expected; biological and chance explanations were most highly endorsed for genetics as a basis of inequality. Importantly, inevitability, complexity and causal explanations partially mediated effects of categorization basis on acceptability ratings. Health inequalities that were rated as more inevitable, biological and psychologically-driven were viewed as more acceptable, whilst those rated as more complex and socioculturally-driven were less acceptable.

We examined whether judgments differed according to explanation target in Study 2. There were no effects of explanation target on complexity or malleability ratings, however, inevitability ratings were on average higher for basis of categorization as explanation target rather than life expectancy by explanation target. So, inequality in income was perceived as more inevitable than inequality in life expectancy by income; and this was true for all the other bases of categorization other than lifestyle choices and social class.

General Discussion

We asked whether, and if so why, acceptability of health inequality varies according to the basis by which it is categorized. Across both studies, respondents viewed life expectancy inequality attributed to genetic factors and lifestyle choices as most acceptable, whilst health inequality attributed to neighbourhood, social class, income and education were least acceptable. Complementary patterns were observed for supporting interventions to address these differences (Study 2) and the priority of doing so (Study 1). This extends evidence that bivariate conceptions of health inequality are less acceptable than univariate (Howarth et al., 2019) because it demonstrates that the nature of the bivariate framing – which we have called the basis of categorization – is also a key determinant of views on health inequality. The present findings provide an emergent framework for understanding the cognitive appraisals underlying this.

Life expectancy inequality was viewed as markedly less acceptable when presented as a function of categorisations often employed in the reporting of socioeconomic and place-based health inequalities: neighbourhood, education, income and social class. This finding confirms the assumption that there are attitudinal consequences of presenting health equality in socioeconomic terms, such as Michael Marmot's assertion that "social and economic differences in health status reflect, and are caused by, social and economic inequalities in society" (Marmot, 2010; Howarth et al., 2019). On first view, the results imply that the exact socioeconomic category to be used matters less than presenting an SES descriptor of *some* kind. A closer look from our convenience sample, however, reveals that even these non-expert respondents made nuanced causal inferences for the different socioeconomic categorizations. A number of cognitive dimensions were identified that varied with basis of categorization *and* predicted views on health inequality and in the case of the four SES indicators could explain between 34% (income) and 59% (neighbourhood) of the total effect of categorization on acceptability.

The first dimension was the ease with which people believed inequalities could be addressed, which we labelled malleability, following Nettle et al. (2023). This dimension was not related to acceptability judgments in Study 2 but was an indirect pathway for effects of education, genetics and lifestyle choices on agreeing that something should be done to address health inequalities. Thinking that something can be done for health inequality matters for whether people think something *should* be done. Moreover, people intuit that some categorizations for health inequality are more malleable than others. In the current studies, and in contrast to Nettle et al. (2023), malleability judgments were only loosely related to views on how inevitable life expectancy variation is. Viewing health inequality as inevitable also positively predicted acceptability: SES categorizations of inequality were viewed as less inevitable than health differences per se and this accounted for 38-47% of the indirect effects of these categories on the acceptability of inequality. Contrary to some concerns that framing health inequalities in more structural terms may induce a degree of fatalism (Kane et al., 2022), socioeconomic framings were associated with a reduced sense of inevitability relative to no framing.

Participants' appraisals of the complexity of inequality were independently and negatively related to acceptability judgments: relative to health differences in the population per se, inequality attributed to all four SES categorizations as well as lifestyle choices were seen to be less complex and this had a net positive influence on acceptability ratings. In other words, certain bases were viewed as simpler than life expectancy variation without a basis and this was associated with increased acceptability. One interpretation of this is that certain inequality framings lead to an increased perceived simplification of the issue of health variation, perhaps because they provide a principal causal factor on which to focus. Nonetheless, despite this simplification effect, the SES categorizations overall markedly reduced acceptability ratings.

Viewing health inequality as being driven by sociocultural factors such as social roles, culture and childhood experiences, was associated with reduced acceptability. We speculate that this may be because this is the causal dimension that respondents view as having the clearest implications for the shaping of self (Hornsey, 2008). If sociocultural factors are key to forging an individual sense of identity it may be that it is unpalatable for them to also lead to unequal outcomes. Future work is required to establish this.

Although participants' ratings of the involvement of uncontrollable and unknowable factors did vary across categorizations, chance as an explanation was not related to acceptability and there were no indirect effects through these appraisals. Work on distributive justice principles often emphasises a distinction between "option luck" (instances where outcomes are derived from deliberate and informed choices) and "brute luck" (instances where an individual has no control) for people's views on health distributions (Tinghög et al., 2017) and on this basis it may have been the case that categorization bases attributed to brute luck or chance would differ in acceptability. There was little evidence of this here. However, insofar as ratings of psychological causes (choices and motivations) correspond with "option luck" there was some evidence for the flipside prediction that differences seen to be driven by individual choices and motivations are more acceptable. This was principally the case for inequality attributed to genetics, although decreased perception of psychological drivers also related to lower acceptability of inequality by lifestyle choices, social class and neighbourhood.

The biggest driver of decreased acceptability for the four socioeconomic framings, however, was a reduced perception that biological factors (e.g., evolution, hormones, genes) cause health differences. This accounted for 50-87% of the indirect effects for SES categorizations. Although public conceptions of health causes are generally multifactorial (Helman, 2007; Schnittker, 2015), in Western countries biological factors such as genes are viewed as particularly important determinants of physical health outcomes (Schnittker, 2015; Freese & Shostak, 2009). The present findings indicate that a sizeable proportion of the reason why socioeconomic framings increase concerns about health inequality in the current sample is because they reduced the perceived involvement of biological determinants in causing health variation. A number of studies employing choice-experiments to assess inequality aversion find that aversion to inequalities in health is greater for inequalities differentiated by socioeconomic groups relative to neutrally-framed groupings (e.g., McNamara et al., 2020; 2021). The present findings are the first, however, to propose underlying appraisals that explain why this is.

Strengths and Limitations

The key strength of the current work is that it examines for the first time the cognitive consequences underpinning different framings of bivariate health inequality. These results unpack further the oft-made observation that people hold complicated and sometimes contradictory causal models about health and illness (Helman, 2007; Hughner & Schultz, 2004; Pill & Stott, 1985). They correspond with the range of typologies that have been applied to folk views of illness causation; some that differentiate individual health maintenance behaviours from uncontrollable external factors (Hughner & Schultz, 2004; Pill & Stott, 1985) as well as broader taxonomies that discern causal roles for the individual, natural world, social world and supernatural world (Helman, 2007), or behavioural, biological, psychosocial from other (or “no”) explanations (MacFarlane & Kelleher, 2002). It is encouraging that intuitive explanatory frameworks that arise from application of core cognitive systems (Spelke & Kinzler, 2007; Nettle et al., 2023) also apply well to health inequality.

We also report that framing health inequality to be due to lifestyle choices had a robust legitimizing effect. This presents an intriguing cognitive complement to arguments about the policy consequences of over-focus on lifestyle choices and behaviours relative to structural interventions for addressing health inequalities (Baum & Fisher, 2014): there are also cognitive consequences to framings of this kind, that encourage perception of the issue as less complex, primarily psychologically-driven and subsequently more legitimate. One limitation of this aspect of the data, however, was that the current mediation models were able to account for less than 10% of the overall effect of lifestyle choices on increased acceptability. Evidently the current framework is not yet comprehensive. Future research should examine a broader range of socio-cognitive inferences elicited by conceptualising inequality on the basis of lifestyle choices and behaviours. It would also be of value to establish whether effects of categorization on legitimacy operate comparably for other kinds of inequality domains such as power, social capital and influence (Howarth et al., 2019).

Another set of limitations concern the sample and sampling method. Whilst our principal research interests were in determining the cognitive consequences of experimentally manipulating inequality categorizations rather than making claims about the views of a nationally-representative population, it remains the case that we recruited via opportunity sampling on a non-representative sample. The usual caveats therefore apply and it is not appropriate to employ these results to make any claims about the views of the UK or US public in general, let alone from non-UK/US populations. Similarly, although we found little evidence that the effects of categorizations and underlying appraisals varied across the two countries - with some exceptions in inevitability ratings and the association between psychological explanations and acceptability - these studies were not designed to be sufficiently powered to make strong cross-country comparisons. Finally, in the current studies we did not examine whether acceptability and corresponding cognitions themselves vary across the social gradient. This is probable in light of evidence that views on whether ill-health is driven by health behaviours, environmental factors and poverty, is associated with an individual’s view of their ranking vis-à-vis others in society (Bridger, 2023).

Conclusion

An important strand of work in social and health science assesses how accurately people conceptualise health determinants (e.g., Haslam et al., 2018). We make no claims about the accuracy or otherwise of non-expert perceptions of the causes of health inequalities but we nonetheless find that these matter for lay views of health inequality. Relatively slight changes in explanatory emphasis led to marked differences in acceptability, underpinned by a range of socio-cognitive appraisals. The findings show that explanatory framings matter for how people conceptualise health variation. They indicate that public support for intervening on health inequalities in the UK and US will be best served by framings that emphasise sociocultural causes and decrease perceived inevitability as well as reduce perceptions of biological and psychological drivers of health inequality. Presenting health inequalities as a function of socioeconomic factors such as neighbourhood, income, education or social class is a first step to this, but future work should further leverage these insights by engaging more fully with the intuitive causal judgments that underpin lay conceptualisations of inequality.

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Figure Captions

Figure 1. Distribution and density plots of participants' answers to questions on how acceptable (upper left), how much of a priority (upper right), malleability (lower left), and inevitability (lower right) for each basis of categorization in Study 1 ($n = 602$). Thick lines represent the mean and shaded boxes depict 95% confidence intervals.

Figure 2. Distribution and density plots of participants' answers to questions on how acceptable (upper left), agreement that something should be done (upper right), inevitability (lower left), and complexity (lower right), for each basis of categorization in Study 2. Thick lines represent the mean and shaded boxes depict 95% confidence intervals.

Figure 3. Distribution and density plots of extent to which differences are perceived to be driven by biological (upper left), chance (upper right), sociocultural (lower left) and psychological explanations (lower right), in Study 2. Thick lines represent the mean and shaded boxes depict 95% confidence intervals.

Figure 4. Conceptualization of direct and indirect effects from four socioeconomic bases of categorization (ref: no-basis of categorization) to acceptability through complexity, inevitability, biological, sociocultural and psychological explanation ratings, in Study 2. Values indicate unstandardized coefficients. ***$p < .001$, **$p < .01$, *$p < .05$

Figure 5. Conceptualization of direct and indirect effects from genetics and lifestyle choices (ref: no-basis of categorization) to acceptability through simplicity, inevitability, biological, sociocultural and psychological explanation ratings, in Study 2. Values indicate unstandardized coefficients. ***$p < .001$, **$p < .01$, *$p < .05$

Table 1. Total and indirect effects for multi-categorical mediation model predicting ratings of acceptability (n = 712) and support for intervention (n = 711) in Study 2. Parentheses report upper and lower 95% confidence intervals (based on 10,000 bootstrap samples). ****p* < .001, ***p* < .01, **p* < .05

		How acceptable?		Something should be done?	
		B	UL,LL 95% CI	B	UL,LL 95% CI
	Intercept	43.70***	35.05,52.35	29.34***	21.38,37.31
Category	No basis (ref)				
	Education	-13.83**	-22.01,-5.64	10.81**	4.28,17.34
	Income	-18.34***	-25.98,-10.70	9.33**	2.65,16.01
	Neighbourhood	-23.34***	-31.18,-15.50	11.88***	5.26,18.51
	Social Class	-19.98***	-27.82,-12.11	7.82*	1.24,14.40
	Genetics	15.41***	8.00,22.83	-12.79***	-19.80,-5.78
	Lifestyle Choices	14.65***	7.15,22.14	-4.17	-11.27,2.92
Covariates	UK	-1.91	-5.94,2.13	4.09*	.53,7.65
	Male	8.32***	4.24,12.40	-9.48***	-13.09,-5.88
	Age	.05	-.09,.20	-.15*	-.28,-.02
		Indirect Effects		Indirect Effects	
Education	Malleability			1.16	.23,2.53
	Inevitability	-3.71	-6.35,-1.42	2.43	.84,4.34
	Complexity	1.00	.11,2.28	-.86	-2.10,-.005
	Biological	-4.02	-6.54,-1.97		
	Sociocultural	-1.08	-2.32,-.20	1.39	.24,2.93
Income	Inevitability	-2.19	-4.58,-.08	1.41	.03,2.93
	Complexity	1.47	.22,3.03	-1.31	-2.97,-.02
	Biological	-4.99	-7.90,-2.45		
Neighbourhood	Inevitability	-5.18	-8.07,-2.71	3.37	1.32,5.42
	Complexity	1.10	.15,2.33	-.99	-2.33,-.08
	Biological	-6.26	-9.77,-3.15		
	Psychological	-2.21	-4.05,-.70	2.24	.74,4.06
Social Class	Inevitability	-3.97	-6.55,-1.68	2.58	1.03,4.43
	Complexity	.85	.05,1.98		
	Biological	-5.04	-8.15,-2.46		
	Psychological	-2.21	-4.05,-.70	1.37	.03,2.91
Genetics	Malleability			-2.16	-3.76,-.86
	Inevitability	3.25	1.32,5.41	-2.16	-3.76,-.86
	Biological	2.24	.84,4.11		
	Sociocultural	2.12	.62,4.08	-3.00	-5.13,-1.29
	Psychological	-3.92	-6.36,-1.92	3.98	1.99,6.31
Lifestyle Choices	Malleability			.90	.07,2.16
	Complexity	1.10	.15,2.33	-.94	-2.37,-.004
	Sociocultural	-1.47	-2.91,-.40	1.96	.68,3.73
	Psychological	-1.35	-2.93,-.01	-1.64	-3.19,-.41

Figure 1.

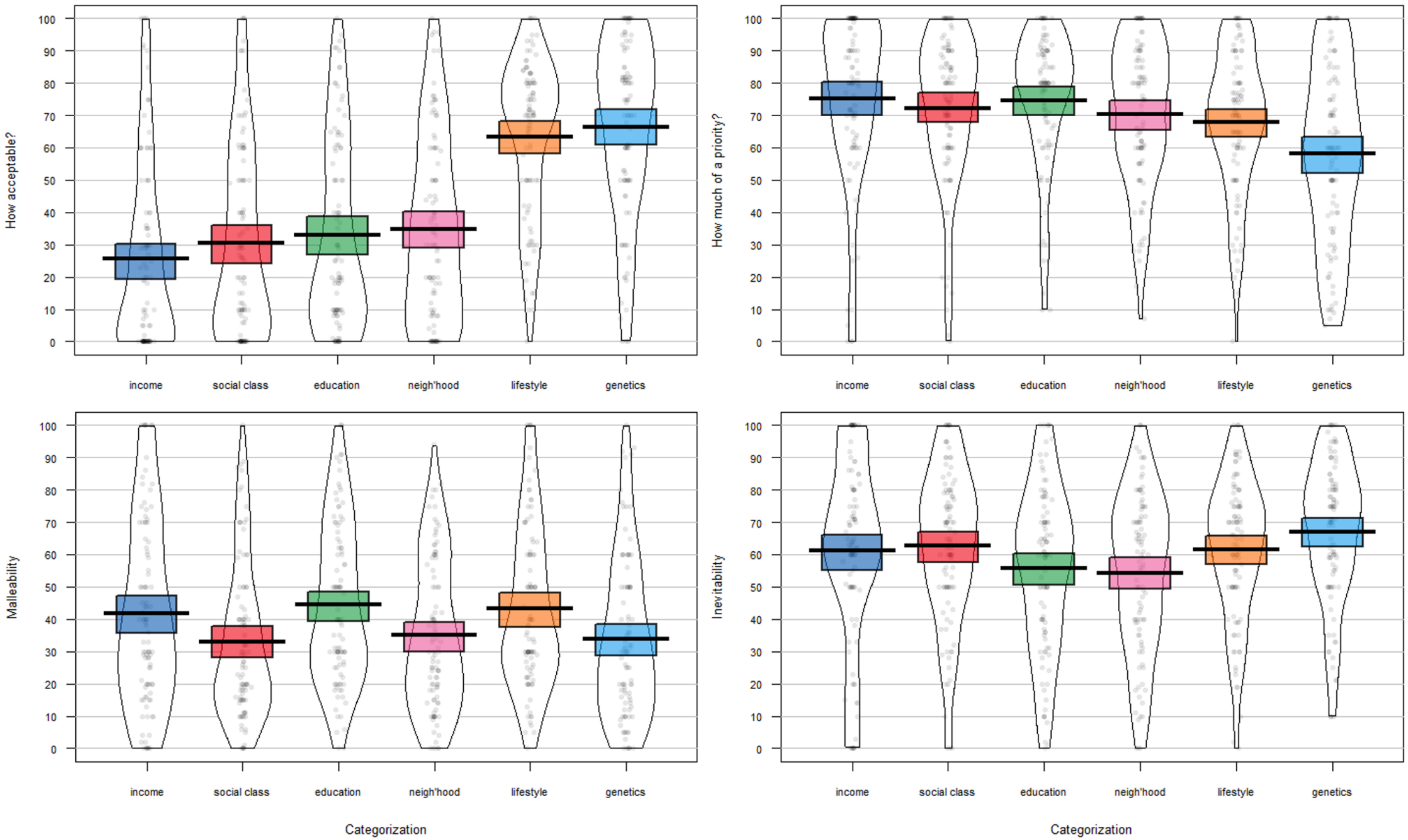

How acceptable?
How much of a priority?
Malleability
Inevitability
income
social class
education
neigh'hood
lifestyle
genetics
Categorization
Categorization

Figure 2.

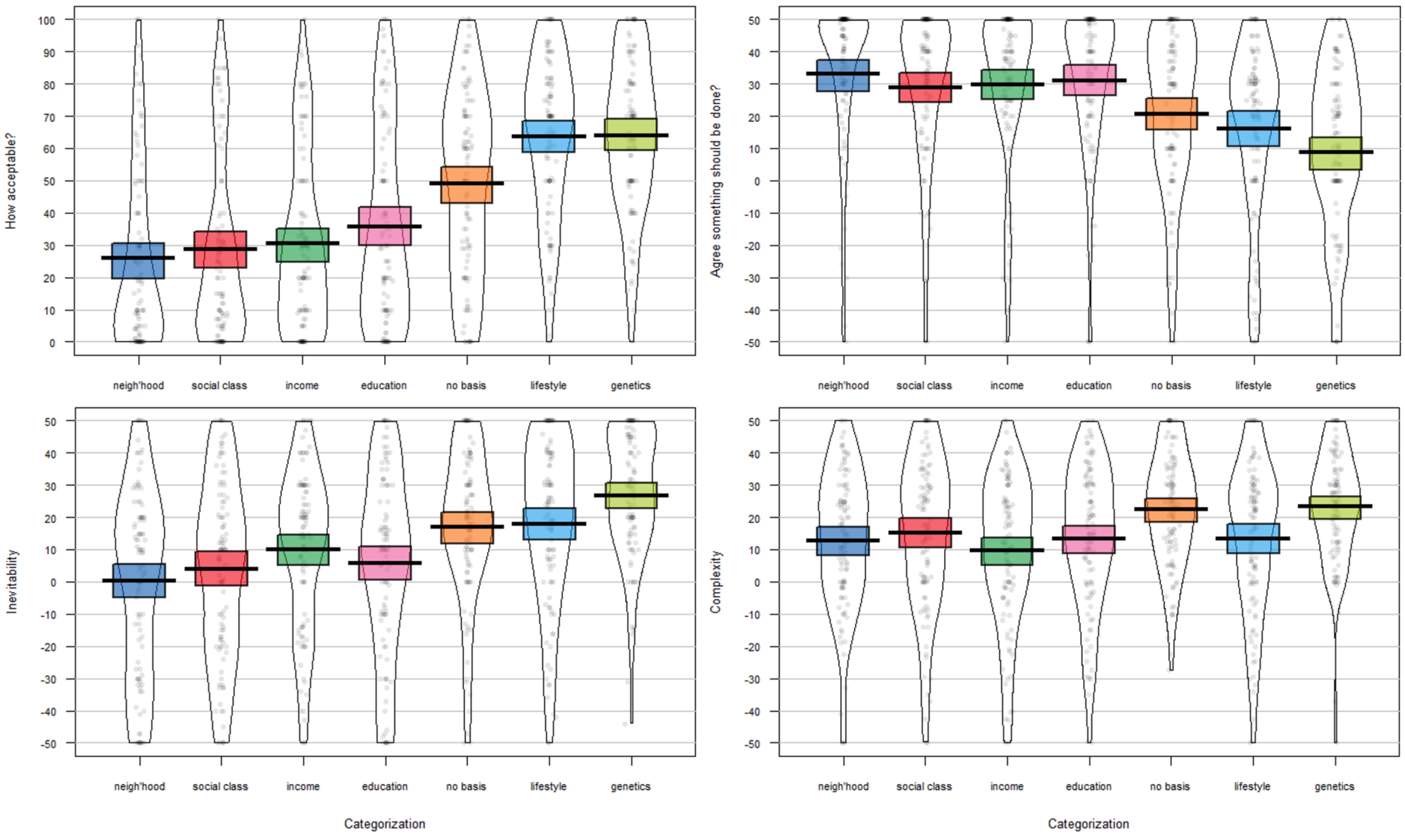

How acceptable?
Agree something should be done?
Inevitability
Complexity
neigh'hood
social class
income
education
no basis
lifestyle
genetics
Categorization

Figure 3.

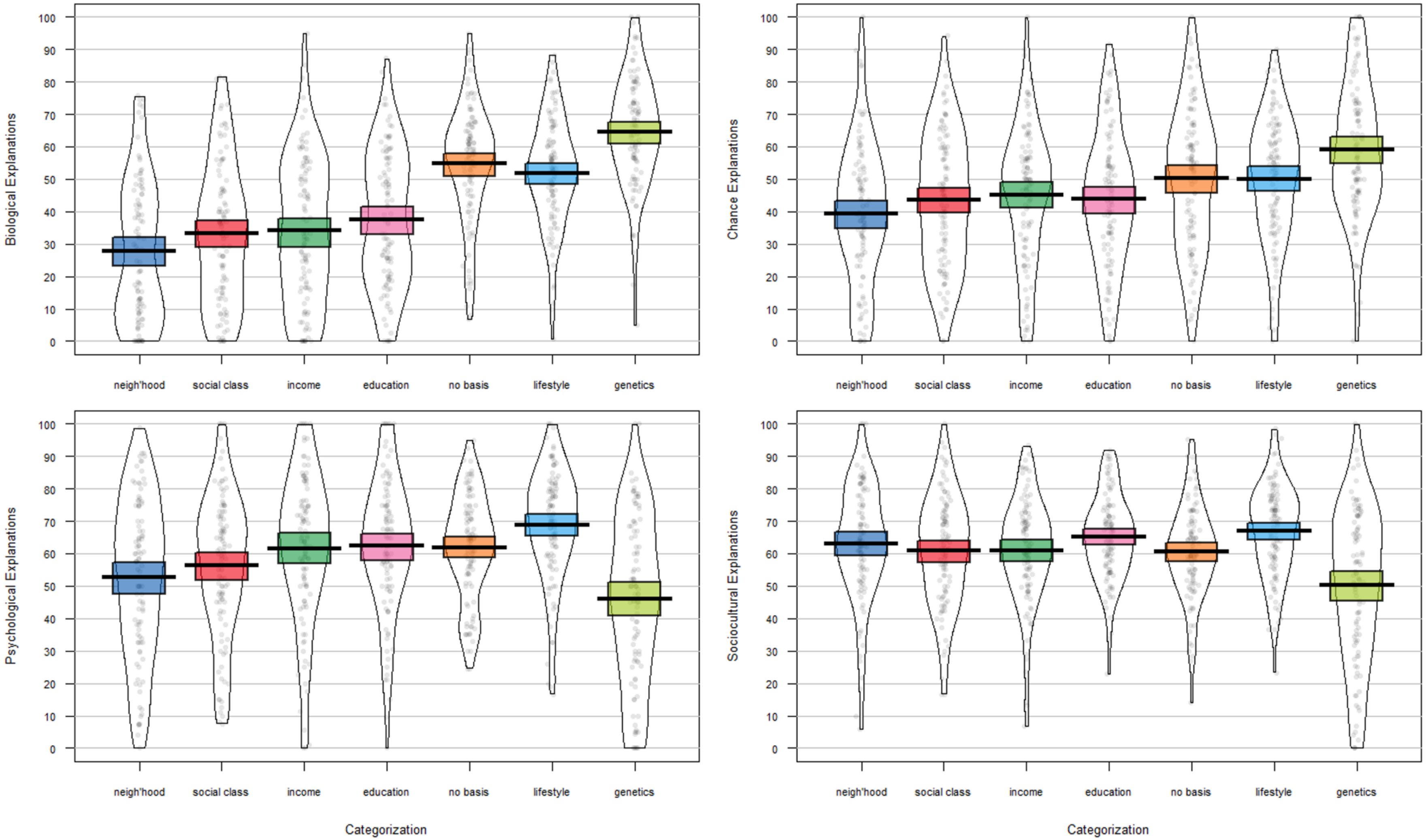

Biological Explanations
Chance Explanations
Psychological Explanations
Sociocultural Explanations
neigh'hood
social class
income
education
no basis
lifestyle
genetics
Categorization
0
10
20
30
40
50
60
70
80
90
100

Figure 4.

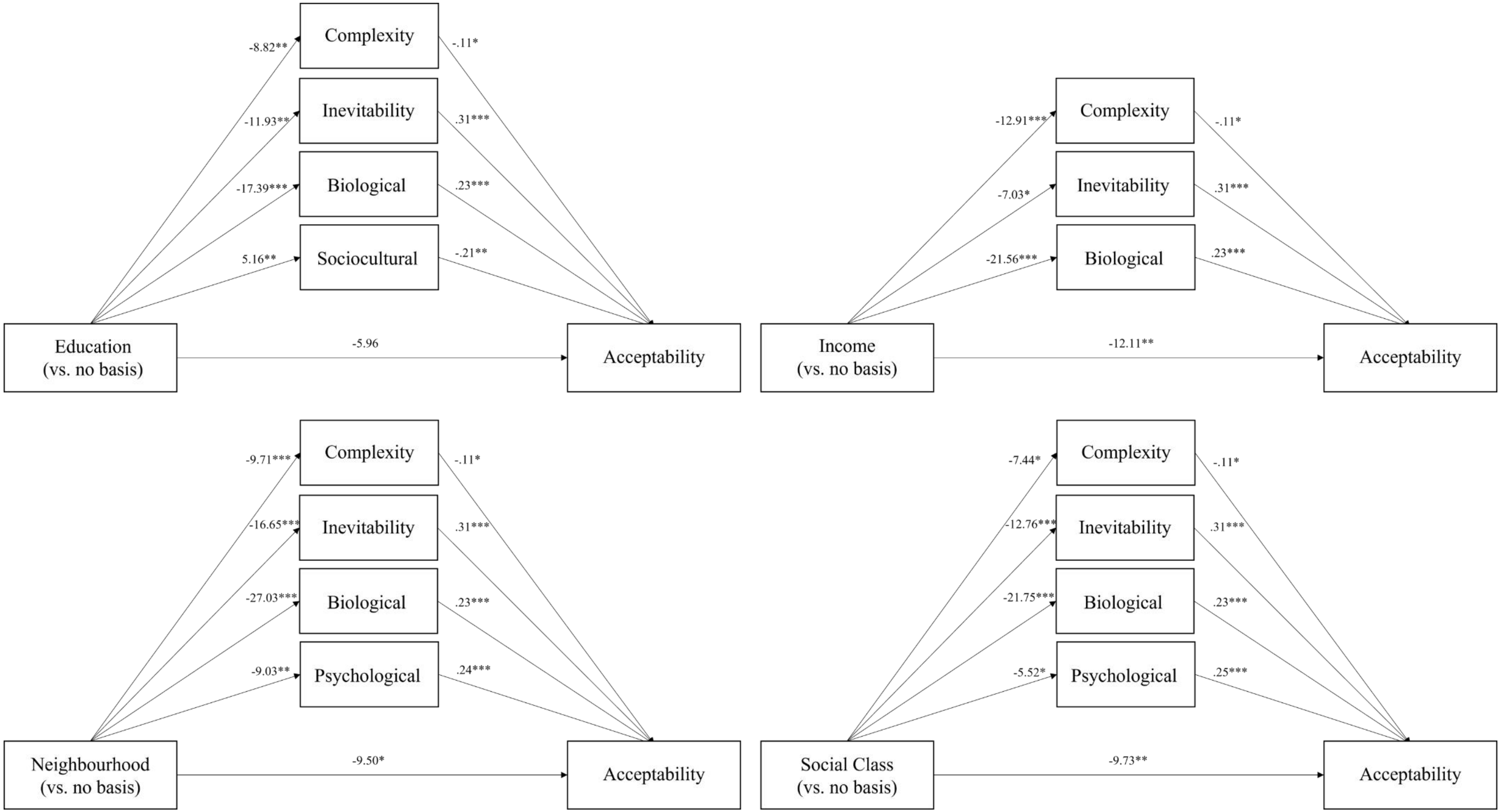
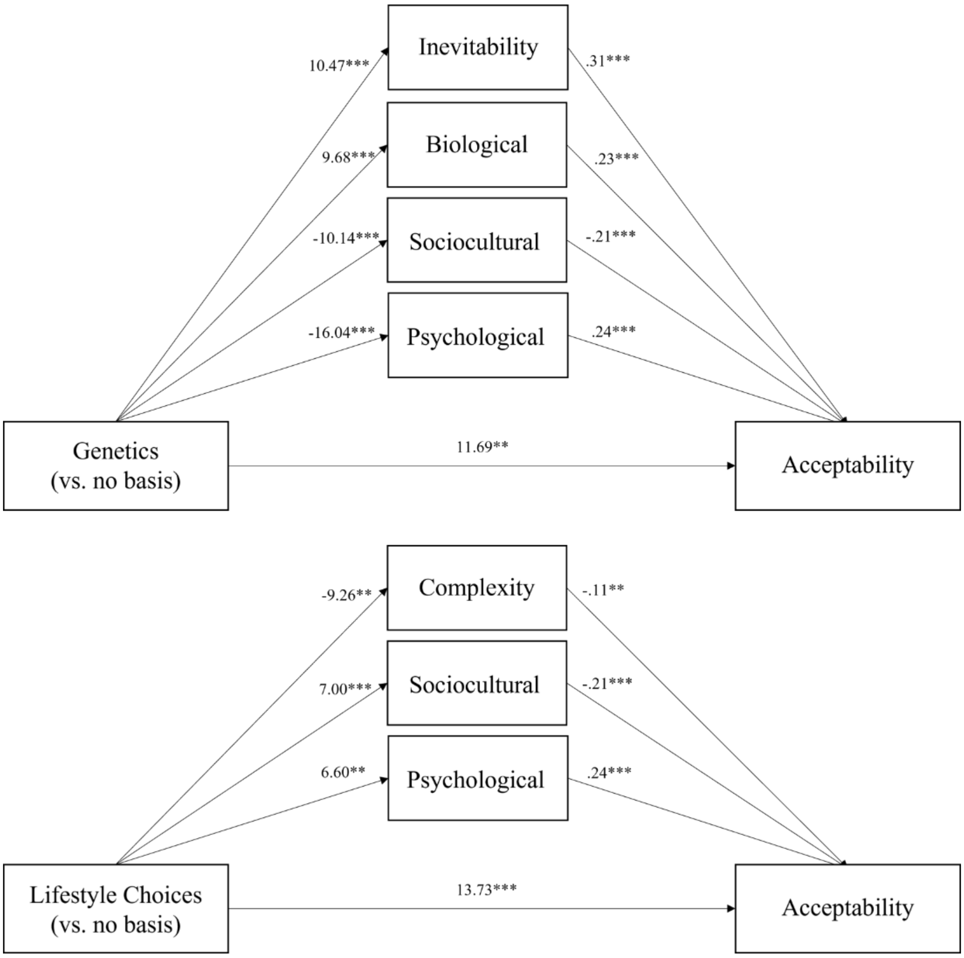

Complexity
Inevitability
Biological
Sociocultural
-8.82**
-11.93**
-17.39***
5.16**
-.11*
.31***
.23***
-.21**
Education
(vs. no basis)
-5.96
Acceptability
Complexity
Inevitability
Biological
-12.91***
-7.03*
-21.56***
-.11*
.31***
.23***
Income
(vs. no basis)
-12.11**
Acceptability
Complexity
Inevitability
Biological
Psychological
-9.71***
-16.65***
-27.03***
-9.03**
-.11*
.31***
.23***
.24***
Neighbourhood
(vs. no basis)
-9.50*
Acceptability
Complexity
Inevitability
Biological
Psychological
-7.44*
-12.76***
-21.75***
-5.52*
-.11*
.31***
.23***
.25***
Social Class
(vs. no basis)
-9.73**
Acceptability

Figure 5.


Inevitability
Biological
Sociocultural
Psychological
10.47***
9.68***
-10.14***
-16.04***
.31***
.23***
-.21***
.24***
Genetics
(vs. no basis)
11.69**
Acceptability
Complexity
Sociocultural
Psychological
-9.26**
7.00***
6.60**
-.11**
-.21***
.24***
Lifestyle Choices
(vs. no basis)
13.73***
Acceptability

Supplemental Materials and Analysis

Study 1

Methods

Participants and Design

In total, 701 participants (351 from UK Prolific and 350 from US Prolific) completed this study. Participants had a mean age of 38.27 (SD = 13.93, 18-83) and 447 (63.77%) identified as female, 249 (35.52%) identified as male, four identified as non-binary and one as agender. In addition to the 602 participants who were allocated to the six bases of categorization and are reported in the main manuscript, an additional 99 participants took part in the study and were allocated to a condition in which no basis of categorization was provided. These participants were not asked to provide ratings of acceptability, priority, malleability or inevitability, responding to causal explanations only, and therefore were not reported in the main manuscript.

Materials

Participants in all seven conditions were asked to indicate to what extent differences in life expectancy (by the given basis of categorization) were "*driven by chance*", "*driven by biological factors (such as genetics, hormones, evolutionary)*", "*driven by psychological factors (such as traits, choices, motivations)*" and "*driven by sociocultural factors (such as social role, opportunities, childhood experiences, culture)*". The order in which the four explanations were presented was randomized and all were responded to on a scale where 0 = *not at all driven by* and 100 = *strongly driven by*. We refer to these variables as measures of *perceived causation*. On the next page, they were then presented with a similar question and response options, which instead asked participants "*to what extent do you think differences in* *life expectancy* (by the provided basis of categorization) *should be driven by the following factors*" (henceforth, 'ideal causation').

Results

Causal Explanations. Ratings of each causal explanation are presented in Figure S3 separated by basis of categorization and perceived-ideal. Perceived explanations were generally higher than ideal explanations and this was notably the case for chance and, to a lesser extent, biological causes. The following exploratory ANOVAs and follow-up contrasts confirm this pattern.

An initial mixed 7 (between: basis of categorization) x 4 (within: causal explanation) x 2 (within: perceived-ideal) revealed main effects of basis of categorization ($F(6,682) = 5.019$, $p < .001$, $\eta^2 = 0.010$), causal explanation ($F(3,2046) = 81.98$, $p < .001$, $\eta^2 = 0.035$), and perceived-ideal ($F(1,682) = 457.43$, $p < .001$, $\eta^2 = 0.070$), as well as interactions between causal explanation and basis of categorization ($F(18,2046) = 10.26$, $p < .001$, $\eta^2 = 0.026$), causal explanation and perceived-ideal ($F(3,2046) = 163.77$, $p < .001$, $\eta^2 = 0.045$) and a three-way interaction ($F(18,2046) = 3.69$, $p < .001$, $\eta^2 = 0.006$).

Simple main effects contrasts for perceived-ideal were conducted for each causal explanation to unpack the two-way interaction between these variables. Ratings were always significantly higher for perceived than ideal causal explanations but this was most strongly the case for chance explanations and least the case for psychological and sociocultural explanations (chance, $F(1) = 765.84$, $p < .001$; biological, $F(1) = 107.09$, $p < .001$; psychological, $F(1) = 32.38$, $p < .001$; sociocultural, $F(1) = 31.06$, $p < .001$).

The three-way interaction was deconstructed with separate 7 (basis of categorization) x 4 (causal explanation) mixed ANOVAs conducted for perceived and ideal causal explanation ratings. For perceived ratings, there were main effects of basis of categorization

(F(6,688) = 4.152, $p < .001$, $\eta^2 = 0.011$), causal explanations (F(3,2064) = 130.059, $p < .001$, $\eta^2 = 0.098$) and an interaction (F(18,2064) = 12.899, $p < .001$, $\eta^2 = 0.058$). Simple main effects examined effects of categorization at each level of explanation. There was no effect of categorization on biological explanations (F(6) = 0.871, $p = .515$), whilst there were effects of basis of categorization for psychological (F(6) = 20.019, $p < .001$), sociocultural (F(6) = 5.131, $p < .001$) and chance explanations (F(6) = 11.134, $p < .001$). Figure S3 shows that psychological ratings were highest in the no-basis and genetics conditions, whilst sociocultural and chance ratings were lowest for genetics.

For ideal ratings there were also main effects of categorization (F(6,686) = 3.959, $p < .001$, $\eta^2 = 0.013$), causal explanation (F(3,2058) = 103.739, $p < .001$, $\eta^2 = 0.077$) and an interaction (F(18,2058) = 3.911, $p < .001$, $\eta^2 = 0.017$). Simple main effects revealed no effects of categorization on biological (F(6) = 1.684, $p = .122$) or chance (F(6) = 1.658, $p = .129$) explanations, but significant effects on psychological (F(6) = 9.588, $p < .001$) and sociocultural explanations (F(6) = 2.44, $p = .024$). Participants indicated that psychological factors should play the greatest role for life expectancy differences by genetics and the no-basis condition. They also indicated that sociocultural factors should be greater for life expectancy by lifestyle than life expectancy by genetics.

Between-country analyses. We conducted unplanned analyses to examine whether effects of categorization interacted with country for each key variable. Separate 2 (country, UK; US) x 6 (categorization) between-subjects ANOVAs were conducted for judgments of acceptability, priority, malleability and inevitability. There were no main effects of country for acceptability, priority or malleability, however, inevitability ratings were significantly higher in the UK compared to the US (F(1,586) = 4.64, $p = .032$, $\eta^2 = 0.008$). No interactions between country and categorization reached significance (*p*s <.07).

Categorical Mediation. We intended to determine whether perceptions of malleability and inevitability predicted acceptability and priority ratings. In order to directly ascertain whether these ratings varied with categorization and explore mediating effects, we replaced planned analyses with a multi-categorical mediation model, using PROCESS (Hayes, 2013). Bases of categorization were dummy coded with education as a reference category. Perceptions of malleability and inevitability ratings were included as parallel mediators and age, being in the UK (vs. US) and being male (vs. all other genders) were included as covariates of interest.

Table S2 reports the direct and indirect effects from this model for acceptability and priority ratings. Acceptability was higher and priority ratings lower for male respondents than those with other identified-genders. There were also total main effects of categorization: relative to education as a category, acceptability was significantly higher for genetics and lifestyle choices. Priority ratings showed the opposite pattern: these ratings were lower for genetics and lifestyle categories (relative to education). These effects of categorization were partially mediated through malleability and inevitability. Relative to education-related inequality, genetics-related inequality was seen as comparatively more inevitable and this explained 14.53% of the total effect of this category on acceptability.

There were also indirect effects of malleability, for genetics, social class and neighbourhood relative to education. These three categorization bases were viewed as significantly less malleable than education and this partly explained their lower acceptability. In the case of genetics, this operated as a suppressor effect against the total effect of increased acceptability. In sum, 88.94% of the direct effect of a genetic categorization basis (relative to education) was direct, -3.49% was indirect through ratings of malleability and 14.52% was indirect through inevitability ratings.

A similar pattern of negative indirect effects through ratings of malleability was observed for priority ratings. Relative to education-related inequality, differences by genetics, social class and neighbourhood were viewed as less malleable and subsequently lower in priority to address.

Study 1 Supplemental Results Summary

A number of aspects of the analysis of causal explanations in Study 1 indicated that participants were not interpreting these questions as we would expect them to. For instance, we did not observe any effects of categorization on biological explanations, which should be highest for genetics. Rather, the most highly endorsed causal explanation for genetics as a basis of categorization was psychological. Chance explanations were viewed as contributing a great deal to most bases of categorization but least of all to genetics, which again ran directly counter to expectations. Our primary concern was that respondents were interpreting superordinate category labels and exemplars (e.g., biological factors such as genetics, hormones, evolutionary factors) rather differently to how they would if these were presented as individual factors, as in Nettle et al. (2023).

We also observed main effects of perceived-ideal, which indicated that causal ratings were always higher for perceived than ideal causal explanations and this was most strongly the case for chance explanations. One possibility was that, in the case of the final ideal causation questions, participants were interpreting these questions as further indicators of whether there should be different kinds of life expectancy inequalities, rather than meaningful judgments about the causes that might or should drive them. We therefore applied alternative wording for questions about ideal causal explanations in Study 2, to address this.

Supplemental Methods and Analysis for Study 2

Methods

Materials

To measure ideal causation, participants were presented with text stating that *Some people think that there will always be differences in life expectancy due to [basis of categorization]. Assuming that is true and that there will always be some differences in life expectancy due to [basis of categorization], to what extent do you think should these SHOULD BE driven by the following factors.* The same 12 factors and response options were presented as in the previous question.

Results

Malleability, Inevitability and Complexity. In order to determine whether explanation target influenced malleability, inevitability and complexity ratings, these were subject to a 6 (categorization basis: income, neighbourhood, education, genetics, lifestyle, social class) x 2 (explanation target: life expectancy by categorization basis, categorization basis) between-subjects MANOVA. There was a main effect of categorization ($F(5,600) = 8.552$, $p < .001$) and an effect of explanation target ($F(1,600) = 3.41$, $p = .017$) but the interaction ($F(5,600) = 1.086$, $p = .364$) did not reach significance. However, the corresponding 6 x 2 ANOVA for inevitability ratings, did reveal a role for explanation target. For this variable only, there was a significant main effect of explanation target ($F(1,601) = 5.052$, $p = .025$, $\eta^2 = 0.007$) and an interaction ($F(5,601) = 2.323$, $p = .042$, $\eta^2 = 0.017$). Inevitability ratings were higher when the explanation target was basis of categorization (e.g., differences by education) than life expectancy by categorization (e.g., life expectancy differences by education). The exceptions to this were lifestyle choices (no difference as a function of target) and social class, where the reverse pattern was observed (see Figure S4).

Causal Explanations. In line with the pre-registration, the perceived causal explanation components were subjected to a 6 (basis of categorization: income, neighbourhood, education, genetics, lifestyle, social class) x 2 (explanation target: life expectancy by categorization basis, categorization basis) between-subjects MANOVA. The MANOVA revealed a main effect of categorization ($F(5,601) = 16.47$, $p < .001$) and a significant interaction ($F(5,601) = 3.07$, $p < .001$), but no main effect of explanation target ($F(1,601) = .960$, $p = .429$). Corresponding 6 x 2 ANOVAs on each perceived causal explanation component showed that the categorization x explanation target was significant for all components (biological, $F(5,602) = 3.58$, $p = .003$; sociocultural, $F(5,601) = 3.49$, $p = .004$; psychological, $F(5,602) = 3.02$, $p = .011$) except for chance ($F(5,602) = 1.60$, $p = .158$). Simple main effects analyses on biological explanations showed that these were significantly higher for genetics per se compared to life expectancy by genetics ($p = .0012$), and were significantly lower for income differences compared to life expectancy by income ($p < .001$), but that there were no other differences by explanation target (see Figure S4). Simple main effects analyses on sociocultural explanations showed that these were significantly lower for genetics per se than life expectancy by genetics ($p < .001$; no other significant effects). Simple main effects on psychological explanations revealed that these were significantly lower for genetics per se compared to life expectancy by genetics ($p = .027$) but also higher for education per se than life expectancy by education ($p = .016$).

Rather than the pre-registered 7 (basis of categorization) x 2 (perceived/ideal causation) MANOVA on causal explanations, we conducted an initial 7 (between-subjects: basis of categorization) x 2 (repeated measures: perceived/ideal) x 4 (repeated measures: causal explanation) mixed ANOVA to determine whether any interactions between categorization basis and perceived-ideal causation varied for the four causal explanation dimensions (see Figure S5). There were main effects of causal explanation (F(Greenhouse-

Geisser corrected: 2.59,1835.20) = 181.65, $p < .001$, $\eta^2 = 0.073$), perceived/ideal (F(1,708) = 133.31, $p < .001$, $\eta^2 = 0.012$) and categorization basis (F(6,708) = 12.75, $p < .001$, $\eta^2 = 0.033$). There were significant two-way interactions between causal explanation and basis of categorization (F(15.55,541.85) = 29.67, $p < .001$, $\eta^2 = 0.072$) and between causal explanation and perceived/ideal (F(2.69,1903.72) = 158.05, $p < .001$, $\eta^2 = 0.028$) as well as a three-way interaction (F(16.13,1903.72) = 3.13, $p < .001$, $\eta^2 = 0.003$). Generally, perceived explanations were higher than for ideal, but this was most notably the case for perceived sociocultural explanations which were significantly higher than ideal sociocultural explanations across all seven bases of categorization (*p*s < .001; see Figure S5).

Between-country analyses. Figure S6 shows acceptability and support for intervention ratings by basis of categorization and country. Additional analyses again examined whether effects of categorization interacted with country for each appraisal. Separate 2 (country, UK; US) x 6 (categorization) between-subjects ANOVAs were conducted for judgments of acceptability, priority, malleability, inevitability, complexity and each of the four perceived causal explanations. There were main effects of country for support for intervention (F(1,703) = 4.10, $p = .043$, $\eta^2 = 0.005$) and inevitability judgments (F(1,703) = 6.076, $p = .014$, $\eta^2 = 0.008$), both of which were higher in the UK. There were no interactions between country and categorization with the exception of sociocultural explanations (F(1,703) = 2.67, $p = .015$, $\eta^2 = 0.020$). Simple main effects of country for each categorization basis showed that US respondents rated sociocultural explanations significantly lower than UK respondents in the genetics category only ($p < .001$).

In order to examine whether country moderated any of the mediation pathways, we conducted an unplanned moderated mediation model using the PROCESS macro (Hayes, 2013). Specifically, we examined whether being in the UK (vs. US) moderated (i) each direct effect of basis of categorization (vs. no-basis) on acceptability and support for intervention, and (ii) both a and b pathways of the indirect effects. Models included age and being male as covariates and all seven parallel mediators were included for comparison with the main analyses. Standard errors were robust to heteroscedasticity (Cribari-Neto) and 10,000 bootstraps were drawn to obtain confidence intervals for indirect effects. There were no significant interactions with UK for any of the pathways for support for intervention. Psychological explanations interacted with UK to predict acceptability ratings (B = .237, SE = .106, p = .024). Conditional effects of psychological explanations on acceptability ratings showed that these were significant for the UK sample (B = .368, SE = .070, p < .001) but not the US sample (B = .130, SE = .079, p = .097). There were no other significant interactions with UK. Care is needed not to overinterpret these findings, however. Whilst this approach is appropriate for confirming moderation of mediation, the absence of significance effects does not disconfirm moderation mediation (Hayes, 2013; Hayes & Rockwood, 2020).

Figure S1. Screenshot depicting text, graphical representation and questions on acceptability and priority as presented to participants in the social class condition in Study 1.

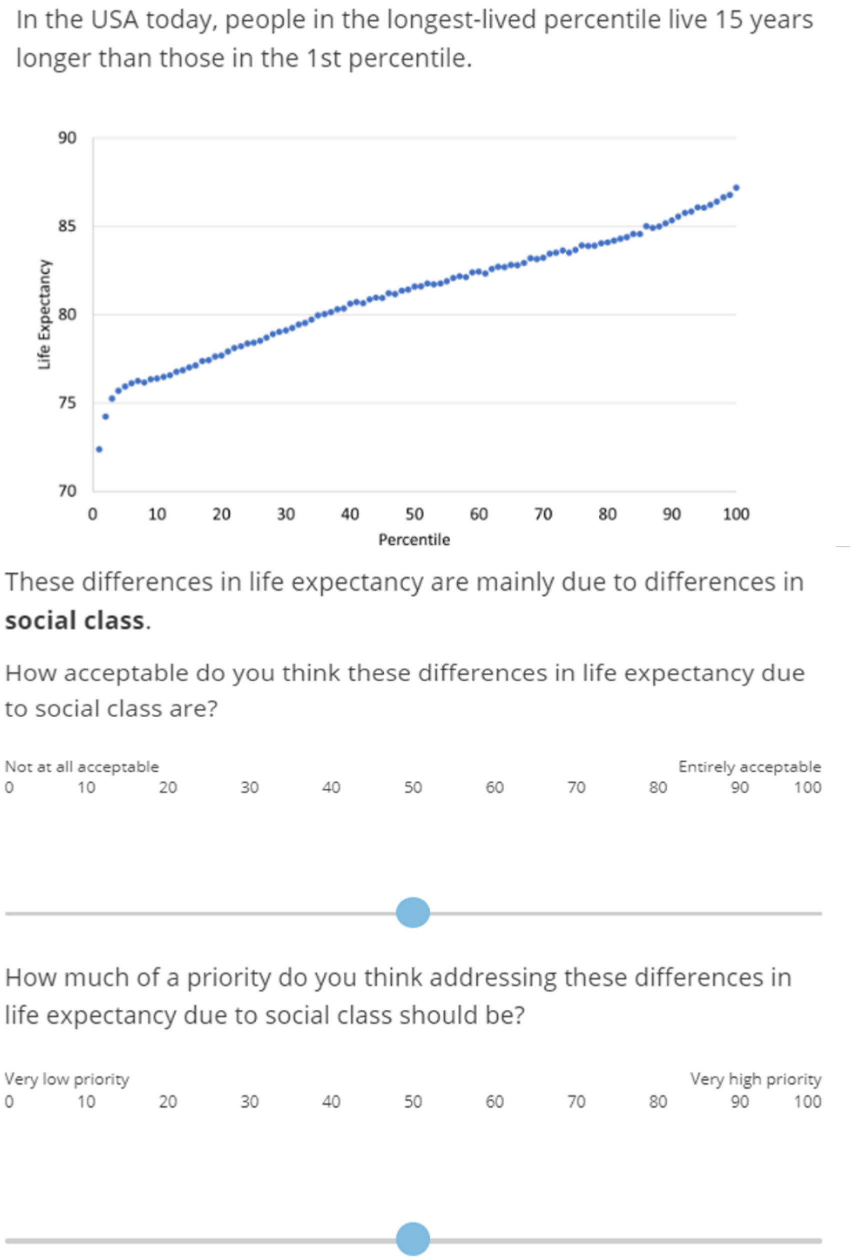


Figure S2. Distribution and density plots of participants' answers to questions on how easily something could be done about life expectancy differences (malleability), for each basis of categorization in Study 2. Thick lines represent the mean and shaded boxes depict 95% confidence intervals.

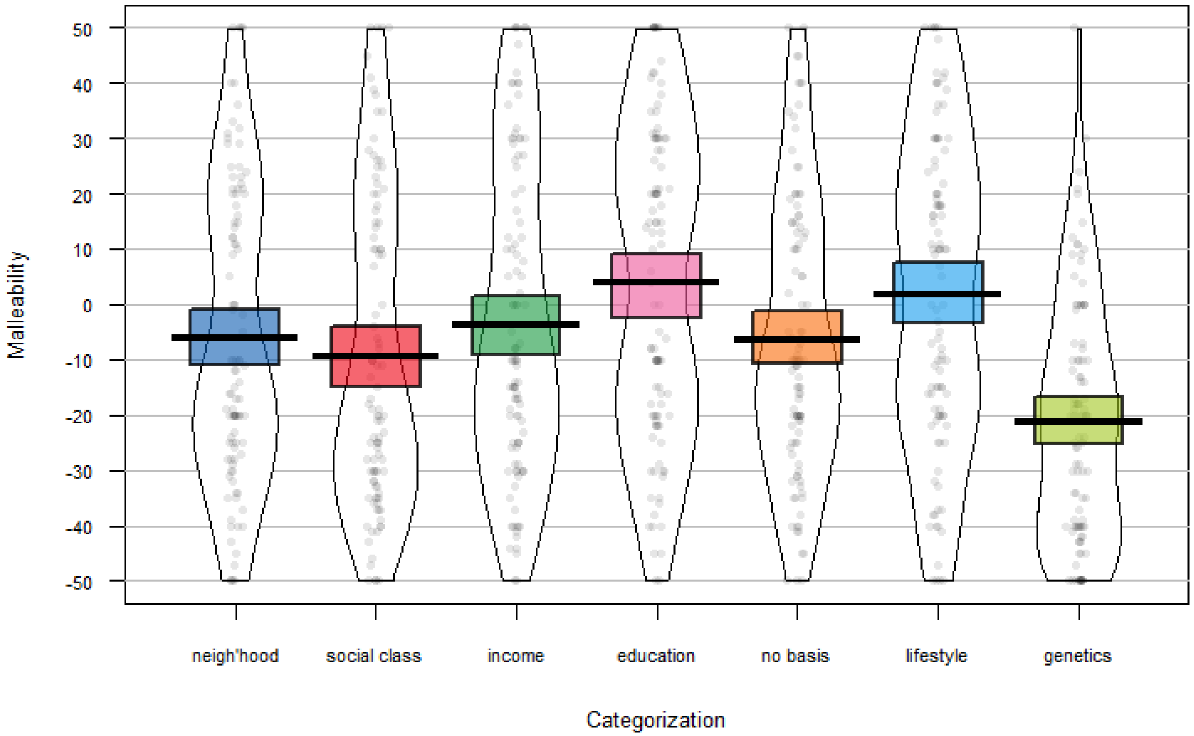


Figure S3. Distribution and density plots of extent to which differences are (perceived) and should be (ideal) driven by biological (upper left), chance (upper right), sociocultural (lower left) and psychological explanations (lower right), in Study 1. Thick lines represent the mean and shaded boxes depict 95% confidence intervals.

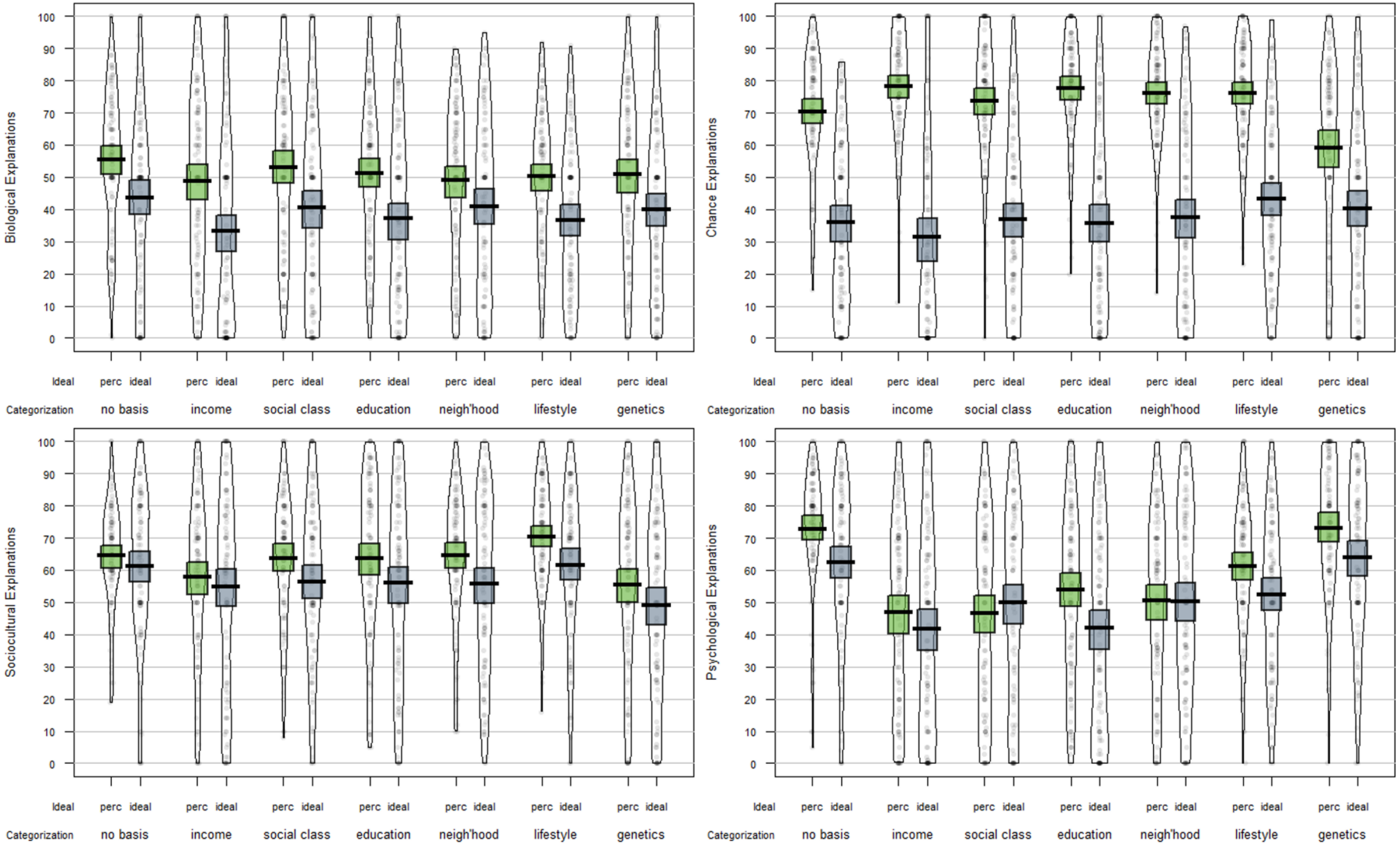


Figure S4. Distribution and density plots of inevitability (upper left), biological (upper right), sociocultural (lower left) and psychological explanations (lower right), in Study 2, by explanation target and categorization. Thick lines represent the mean and shaded boxes depict 95% confidence intervals.

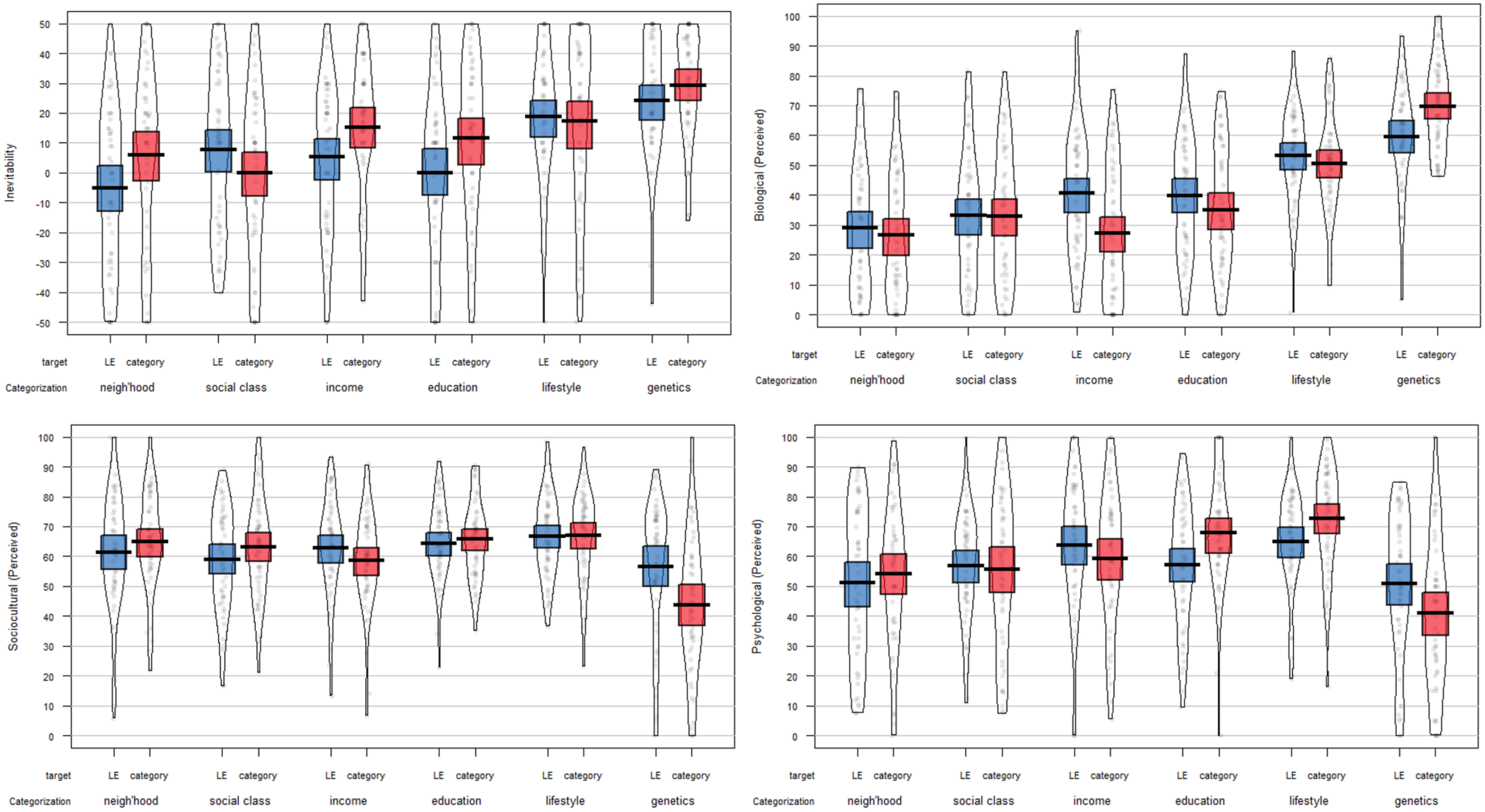


Figure S5. Distribution and density plots of extent to which differences are (perceived) and should be (ideal) driven by biological (upper left), chance (upper right), sociocultural (lower left) and psychological explanations (lower right), in Study 2. Thick lines represent the mean and shaded boxes depict 95% confidence intervals.

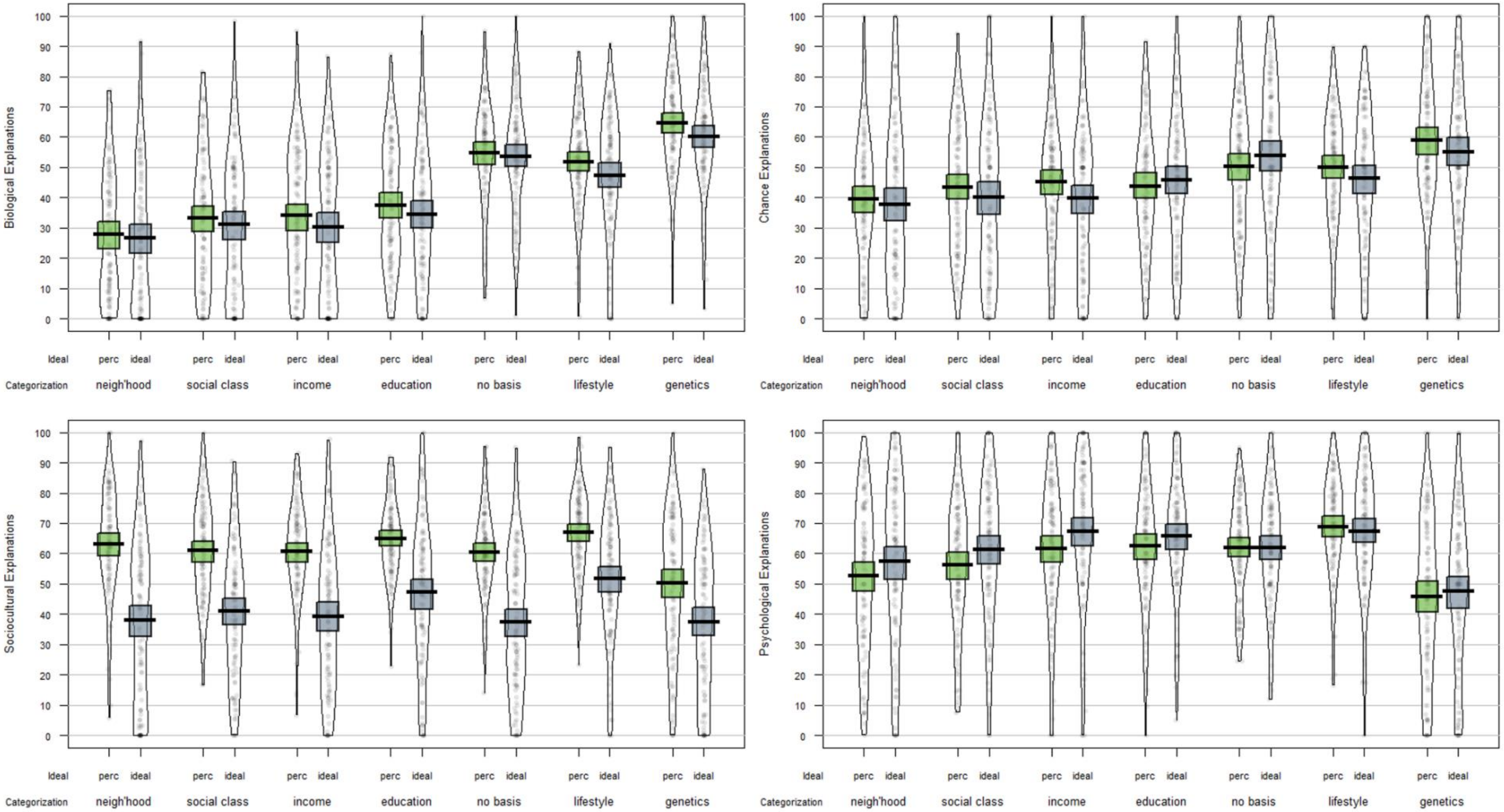


Figure S6. Distribution and density plots of participants' answers to questions on how acceptable (left), how much of a priority (right), for each basis of categorization in Study 2 and for UK respondents on the left and US respondents on the right. Thick lines represent the mean and shaded boxes depict 95% confidence intervals.

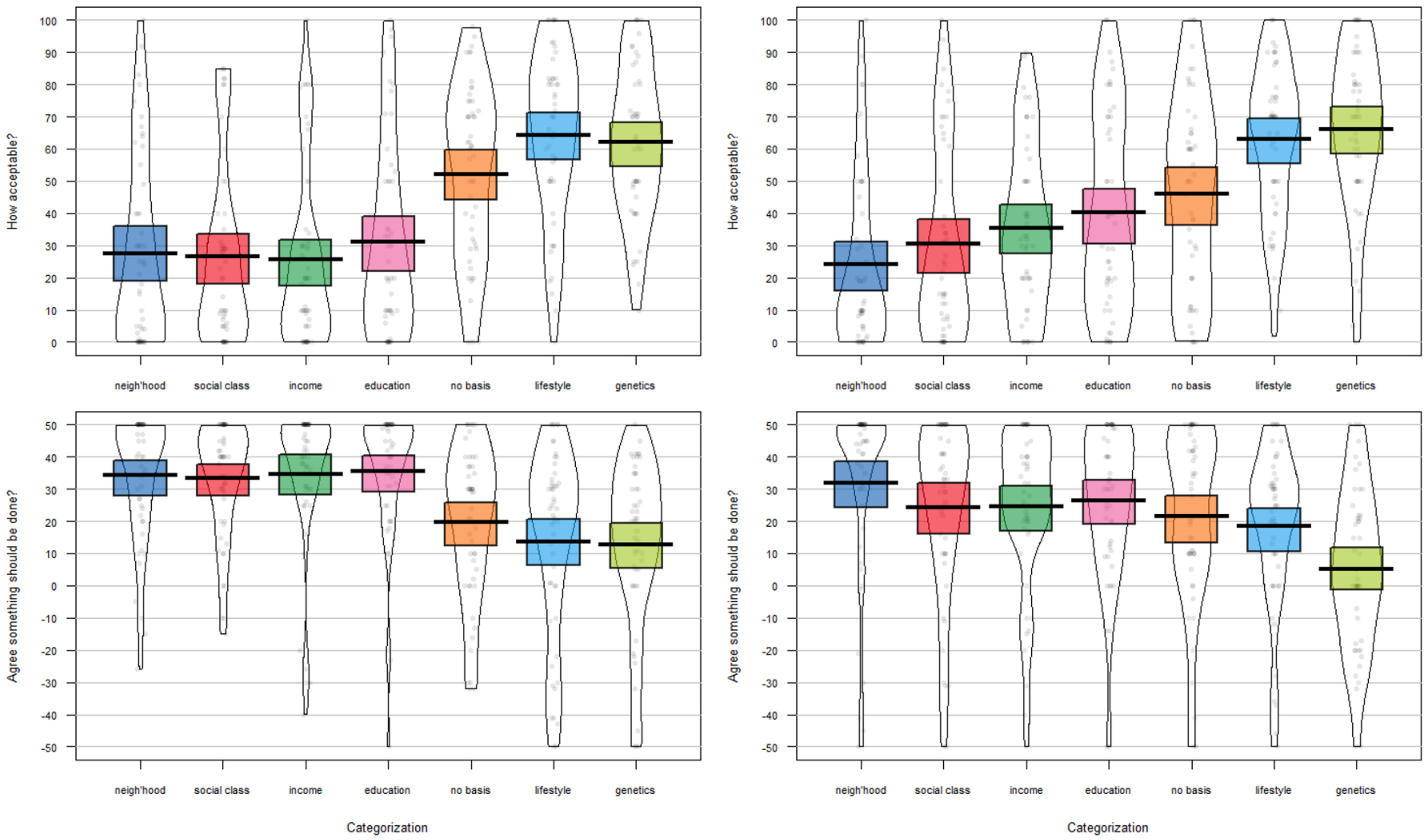


Table S1. Zero-order correlations in Study 1 (n ~ 597)

Variable	2	3	4
1. Acceptability	—		
2. Priority	.363***	—	
3. Malleability	.052	.247***	—
4. Inevitability	.354***	-.099*	-.091*

Table S2. Total and indirect effects for multi-categorical mediation model predicting ratings of acceptability and how much of a priority in Study 1. Parentheses report upper and lower 95% confidence intervals (based on 10,000 bootstrap samples). ****p* < .001, ***p* < .01, **p* < .05.

		How acceptable?		How much of a priority?	
		B	UL,LL 95% CI	B	UL,LL 95% CI
	Intercept	28.24***	18.74,37.75	79.88***	72.44,87.32
Category	No basis (ref)				
	Income	-7.97	-16.03,.08	.71	-5.91,7.33
	Neighbourhood	2.16	-5.93,10.25	-4.30	-10.52,1.91
	Social Class	-1.65	-9.82,6.51	-3.15	-9.49,3.18
	Genetics	33.87***	25.85,41.89	-16.77***	-23.68,-9.87
	Lifestyle Choices	30.16***	22.58,37.74	-7.28*	-13.45,-1.11
Covariates	UK	-3.12	-7.75,1.51	-.55	-4.55,3.45
	Male	7.36**	2.54,12.18	-5.28*	-9.38,-1.19
	Age	.09	-.09,.26	-.07	-.23,.08
		Indirect Effects		Indirect Effects	
Neighbourhood	Malleability	-1.04	-2.35,-.08	-2.07	-3.98,-.55
Social Class	Malleability	-1.33	-2.85,-.16	-2.60	-4.63,-.98
	Inevitability	3.20	.28,6.33		
Genetics	Malleability	-1.19	-2.61,-.13	-2.26	-4.15,-.72
	Inevitability	4.92	2.01,8.09		

Table S3. Overview of design and sample size per cell in Study 2

		Basis of Categorization						
Sample	Explanation target	income	n'hood	education	genetics	lifestyle	social class	no basis
UK	Life expectancy by basis	29	25	26	25	26	26	53
	Basis of categorization	26	25	26	25	26	26	
US	Life expectancy by basis	25	26	26	25	26	25	51
	Basis of categorization	25	25	25	26	25	25	

Table S4. Zero-order correlations in Study 2 (n ~ 717)

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. Acceptability	—											
2. Something should be done	-.600***	—										
3. Malleability	-.048	.189***	—									
4. Inevitability	.456***	-.376***	-.216***	—								
5. Complexity	-.013	-.018	-.435***	.102**	—							
6. Biological (perceived)	.439***	-.273***	-.094*	.304***	.108**	—						
7. Chance (perceived)	.293***	-.199***	-.159***	.281***	.154***	.549***	—					
8. Sociocultural (perceived)	-.033	.133***	.115**	.012	-.045*	.091*	.067	—				
9. Psychological (perceived)	.258***	-.192***	.075*	.262***	-.083*	.235***	.227***	.477***	—			
10. Biological (ideal)	.443***	-.265***	-.031	.258***	.034	.749***	.418***	.013	.171***	—		
11. Chance (ideal)	.244***	-.133***	-.003	.172***	.093*	.383***	.514***	.050	.138***	.510***	—	
12. Sociocultural (ideal)	.282***	-.125***	.105**	.141***	-.136***	.297***	.222***	.423***	.418***	.368***	.208***	
13. Psychological (ideal)	.143***	-.129***	.006	.210***	-.030	.105**	.083*	.390***	.549***	.065	.045	.360***