Social Utility, Inequality Aversion, and Rank-Status

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Keywords: Social preferences, inequality aversion, status, relative position

MSC Codes: *Primary* – 91E10; *Secondary* – 91B08, 91B14

Abstract
Several distinct strategies or motivations have been proposed in order to characterise the ways in which people compare themselves to others, and how such information influences the decisions they make. Among the most studied type of social preference is inequality aversion, which describes a preference for equal outcomes for all group members, usually with a particular dislike for doing worse than others. A second, rank-status, describes the tendency to focus on the ordinal position (rather than the magnitude) of outcomes and the desire to rank higher than others in outcome standings. Though these competing forms of social preference describe very different psychological processes, these theories do—under certain circumstances—generate identical predictions. To accurately assess how people use information about others in decision-making, these theories must be deliberately, directly, and carefully disentangled. This paper presents two studies in which we competitively test these models of social preference as well as self-interest. We construct social utility curves from a series of satisfaction ratings of allocations for the self and one peer (Study 1) and two peer (Study 2) reference points. In both studies we find some heterogeneity expressed in preferences regarding distribution of several different attributes. Overall, a consistent plurality of participants are best fit by the Fehr and Schmidt inequality aversion model compared to mean reference fairness models and rank-based preference models; though a lesser proportion than found elsewhere in the literature (i.e., without comparison against competing models). Surprisingly, this preference is also prominent in considerations of vacation time, a leisure attribute assumed to be unaffected by social judgement. The results highlight both discrete and continuous individual differences in the form of social preference.

1. Introduction

The classical economic approach assumes people are self-interested and seek to maximise expected utility, indifferent to the outcomes of others (Friedman, 1953/1970; Hirschman, 1977; Mueller, 1986; Sen, 2004; Winship & Rosen, 1988). However, there is a substantial amount of work from psychology and behavioural economics indicating that people do attend to information regarding others when considering economic outcomes or resource distributions. Systematic violations of the self-interest axiom indicate that many people are strongly motivated by contextual factors such as the (current or future) outcomes of others (usually peers or competitors) in utility evaluation (for reviews see Buunk & Mussweiler, 2001; J. Suls et al., 2002; J. V. Wood, 1996). People partake in comparative evaluation of outcomes, judging their own outcome in the context of outcomes attained by (or offered to) others (e.g., Festinger, 1954; J. M. Suls et al., 2020; Wheeler & Miyake, 1992).

In light of the evidence for preferences informed by social context, critics of the pure self-interest model suggest it is worth the loss of parsimony in economic models to allow for other regarding preferences in addition to exclusive self-interest (e.g., Mansbridge, 1990; Sen, 1977, 2004). Subsequently, formal models have been created to account for a variety of potential "social preferences" including:

altruism (e.g., Andreoni & Miller, 2002), reciprocity (e.g., Segal & Sobel, 2007), procedural justice or "deservingness" (e.g., Krawczyk, 2011; Lerner, 1977), "social welfare" preferences regarding maximising the payoffs for the least-well-off players in the group (maxi-min preferences; e.g., Rawls, 1971) and efficiency (maximizing total payoffs for the group; e.g., Engelmann & Strobel, 2004), and spite or envy (e.g., Kirchsteiger, 1994). There have also been a number of principled attempts to incorporate multiple distinct social preferences (i.e., "hybrid models"; e.g., Charness & Rabin, 2000, 2002; Falk & Fischbacher, 2006).[1] In the current paper, we focus on two of the most well-studied forms of social preference; concerns related to equality of outcomes: *inequality aversion* (Bolton & Ockenfels, 2000; Fehr & Schmidt, 1999); and concerns regarding relative position in status competition, or *rank-based concerns* (Rablen, 2008; Robson, 1992; Stewart, 2009; Stewart et al., 2006).

1.1. Inequality-Averse Social Preferences

Preferences regarding fairness and equality have arguably received the most attention in the literature. Formal models of inequality aversion assume that, in addition to material self-interest, an individual's utility is comprised of a component regarding the fairness of outcomes for others. There are a number of distinct formal models which differ in the way this latter concern is conceptualised and accounted for. Arguably, the "gold standard" formal inequality aversion model is the Fehr and Schmidt (1999) (henceforth "FS") model. Fehr and Schmidt theorise that people seek to achieve an egalitarian distribution and inequalities within a given reference group are considered on the basis of one's comparison to individual peers, rather than to an aggregate reference such as the group mean. Thus, identical outcomes for all parties elicits the greatest satisfaction. To account for the asymmetric tent-shaped curves of Loewenstein et al. (1989), the FS model allows for a greater dissatisfaction with disadvantageous inequality (estimated as the parameter α) compared to advantageous inequality (estimated as the parameter β; with the constraint that $\alpha \geq \beta \geq 0$).

The formal specification for the FS model states that the subjective value U_i of a resource distribution, corresponds to one's own outcome, x_i, minus the disutility associated with disadvantageous inequality (weighted by the α parameter) and minus advantageous inequality (weighted by the β parameter):

$$U_i = x_i - \alpha_i \frac{1}{n-1} \sum_{j \neq i} \max \left\{x_j - x_i, 0\right\} - \beta_i \frac{1}{n-1} \sum_{j \neq i} \max \left\{x_i - x_j, 0\right\}, \tag{1.1}$$

where $n \in \left\{1, \ldots, n\right\}$ is the number of people within the reference group, and x is the vector of respective individual payoffs within the reference distribution.

Fehr and Schmidt (1999) showed that the model captures human behaviour across several paradigms including bargaining, market, and social dilemma games. The FS model has since been consistently substantiated as a primary form social preference held by a substantial proportion of individuals (e.g., Cooper & Kagel, 2016). This model is therefore considered the primary model of inequality aversion, and further, one of the most dominant models of social preference overall.

One alternative fairness model, the "Equity, Reciprocity, Competitiveness" (ERC) model (Bolton & Ockenfels, 1998, 2000, 2008) is also focused on balancing one's concerns with absolute outcomes, with concerns regarding one's own payout relative to others. This relative component of the utility function is maximized when an individual's proportional payoff is equal to the average group payoff. The distinguishing feature of the equity component of the ERC is that an individuals satisfaction with an outcome distribution is based on the proportion of total payoffs a player receives, rather than absolute inequalities among individual peers. Therefore (and unlike the FS model) a given decision-maker is not negatively affected by the inequality posed by an extremely well performing peer, as long as the decision-maker is equal to the mean of all peers.

[1]See Fehr and Schmidt, 2006 for a review of a number of the most influential preference models.

Again assuming individual payoffs within the reference group, $x = x_1, ..., x_n$ summing to the group payoff total (c), Bolton and Ockenfels (2000) describe the utility of a given outcome distribution with the function:

$$U_i = \mu_i x_i - \frac{\nu_i}{n}\left(\frac{x_i}{c} - \frac{1}{n}\right)^n, \tag{1.2}$$

where the weight attributed to one's own absolute income is $\mu_i \geq 0$, and the weight attributed to one's outcome relative to the total sum of outcomes is ν_i >0. Thus, the component left of the first minus sign expresses standard self-interest and the component after corresponds to one's outcome relative to the total pie.

1.2. Status-Based Social Preferences

A second distinct class of social motivation in decision-making is a concern for the role of one's rank within a group. Social status refers to an individual's relative position in domains relevant to competition for social capital, dominance or prestige (e.g., education, income, occupational status) or embodied capital (e.g., attractiveness, personality traits, intellectual abilities; Mishra, 2014). The status-based hypothesis of social motivation suggests social status is inherently desired and people are therefore driven to improve their social standing (Anderson et al., 2015; Becker et al., 2005).

To formally describe rank-status behaviour, we consider a simple rank-based model (e.g. Rablen, 2008; Robson, 1992), applying the "frequency" principle of range-frequency theory (RFT; Parducci, 1965, 1995) to economic judgement (e.g., Stewart, 2009; Stewart et al., 2006). A rank-comparison account of economic decision-making describes utility as determined by the ordinal position of a given individual's outcome within a distribution or set of comparison outcomes. The ordinal rank of a given individual can be surmised by ordering the outcomes of all individuals within the context set in increasing magnitude, and determining how many peers within this context set that the individual is better than. Judgement of a given outcome is determined by the proportion of payoffs to others below this outcome in the relevant attribute.

We formalise this rank-based comparison by taking the aforementioned individual outcomes ranked in order of magnitude $\{x_1, x_2, ... x_i, ... x_n\}$ and comparing the number of comparison outcomes worse than the decision-makers outcome $(i - 1)$ with the total number of people within the individual's reference group $(n - 1)$. This ratio gives an individual a relative rank R_i:

$$R_i = \frac{i-1}{n-1} \tag{1.3}$$

Individuals gain utility from occupying a higher ranked position within a given outcome distribution, and therefore seek to improve their relative standing within a given group of peers. Due to the discrete ordinal nature of rank, utility functions derived from this model follow a distinctive "step" function and the relationship between income and satisfaction is indirect. An increase in income will not be accompanied by an increase in utility if this increase is not sufficient to afford an increased ranked position (i.e., it is not sufficient to "close the gap" by reducing the advantage of a better-off peer). Additionally, since rank is zero-sum, this in turn reduces the utility of others whose rank was overtaken. Therefore individuals may seek to prevent others from overtaking their own status-rank.

There is evidence that an individuals income rank (Daly et al., 2015; Henry, 2009; Powdthavee, 2009), for example, is an important factor in judgement and decision-making. In considering wage comparisons, G. D. A. Brown et al. (2008) found that satisfaction and well-being ratings of British workers were well predicted by the rank-ordered position of an individual's wage within a given comparison group (see also Kifle, 2014 in Australia). Similarly, income rank within one's neighbourhood, also affects individual's satisfaction with their economic conditions (Clark et al., 2009; Smith et al., 1989).

Such rank-based judgements may have an important effect on one's daily life. Relative income rank has also been found to predict individual general life satisfaction (Boyce et al., 2010; G. D. A. Brown et al., 2017), as well as several markers of mental and physical health (Daly et al., 2015; Elgar et al., 2013; Hounkpatin et al., 2015, 2016; A. M. Wood et al., 2012).

1.3. The Ubiquity and Heterogeneity of Social Preferences

Prior work has established that people contemplating the same distributive task respond in identifiably distinct ways, due to discrete differences in strategies in economic decisions (e.g. Loewenstein et al., 1989). The notion that a given model may only fit a select subset of individuals has been acknowledged by model authors themselves (most relevant to this paper Fehr & Schmidt, 1999). Discrete individual differences in social motives have since been corroborated in a number of experimental economic tasks (e.g. Bellemare et al., 2008; Brandts et al., 2015; Chen & Fischbacher, 2020; Kerschbamer & Müller, 2020).

However while such investigations do compare different models, these studies largely explore the relative performance of competing models from the same general class or type. For example Bruhin et al. (2019), Kerschbamer and Müller (2020) and Epper et al. (2020) all differentiated fairness-based preferences across a number of unique contexts (in the lab, using German panel data and Swiss plebiscite records, respectively). Each study classified distinct groups of individuals characterised by specific forms of fairness such as altruism, inequality aversion or reciprocity, with only a small minority of individuals displaying preferences more consistent with pure self-interest. Thus, these authors have demonstrated individual differences in regards to prominent models of fairness-based preferences, it is less clear the extent to which individuals show different concerns aligning with different classes of model.

However, despite the volume of support accumulated by inequality aversion and rank-status models, models of fairness related concerns, such as FS and ERC, have been considered in a literature largely separate to competitive status concerns. The bodies of evidence supporting each preference are difficult to reconcile as they generate directly conflicting predictions for satisfaction when considering resource distributions.

One notable exception mentioned earlier, G. D. A. Brown et al. (2008), discussed FS and RFT models in fitting data regarding satisfaction with hypothetical wages. Both models generated similarly good model fits (median R^2 of FS = 0.968; RFT = 0.998). The authors explained that in their paradigm FS parameter estimation will mimic RFT assumptions and therefore RFT presents the more parsimonious and psychologically motivated approach. However, these results do not seem to have been replicated or extended to other domains of economic importance. Returning to individual differences, comparisons of individual model fits of inequality aversion and status-rank preferences are also yet to be explored.

In addition to discrete individual differences in the form of preference elicited, there is evidence of heterogeneity in the specific parameters estimated for a given preference model. That is, beyond individual differences in *type* of a given preference, there are individual differences in the *strength* of such preferences (Blanco et al., 2010; Cabrales et al., 2010). In establishing the general form of a given preference Loewenstein et al. (1989) for example, calculated a mean utility function aggregated over the sample; a tent-shaped function which became the foundation of the FS model. However, examination of individual parameter estimates show a considerable amount of individual difference in the satisfaction ratings elicited. Loewenstein et al. (1989) explored these individual differences by obtaining individual regression estimates and categorising participants on the basis of preference towards advantageous (β) and disadvantageous inequality (α) respectively (by examining whether parameter estimates in each case were positive or negative). Whilst dislike of disadvantageous inequality was near universal, Loewenstein et al. (1989) found substantially less homogeneous responses in the case of advantageous inequality across a number of experimental scenarios. The variation in parameter estimates is most clearly shown in the partial replication of this study by Beranek et al. (2015), who graphically illustrate the spread of α and β parameter estimates. These scatter plots show a "spread" of parameter estimates, rather than uniform consistency between individuals. Thus, despite being categorised as inequality aversion responses, individual responses are far from uniform.

Individual differences in preference are important to understand, as distinct preferences regarding others' outcomes (or differing forms within the same class of model) may produce differing economic consequences (Aronsson & Johansson-Stenman, 2020; Aronsson et al., 2016; Støstad & Cowell, 2021). Aronsson and Johansson-Stenman (2020) for example, explored the implications of a number of fairness models (including FS and ERC models), and found that the social comparisons specified by such preferences have a considerable impact on optimal redistributive income taxation. Thus, even related forms of social preference may have distinct impacts on fiscal policy. In order to have a more complete account of fundamental economic behaviour we must therefore consider not only the role of social concerns generally (e.g. Fehr & Fischbacher, 2002), but the relative prominence of different forms of social preference, and the nature of the trade-offs among these competing motives. Therefore given the independent success of both models of fairness, and rank-based concerns, a targeted differentiation of these social preferences offers valuable insight into the economic decision-making and policy preferences of individuals.

1.4. Social utility functions

A predominant concern for equality was firmly established in Loewenstein et al.'s (1989) study, in which individuals were asked to rate their satisfaction with a number of hypothetical resource distributions awarded to themselves and a hypothetical peer. The ratings were used to estimate individual social utility functions (e.g. Conrath & Deci, 1969; Messick & Sentis, 1985), an adaptation of the interpersonal indifference curve (e.g. Lurie, 1987; Maccrimmon & Messick, 1976; Scott, 1972), illustrating an individual's satisfaction as a function of the difference in outcomes between themselves and their peer.

Loewenstein et al. (1989) estimated social utility functions in a number of social contexts by presenting participants with a series of hypothetical scenarios in which they were in a dispute with another person. For each scenario, participants were then presented with a series of possible outcomes of this dispute detailing exact dollar pay-outs for themselves and the other disputing party. Participants were asked to indicate their satisfaction (-5 "very unsatisfied" to 5 "very satisfied") for each of the possible dispute outcomes.

The social utility function estimated by the authors was best fit by a form which allowed separate slopes and curvature for disadvantageous inequality and advantageous inequality. Together these slopes formed a non-monotonic, asymmetrical "tent-shaped" curve with utility peaking at equality of outcomes as seen in Loewenstein et al. (1989). This suggests people are most satisfied with equal outcome distributions. As the difference in outcomes increased, satisfaction ratings decreased. The associated satisfaction loss, however, was markedly more steep when the decision-maker's outcome was worse than others ("disadvantageous inequality"), compared to when the decision-maker outperformed their counterpart(s) ("advantageous inequality"). This asymmetry in the social utility curve suggests where inequality is unavoidable, advantageous inequality is preferable. A predominant concern for this asymmetrical inequality aversion was largely corroborated in a partial replication (Beranek et al., 2015), and a range of other preference-elicitation paradigms (see e.g., Cabrales & Ponti, 2015; Cooper & Kagel, 2016; Fehr & Schmidt, 2001; Fehr & Schmidt, 2006). These results form the basis of the aforementioned Fehr and Schmidt (1999) model of inequality-aversion, the asymmetrical tent shape translating to "self-centred" equality concerns whereby inequality disadvantageous to oneself generates greater disutility than inequality which is advantageous.

The findings of Loewenstein et al. (1989) were broadly supported in a replication with a large, diverse sample by Beranek et al. (2015) that found qualitatively similar (though mostly weaker) inequality-averse preferences. Consistent with the original study, the slopes indicated that the impact of disadvantageous inequality outweighs that of advantageous inequality. The mean utility curve had a more pronounced downward slope in the case of advantageous inequality than the original, suggesting that people actively prefer not to outdo their peers. This is more suggestive of an aggregate concern with "pure" equality than egocentric inequality-aversion. Despite this aggregate preference, at the individual level approximately one third of respondents showed a distinct preference for advantageous inequality. This provides evidence of variation in individual participant responses.

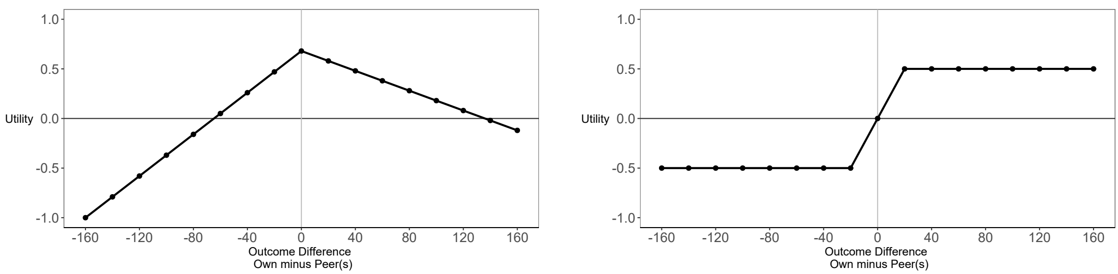
1.5. Current Paper

The current paper presents a series of studies seeking to systematically investigate aggregate and individual social preferences. To this end, we construct social utility curves and Bayesian model selection was used to establish the prevalence of competing forms of social preference (major models of equality and status competition) in hypothetical decision sets. We explore such preferences in a variety of attributes to examine whether such preferences are different for status (i.e., income, attractiveness) and leisure related attributes (vacation time).

2. Study 1

Study 1 aimed to investigate to what extent people's satisfaction with hypothetical resource allocation (for oneself and others) accords with key models of social preference. As illustrated in Figure 1, inequality aversion and rank-status models generate clearly discriminable social utility curves: the Fehr and Schmidt (1999) model assumes a tent-shaped piecewise linear function (a), while a rank model will predict a step function (b). We employ Bayesian model comparison to characterise each individual's preference by establishing relative evidence for competing models: two forms of the FS model of inequality-aversion (piecewise linear and quadratic), two models of rank-based relative concern (strict and a general version "relaxed" at the point of equality), self-interest and a baseline model of random responding.

Figure 1: Model predictions for Social Utility Curves in Study 1. Each line illustrates utility as a function of difference in outcomes. Grey horizontal line marks the midpoint of neutral (dis)satisfaction. Grey vertical line marks an outcome difference value of zero.



(a) Fehr and Schmidt model (b) Rank model

Study 1 also looked at whether the nature of comparators matters. In previous studies, in interpreting the phrase "the average other" (e.g. Grolleau et al., 2012; Solnick & Hemenway, 1998; Solnick et al., 2007) it is unclear if individuals make their judgement relative to a single "average" peer, the mean outcome of a number of peers, or all peers. In other domains, comparisons to a specific individual elicits greater competitive motivations than comparisons to people more generally (e.g. Buckingham & Alicke, 2002; Klein, 2003; Locke, 2007; Zell & Alicke, 2010). Therefore, it is possible that presenting reference points as one distinct competitor (either explicitly or via unclear explanations to participants) effects observed competition in binary worlds tasks.

To examine whether the comparator makes a difference, we imposed a between-participants manipulation by which we refer to the reference point as either a single peer ("individual co-worker" condition) or the calculated average of all peers ("average other" condition). These two peer conditions were identical in all respects, except for the description with which the reference point is defined, either in reference to a "co-worker" (individual co-worker condition) or in reference to "others" (average other condition).[2]

2.1. *Method*

2.1.1. Participants

Participants ($n = 260$; 130 in each peer condition) were recruited using Prolific (prolific.co) to participate in this study online. Eligible participants were required to be over the age of 18, report English as their first language and have a Prolific approval rating of over 90% (over at least 5 previous studies), and be self-reported UK residents as all monetary amounts were presented in pounds Sterling. Participants were reimbursed for their time according to standard Prolific rates at the time of testing (approximately $6 /hour).

Forty one participants did not pass questions regarding comprehension of instructions and were therefore excluded from analysis. One participant attempted to complete the task twice, and we excluded the second attempt. We identified an additional nine individuals who demonstrated little variation (<10% of total slider range) in responses for more than one attribute in this task. This was taken to indicate inattentive or automatic responding, and these participant's data were removed from analysis, resulting in a final N of 209 (109 participants in "average other" peer condition; 100 in "individual co-worker" condition). One participant completed 3 of 4 attributes and was retained for these attributes. No further exclusions were applied.

2.1.2. Task

Study 1 adapted Loewenstein et al.'s (1989) utility elicitation methods, simplifying some elements such as the elaborate narratives and relationship-contingent motives. The design involved one between-participants manipulation of the reference point: a single individual versus a single aggregate reference point. In the first condition, participants were presented with information regarding themselves and a single co-worker (e.g., the single disputant of the Loewenstein et al., 1989 task). In the second condition, participants were presented with information regarding themselves and the "average other person" in society (similarly worded to binary choice tasks, e.g., Solnick & Hemenway, 1998). Participants were randomly allocated to one of the two conditions.

Participants were asked to rate their satisfaction with a series of items or hypothetical "worlds". Each consisted of a pair of outcomes: one assigned to "yourself" and the second to ones "co-worker"/"other". We constructed 22 total items for each attribute considered by crossing two values offered to "yourself" with 11 relative outcomes awarded to peer(s) (either "co-worker" or "others" as per peer condition assigned). The values to "other"/"co-worker" were regularly spaced across intervals defined by specified minimum and maximum amounts, and such that the midpoint was 0 (equivalent to no difference between "yourself" and "others"/ "co-worker"). For example, in the income high attribute, the value allocated to the "other"/"co-worker" ranged from $500 less than "yourself" to $500 more, in increments of $100. Table 1 details the item sets completed for the each attribute. Item sets were created for four of the six attributes from Study 1 (attractiveness, income low, income high, vacation) for a total of 88 ratings elicited.[3]

[2]Due to error, we failed to properly upload the pre-registration file for Study 1 as intended. As such the record online was made after data collection was completed (but before data had been looked at for analysis). Whilst this does violate the requirements of formal pre-registration, we nevertheless follow the plan as set out in the document (osf.io/mfe8t/).

[3]The results of Study 1 indicate that intelligence and praise, elicit similar responses to that of attractiveness and so they were removed in the interest of time efficiency; as each scenario contains 22 ratings, we were concerned that retaining all six attributes would impose undue time demands or otherwise make participants less engaged with the task.

Table 1: Item Sets Completed in Study 1.

Income High ($/pw)												
	Difference value	-500	-400	-300	-200	-100	**0**	100	200	300	400	500
Lower self value Self = 500	Peer value (“Other”/ “Co-worker”)	1000	900	800	700	600	**500**	400	300	200	100	0
Higher self value Self = 1000	Peer value (“Other”/ “Co-worker”)	1500	1400	1300	1200	1100	**1000**	900	800	700	600	500
Income Low ($/pw)												
	Difference value	-150	-120	-90	-60	-30	**0**	30	60	90	120	150
	Peer value (“Other"/ “Co-worker")											
Lower self value Self = 150	Peer value (“Other”/ “Co-worker”)	300	270	240	210	180	**150**	120	90	60	30	0
Higher self value Self = 300	Peer value (“Other”/ “Co-worker”)	450	420	390	360	330	**300**	270	240	210	180	150
Attractiveness (Scale 1 - 10)												
	Difference value	-3	-2.4	-1.8	-1.2	-0.6	**0**	0.6	1.2	1.8	2.4	3
	Peer value (“Other"/ “Co-worker")											
Lower self value Self = 4	Peer value (“Other”/ “Co-worker”)	7	6.4	5.8	5.2	4.6	**4**	3.4	2.8	2.2	1.6	1
Higher self value Self = 7	Peer value (“Other”/ “Co-worker”)	10	9.4	8.8	8.2	7.6	**7**	6.4	5.8	5.2	4.6	4
Vacation (Days/year)												
	Difference value	-15	-12	-9	-6	-3	**0**	3	6	9	12	15
	Peer value (“Other"/ “Co-worker")											
Lower self value Self = 15	Peer value (“Other”/ “Co-worker”)	30	27	24	21	18	**15**	12	9	6	3	0
Higher self value Self = 25	Peer value (“Other”/ “Co-worker”)	40	37	34	31	28	**25**	22	19	16	13	10

Cells highlighted blue indicate decision items in which peer’s value is equal to ones own.

An example item block as completed by participants is illustrated in Figure 2. This task was completed on the Qualtrics platform (qualtrics.com) using the "Slider" question type and the "Bars" slider type. Participants were asked to indicate their satisfaction with each one of these outcome combinations by placing the slider-thumb along a continuum from "very unsatisfied" to "very satisfied" at the point reflecting their level of satisfaction.

Each item for a given attribute was presented to participants as a row within the full item set or "block" for a given attribute. Thus, all items for a given attribute were displayed simultaneously. While instructed to evaluate these worlds independently, this presentation did allow participants to evaluate multiple worlds at the same time, or within context of each other. Participants were also able (but not actively encouraged) to re-adjust previous answers within a given attribute. To avoid response set and automatic responding, items were presented in a random order within each attribute. The order of attributes was also randomly determined for each participant.

Figure 2: Satisfaction Rating Task for the Income High Attribute.

2.2. Results

2.2.1. Pre-registered Analysis

Social Utility Curves.

Social utility curves were constructed by plotting utility as a function of the difference in payoff for "yourself" (which we refer to as "self value") and peer(s). Figure 3 illustrates mean social utility curves constructed for each of the different attributes and for each peer reference condition separately.[4] Largely, the curves show little visual effect of the between-participants manipulation of reference point. The vacation time domain features the most dissimilar curves as a function of the between-participants condition. Though the curves take broadly similar shapes, the average-other condition returns a steeper slope in the case of disadvantageous inequality than the single reference-point condition. Additionally, the effect of absolute value for the average-other condition is weaker, with the lines corresponding to each level of self value (in this case 25 days vacation versus 15 days) much closer than in the other attributes. Overall, the curves provide evidence of minor between-participants differences in the vacation domain, but not the other attributes.

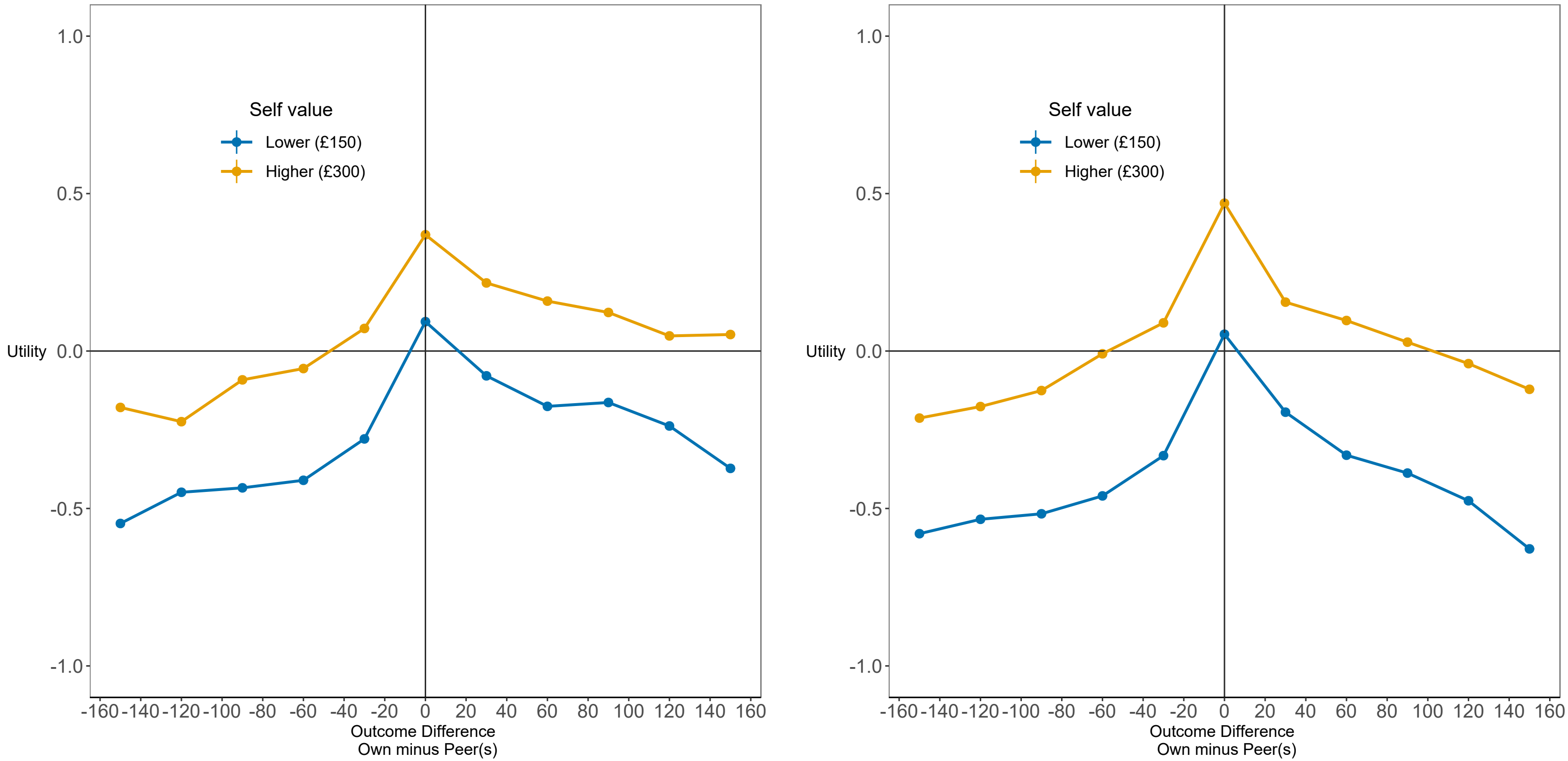
[4]For individual social utility curves, grouped by best fitting model, see the Supplementary Materials on the OSF.

In this series of somewhat similar functions, each curve peaks at an outcome difference of zero (indicated by the vertical grey centre line). This suggests a consistent aggregate preference for equal outcomes. From this peak at the centre-point the lines run roughly symmetrical through the regions of disadvantageous inequality and advantageous inequality, respectively. Thus we do not observe (at the group level) a sharper utility loss in the domain of increasing disadvantageous inequality than in the region of advantageous inequality, as expected. The exception is the noted difference in the average other condition of the vacation attribute in which the slope associated with disadvantageous inequality is steeper.

Another consistent pattern is that the curve for the higher outcome level of any given attribute runs above and parallel with the lower outcome level, indicating some additional concern with absolute value. In other words, individuals value equality, and they prefer to be equal at $1000 than at $500. There seems to be less separation between the lines in the mean reference condition compared to the individual peer reference condition, especially in regards to the vacation attribute. In both peer reference conditions, the shape of the curve corresponding to the attractiveness attribute is flatter than that of the other attributes (i.e., shallower slopes in regards to both advantageous and disadvantageous inequality).[5]

[5]Mean social utility curves for each attribute, collapsing over peer condition are documented in the Supplementary Materials.

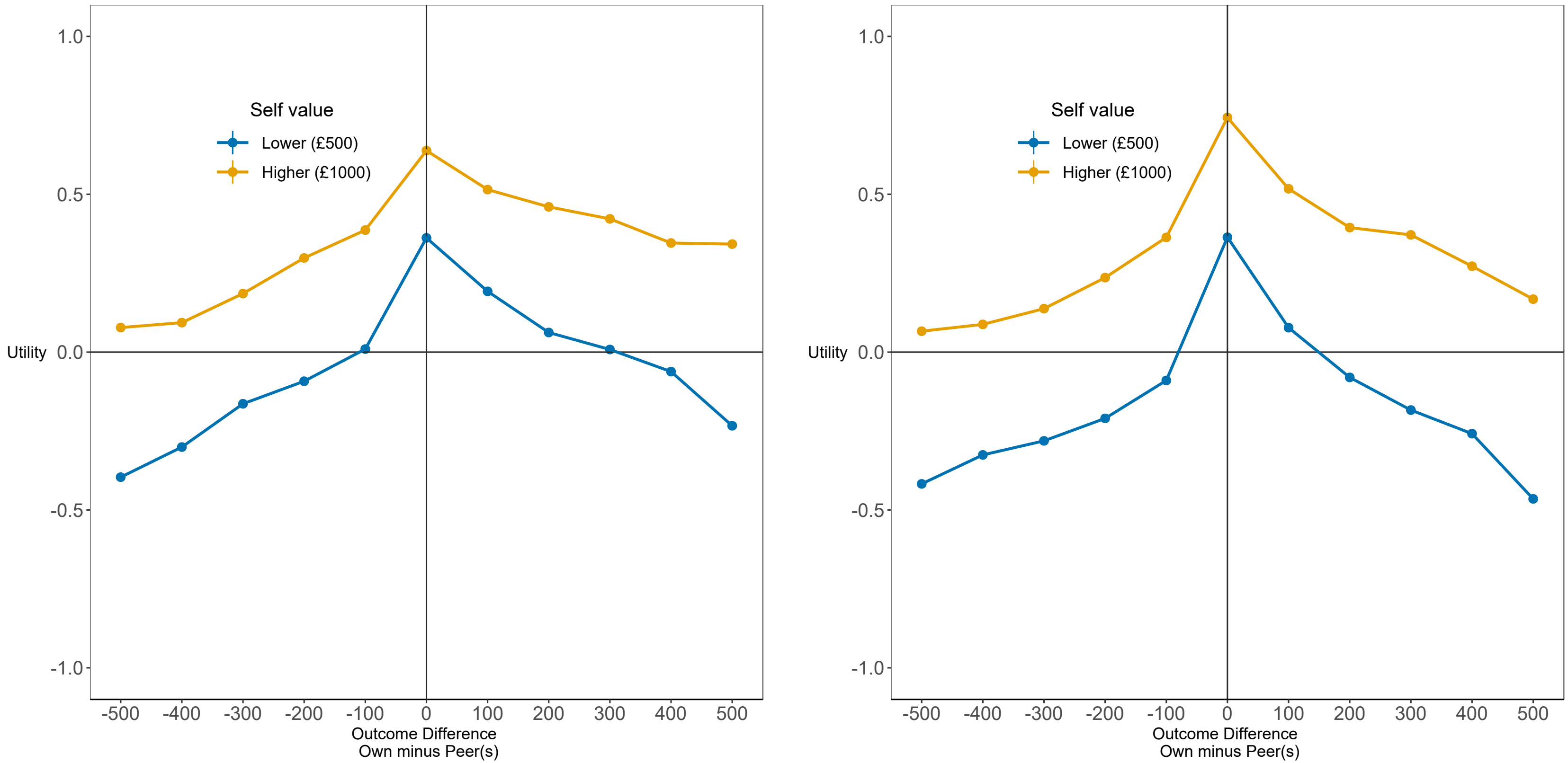
Figure 3: Mean Social Utility Curves by Scenario for Study 1. Plots separated by between-participants peer condition. Each coloured line illustrates utility as a function of difference in outcomes, for one of two outcome levels. Grey horizontal line marks the midpoint of neutral (dis)satisfaction. Grey vertical line marks an outcome difference value of zero.



(a) Income Low - Average other (n =109)

(b) Income Low - Co-worker (n =100)

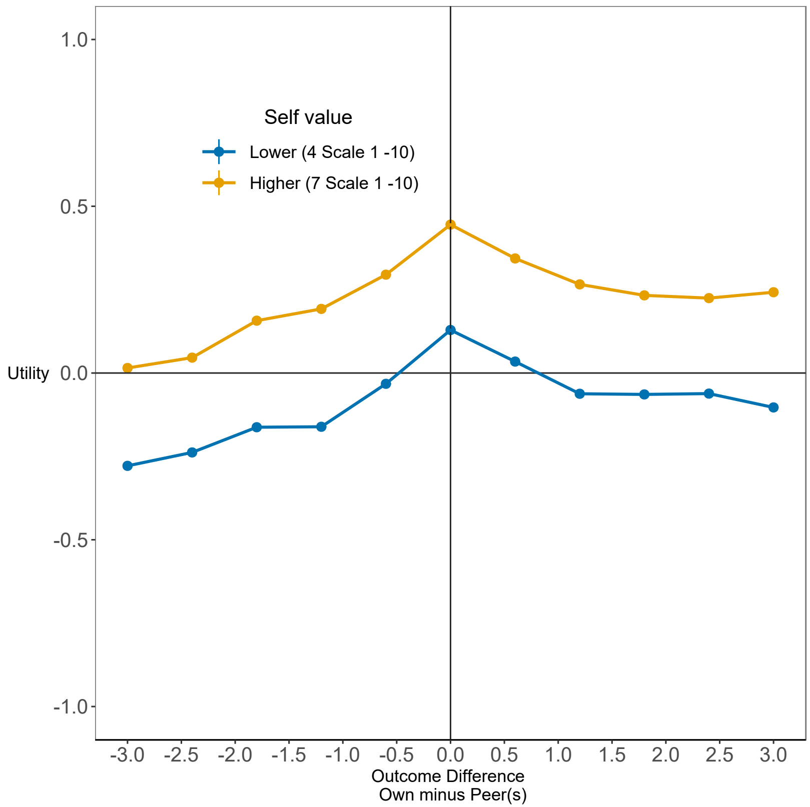
Figure 3: *Cont.*



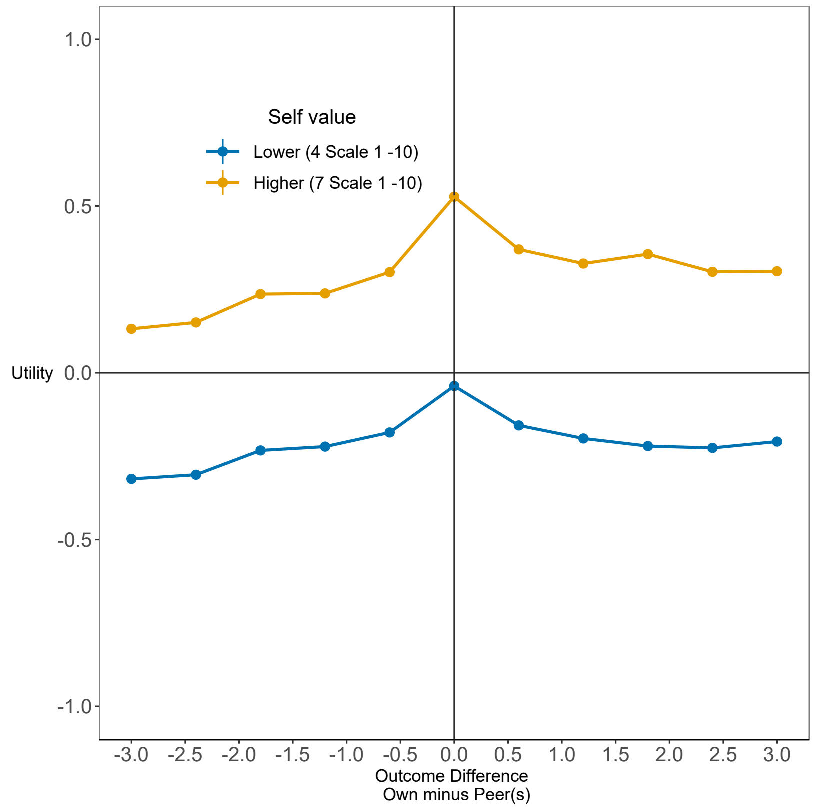
(c) Income High - Average other (n =109)

(d) Income High - Co-worker (n =100)

Figure 3: *Cont.*

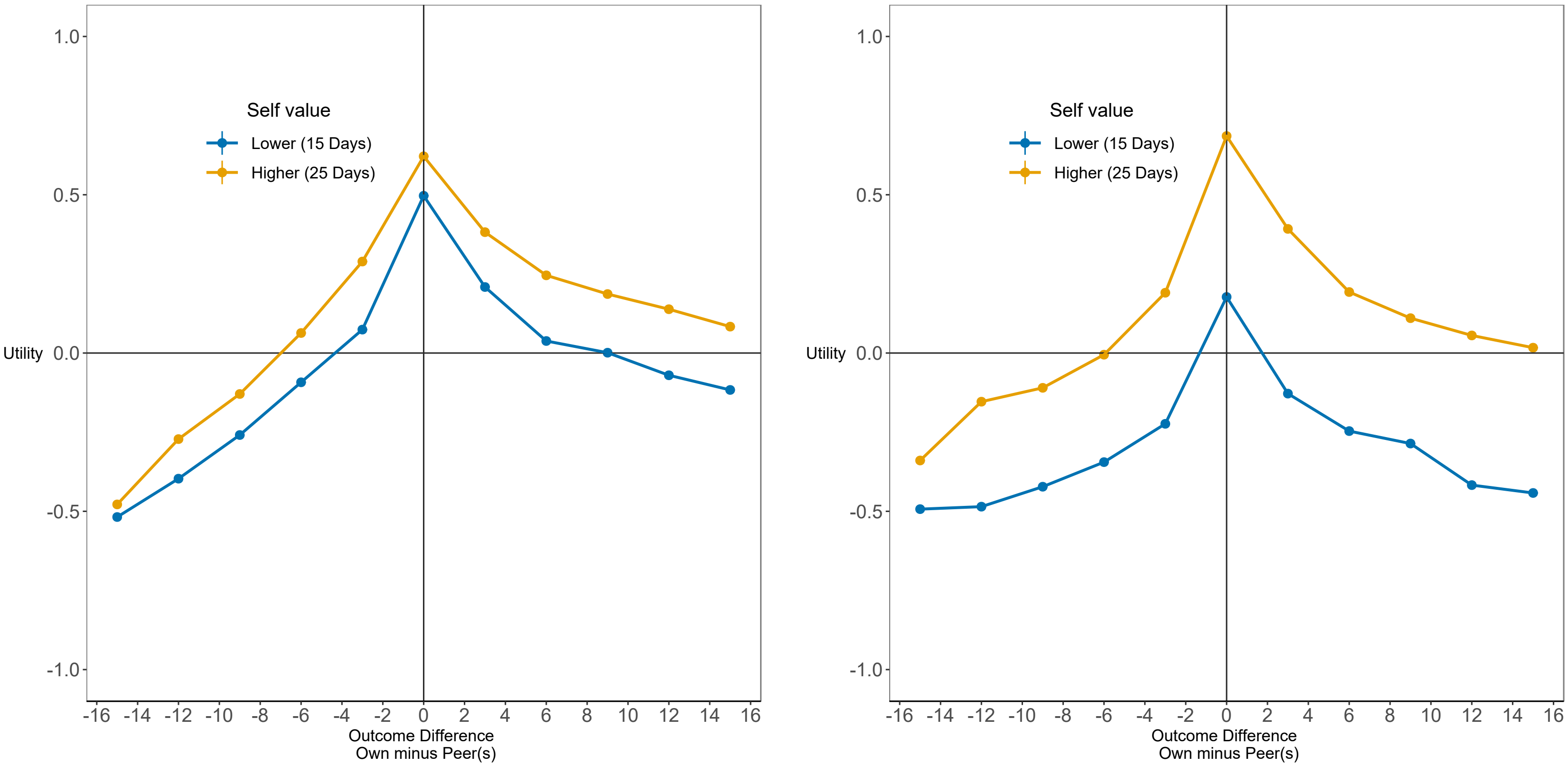


(e) Attractiveness - Average other (n =109)



(f) Attractiveness - Co-worker (n =99)

Figure 3: *Cont.*



(g) Vacation - Average other (n =109)

(h) Vacation - Co-worker (n =100)

Bayesian Model Selection.

We next examine individual differences to understand variation in preferences. This also allows us to explore whether noted aggregate similarities in motivations regarding each attribute are also present beyond the aggregate level. To examine individual preference, we first constructed separate social utility curves for each individual. We then performed Bayesian model comparison for each participant and each attribute individually. Bayesian model selection allows us to competitively test these models and explicitly calculate the relative strength of evidence for each (Raftery, 1995; Rouder & Morey, 2012).

Several forms of the social utility curves were evaluated in the model selection. For all models, based on Fehr and Schmidt (1999), overall utility is assumed to be a sum of utility arising from one's own value (self-interest component), and the utility obtained from the social utility curve (social preference component). We include two forms of the FS model of inequality aversion; the standard piecewise linear form (Fehr & Schmidt, 1999) and a quadratic form examined by Loewenstein et al. (1989). We also examine two forms of status preference. The "strict" rank model corresponds to the standard model of rank-based relative concern (e.g. Boyce et al., 2010; Stewart et al., 2006) which enforces a step-shaped utility function. In addition, we fit a "general" model of rank-based relative concern, with separate parameters weighting disadvantageous inequality and advantageous inequality akin to the Fehr and Schmidt (1999) model. Finally we include two non-social preference models: a self-interest model based solely on ones own absolute value (which essentially fits flat lines with a freely estimated intercept for "self" value), and a baseline model with a single term corresponding to the function intercept, intended to capture random responding.

Each model was fit to the data of each of the attributes considered separately, for each individual participant. As each model equation is expressed as predicting an outcome (satisfaction) from weighted terms, we used the "lm" function in "R" (version 3.5.0) to fit separate regression functions for each model, with predictors (mapping onto the different terms in each equation) coded to capture the form of the different models. For example, for the FS model, there were two predictors: one coding a linear relationship in the region of disadvantageous inequality (corresponding to the α parameter of the FS model), and another predictor coding a linear relationship in the region of advantageous inequality (corresponding to the β parameter of the FS model). The fitting procedure returned both the maximum likelihood estimates and goodness of fit indices. For each, we obtain a model fit index known as the BIC (Bayesian Information Criteria; Schwarz, 1978). The BIC is a measure of comparative model fit that approximates the marginal likelihood to indicate how consistent the data are with a model and penalises complexity (i.e., accounts for the number of parameters; Rouder et al., 2016). The BIC uses the unit information prior that provides a relatively weak prior informed by the data rather than being specified by the researcher. Using the BIC values for each model, we calculate the ratio of the marginal likelihoods to produce a Bayes factor (BF) indicating evidence for the best fitting model, relative to the alternative models. The value of the BF indicates the relative evidence, provided by the data, in favour of one statistical model over another. In our case, the model with the largest BF has the most evidence favouring it, relative to the other models tested (for a detailed explanation of Bayes factors see, e.g., Jeffreys, 1998; Wagenmakers, 2007). This allows us firstly to establish the simplest, best fitting model, and secondly to determine the relative strength of evidence for this model.

We apply a BF cut-off of BF >3, as the standard required to demonstrate "moderate" evidence that a model best fits a given series of ratings (e.g. Jeffreys, 1998; Lee & Wagenmakers, 2014). Table 2 details the proportion of all participants with moderate evidence of being best fit by each model, split by peer condition and attribute. There is substantial overall variation in preference, in that no single model well accounted for all participants in all attributes.

The piecewise linear instantiation of FS inequality aversion has the highest frequency of best fit across all attributes except the mean reference condition in the vacation attribute, where the quadratic form of FS was the most frequently favoured. The quadratic form of FS inequality aversion performed second best in the high income attribute for both peer reference conditions. There are also a non-trivial number of participants best fit by the "general" adaptation of the rank-based status model, most notably in the low income attribute. Somewhat consistent with the flat curves in the attractiveness domain, there was substantial evidence for the self-interest model.

To test the degree to which the flexibility provided by the two free parameters of the FS model accounts for the strong fit, I re-ran the model selection analysis, fixing the FS parameters to default values (α = 1/attribute range, β = 0.5/attribute range).[6] To briefly summarise these results, the FS models together still fit a similar proportion of individuals, for each attribute, however the functional form is inverted; the piecewise linear form of the FS model now accounts for relatively low number of individuals, while the quadratic form accounts for a much greater proportion of preferences. The difference in FS fits with estimated and fixed parameters indicates that the performance of the FS model in main analysis is potentially related, to some degree, to the relative flexibility of this model. Overall, however, this class of model continues to account for the data surprisingly well without parameter flexibility.

In regards to the effect of peer condition, the proportions best classified in line with FS piecewise linear was overall slightly higher in the group peer condition, while the general form of rank was more frequent in the single peer condition, but overall there was not a substantial effect of this variable.

Table 2: Best Relative Model Fit (BF >3) in Study 1.

	Average Other				Single Co-worker			
	Income Low	Income High	Attractiveness	Vacation	Income Low	Income High	Attractiveness	Vacation
Fehr & Schmidt (Linear)	28 %	31 %	21 %	28 %	30 %	24 %	12 %	21 %
Fehr & Schmidt (Quadratic)	4 %	11 %	8 %	36 %	8 %	18 %	2 %	10 %
Strict Rank	2 %	1 %	2 %	2 %	4 %	2 %	3 %	1 %
General Rank	14 %	6 %	7 %	9 %	21 %	14 %	4 %	18 %
Self-interest	3 %	5 %	8 %	1 %	4 %	2 %	10 %	1 %
Baseline	2 %	2 %	8 %	4 %	1 %	0 %	6 %	2 %
Not fit (i.e., BF $\leq$ 3)	49 %	45 %	45 %	21 %	32 %	40 %	63 %	47 %
Total N	109	109	109	109	100	100	99	100

Parameter Estimates.

Thus far, minimal peer condition differences are evident in social utility curves, and Bayesian model selection finds FS inequality aversion has the highest frequency of best fit. To establish whether people treat a group average as a single reference point, or a set of multiple individuals, we next examine the sensitivity to inequality for each between-participant condition. We seek to establish whether there is a difference in mean parameter estimates associated with disadvantageous (α) and advantageous (β) inequality as per the piecewise linear FS estimates. In calculating mean parameter values we include estimates from all individuals, not just those best fit by the respective model. Therefore parameter estimations should be treated with care.

Table 3 details the mean FS parameter estimates for each attribute by between-participants condition. These parameters quantify the degree of *disutility* associated with the difference between self and other/co-worker. This table also contains the Bayes factor for the respective between-participants Bayesian t-test for each parameter.

A Bayesian independent samples t-test was run between the means for each given parameter estimate of the two between-participants conditions. Bayes factors were estimated using the BayesFactor package (Morey & Rouder, 2018); the scale of the prior on effect size (r scale) was set to .707, labelled the "medium" prior in the package, and an uninformative Jeffrey's prior on the variance, and a standard Cauchy prior of $\sqrt{2}/2$. Only income low (β term) and vacation (α term) appeared to show any non-trivial difference in mean sensitivity to inequality. However, in none of the attributes do the between-participants comparisons show sizeable evidence for an effect (e.g., meet the threshold to be considered strong

[6]Full details of this analysis can be found in the Supplementary Materials on the OSF (osf.io/f3xw9/).

evidence of a difference, BF >10; Jeffreys, 1998; Lee & Wagenmakers, 2014), and in 4 cases there was non-trivial evidence against any effect.

Table 3: Fehr and Schmidt (1999) Parameters Estimated for each Between-Participants Condition in Study 1.

	Average Other		Single Co-worker		Bayesian t-test (BF)	
	$Mean_\alpha$ (SD)	$Mean_\beta$ (SD)	$Mean_\alpha$ (SD)	$Mean_\beta$ (SD)	α	β
Income Low	-0.004 (0.003)	-0.002 (0.004)	-0.004 (0.004)	-0.003 (0.004)	0.160	3.400
Income High	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	0.163	0.775
Attractiveness	-0.126 (0.143)	-0.059 (0.177)	-0.091 (0.122)	-0.044 (0.142)	0.814	0.184
Vacation	-0.063 (0.040)	-0.032 (0.048)	-0.048 (0.036)	-0.032 (0.040)	8.102	0.151

Bayesian t-test calculating evidence for a difference in means as a between-participants effect (BF) in Study 1.

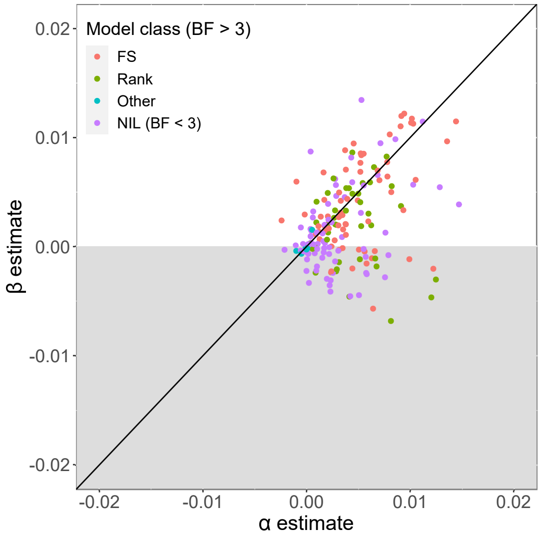
2.2.2. Analyses Not Pre-registered

Individual Differences in Model Parameters, and Violations of Model Assumptions.

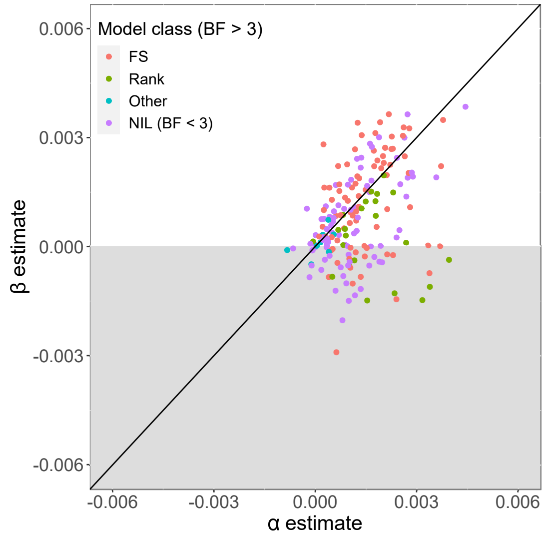
Finally, we explore the degree to which individual differences are evident in the parameters estimated for the FS model (via piecewise linear form and for each participant, regardless of best model fit). Figure 4 illustrates the α and β parameters estimated for each individual, in the context of the assumptions made by FS. Points are plotted in colours corresponding to the model class (BF >3); individuals best fit by either form of the FS model are classified as "FS", those best fit by either form of the rank models as "Rank", self-interest and baseline as "Other", finally, anyone fit BF ≤ 3, is classified as "NIL". Care should be taken in interpreting parameter estimate values, for individuals not best fit by the FS model.

Similar to Beranek et al. (2015) we find substantial individual differences in estimated parameter values. Scatter plots for each attribute look largely similar with a trend to cluster just to the top right space of the centre coordinates, slightly positive α and β estimates, which correspond to slight disutilities associated with both advantageous and disadvantageous inequality.

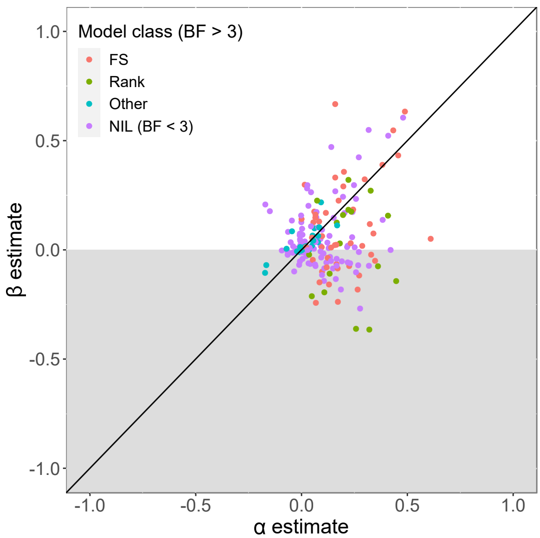
Figure 4: α and β Parameters Estimated in Study 1. Colour of points correspond to best fitting model class (BF >3). Points on the top-left side of the of $\alpha = \beta$ line violate the assumption that $\alpha \geq \beta$. Points within the grey shaded area of β <0 violate the assumption that there is disutility (and not utility) in doing better than others. To account for differences in the magnitude of values presented in each attribute, plot axes limits are determined based on the range of values shown in a given attribute (10/attribute range).



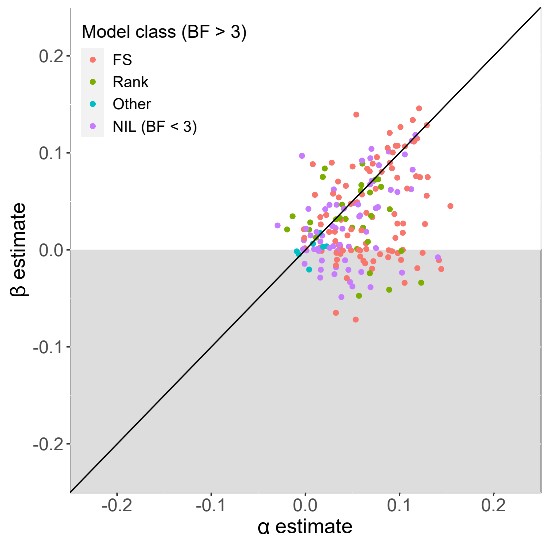
(a) Income Low (n =209)



(b) Income High (n =209)



(c) Attractiveness (n =208)



(d) Vacation (n =209)

Following Beranek et al. (2015) we also explore the extent to which participants conform to the assumptions made in Fehr and Schmidt (1999) regarding the parameter estimate values. That is, firstly, that disadvantageous inequality causes greater disutility than advantageous inequality ($\alpha \geq \beta$) and secondly, that advantageous inequality is associated with disutility and not positive utility($\beta \geq 0$). Those who abide by both assumptions are depicted in Figure 4 as to the right of the $\alpha = \beta$ line, and above the grey shaded area. The percentage of participants who violate each assumption is further detailed in Table 4. Both violations are broadly consistent among all attributes considered.

Examining the α and β parameters estimated, we find notable violation of the assumption that disutility caused by disadvantageous inequality is greater than that caused by advantageous inequality ($\alpha \geq \beta$). This implies that disutility associated with advantageous inequality is greater than that associated with disadvantageous inequality, for a subset of participants. We also find some violation of the assumption that $\beta \geq 0$. This suggests approximately a third of all individuals in this sample express positive utility in outdoing their peers. Focusing on individuals best fit by the FS class of models, a small proportion (19% in income low; 22% income high; 37% attractiveness, 28% vacation) return estimates such that $\beta \geq 0$.

To help visualise how these parameter violations map onto people's satisfactions ratings, Figure 5 re-illustrates the example social utility curve from the introduction to Study 1 (Figure 1), with beta values that are negative, zero and positive. This example highlights that estimated β parameters which violate the $\beta \geq 0$ assumption, reflect a substantially different pattern of satisfaction ratings, in which positive utility is associated with positive outcome differences.

Table 4: Fehr and Schmidt's (1999) Assumption Violations in Study 1.

	Income Low	Income High	Attractiveness	Vacation
Violates $\alpha \geq \beta$ assumption	39 %	41 %	40 %	34 %
Violates $\beta \geq 0$ assumption	32 %	27 %	41 %	27 %
Violates either (or both) FS assumptions	69 %	67 %	73 %	60 %

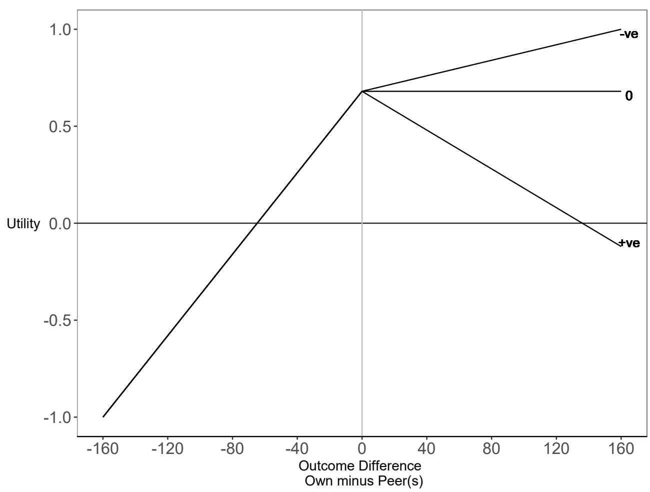


Figure 5: Example β values in Social Utility Curves illustrating how β value direction maps onto satisfaction ratings.

2.3. Discussion

Study 1 was undertaken in order to better differentiate between asymmetrical inequality aversion preferences and concerns for status. For all four attributes examined in Study 1, individual model fits indicate little status concern was expressed by participants. The predominant trend was for participants to prefer equal outcomes. Aggregate utility was consistently positively sloped in the region of disadvantageous inequality, and negatively sloped in the case of advantageous inequality. The marked disutility associated with both disadvantageous and advantageous inequality suggest a concern with a "purer" form of equality than egocentric assumptions of most models of inequality aversion whereby disadvantageous inequality is weighted more strongly. The more symmetrical tent shape of social utility curves suggests participants are, on aggregate, only marginally more concerned with disadvantageous than advantageous inequality.

Examining estimated parameters of the FS model on an individual level, we found that a substantial minority of participants (approximately 40% of all participants and 20 - 30% of those best fit by the FS model) violate the assumption in Fehr and Schmidt (1999) that disadvantageous inequality weighs heavier than advantageous inequality (i.e., that $\alpha > \beta$). We also found violations of Fehr and Schmidt (1999)'s assumption $\beta > 0$, approximating the frequency observed in Beranek et al.'s replication of the original study by Loewenstein et al. (1989). The violations in Study 1 also include a small minority of those people best fit by the FS models who may have a preference for being ahead.

One specific observation is that attractiveness exhibited flatter social utility curves than expected, with a comparatively muted peak at equality. Looking at the individual model fits (Table 2), this attribute had the highest frequency of responses consistent with the self-interest model and baseline model of random responding. This suggests individuals find social information less relevant to their judgement of preferences than expected. This is noteworthy given that attractiveness is generally considered to imbue a form of embodied capital which is relevant in peer competition and status acquisition (Mishra, 2014). There is also evidence of context effects in perceptions of physical attractiveness. For example, individuals' judgement of both their own attractiveness (J. D. Brown et al., 1992; Little & Mannion, 2006) and the attractiveness of others (Geiselman et al., 1984; Wedell et al., 1987) is influenced by exposure to images of attractive faces. Therefore we would expect people are sensitive to information about relative attractiveness, which was not borne out by our results.

This may be explained by two factors related to our methodology. Firstly, "attractiveness values" assigned to hypothetical others may not be as visceral reference points as images of faces or bodies (used in the studies of social comparison and attractiveness referenced above) or in-person exposure to others, and may therefore not elicit the same type of competitive drive. Secondly, we do not specify the sex of our hypothetical peer(s). Therefore it may be unclear to participants as to whether "others" or the "co-worker" should be considered potential mates, in which case participants may want to maximise others attractiveness, or as peer competition which may elicit more competitive preferences. This distinction has been made by researchers previously. J. D. Brown et al. (1992), for example, found that self-evaluations of attractiveness were impacted by exposure to attractive same-sex targets, but not opposite-sex targets. One resolution to this ambiguity, from a participant's point of view, may therefore be to focus on maximising ones own attractiveness in line with self-interest. It may be interesting for future work to examine how social preferences elicited are affected by clarifying the reference population.

Considering the between-participants peer condition, we found largely similar patterns of preference irrespective of how the comparator was phrased. There is some evidence of a difference between individuals making judgements relative to average others, versus specific individual peers, however, this was limited to the vacation time attribute. Specifically, in considering vacation time, people were more sensitive to disadvantageous inequality relative to the "average other" than relative to a "single co-worker". Otherwise, however, there is no difference between the average others versus individual co-worker condition, which suggests that people treat the group mean effectively as a single individual, rather than as multiple discrete individuals. Thus, the inconsistent or vague use of "others" as a reference point in the literature is not likely to be of major consequence.

Study 1 provides insight into social preferences in a number of attributes via social utility curves and Bayesian model comparison to directly test competing models of social preference. In doing so, we find surprisingly little evidence of rank-based status concern. We therefore extend the current paradigm in Study 2 to include two individual competitors, with the purpose of providing more favourable conditions for elicitation of status concerns. That is, multiple separate competitors with distinct outcomes may make competitive social concerns most salient, and allow us to more clearly pull apart the different models.

3. Study 2

Study 2 examined comparisons made to multiple others. To assess the effect of multiple discrete comparison points upon social preference, the paradigm in Study 1 was extended by including information regarding two individual peers, each with unique outcomes. This allowed a finer-grained examination of any role of outcome rank, and a piecewise linear function producing more diagnostic data for the FS model.

In addition, having multiple reference points allowed us to disentangle comparison to the mean versus comparison to multiple others. The ERC model (Bolton & Ockenfels, 2000), discussed in the introduction, assumes that individual's fairness preferences are expressed in relation to mean outcome, rather than individual peers. In contrast to the FS model, for two referents, this predicts a symmetric bi-linear utility function around the mid-point (average) between the two referents.[7]

3.1. Method

3.1.1. Participants

Participants (n = 260) were recruited using Prolific (prolific.co) to participate in this study online. Eligibility criteria and participant payment were the same as that for Study 1. We added an additional criterion that participants were not to have participated in Study 1 or an additional study from the lead authors PhD (Cavve et al., under review).

Twenty five participants did not pass comprehension check questions and were therefore excluded from analysis. We identified an additional individual who demonstrated little variation (<10% of total slider range) in responses for more than one attribute in this task. This participant's data were removed from analysis, resulting in a final N of 234. All participants completed all attributes. No further exclusions were applied.

3.1.2. Task

The method for Study 2 was similar to that for Study 1. Participants were asked to make a series of ratings using information regarding three entities (themself and two individual peers). There is no between-participants peer condition in Study 2, as participants were comparing themselves to individual hypothetical others. We also removed one of the four attributes from Study 1—low income—as it produced very similar behaviour to the high income condition. An example item block as completed by participants is illustrated in Figure 6.

The set of hypothetical outcomes for each each item were constructed much in the same way as Study 1. Two outcome levels for "yourself" were used for each attribute. For each level of self, the relative placement for "yourself" with respect to the two co-workers was varied across 11 items, from below the lowest comparator to above the highest comparator. Co-worker 1 was consistently less well off than Co-worker 2 and the difference ratio between the two Co-workers was consistent throughout a given attribute.

For example, in the income attribute, the value allocated to Co-worker 1 ranged from $ 150 more than "yourself" to $ 350 less, in increments of $ 50. As Co-worker 2 remains $ 200 worse off than Co-worker 1 throughout the item set, the corresponding range for Co-worker 2 is $ 350 more than "yourself" to $ 150

[7]Pre-registration can be found on the Open Science Framework (osf.io/qa9me/).

Figure 6: Satisfaction Rating Task for the Income Attribute.

less. Table 5 details the item set completed for each attribute (left side). Items offering equal outcomes to Self and each individual Co-worker are highlighted. In addition, for each level of self outcome there were three items in which all three entities receive equal outcomes. The right side of Table 5 details the equality item set for each attribute.

The domain of attractiveness involved the construction of items on two attribute levels (high and low) within a small range (scale of 1–10). Therefore, there was a limited number of unique items that could be created and regular and interpretable intervals (e.g., avoiding values at multiple decimal places or at increments that might be considered awkward or unnatural). The construction of items where all three entities receive equal outcomes resulted in two duplicate items across the two attribute levels. These duplicate items were presented to participants only once. In sum, participants made 26 ratings for attractiveness and 28 each for income and vacation, for a total of 64 ratings. Preferences were otherwise elicited in the same manner as Study 1.

Table 5: Item Sets Completed in Study 2.

		Regular decision items												Equality items		
Income ($/pw)																
	Difference value (self minus Co-worker 2)	-350	-300	-250	**-200**	-150	-100	-50	**0**	50	100	150		Equality item 1	Equality item 2	Equality item 3
													Self	300	500	700
Lower self value	Co-worker 1	650	600	550	**500**	450	400	350	300	250	200	150		300	500	700
Self = 500	Co-worker 2	850	800	750	700	650	600	550	**500**	450	400	350		300	500	700
													Self	800	1000	1200
Higher self value	Co-worker 1	1150	1100	1050	**1000**	950	900	850	800	750	700	650		800	1000	1200
Self = 1000	Co-worker 2	1350	1300	1250	1200	1150	1100	1050	**1000**	950	900	850		800	1000	1200
Attractiveness (Scale 1-10)																
	Difference value (self minus Co-worker 2)	-3.5	-3	-2.5	**-2**	-1.5	-1	-0.5	**0**	0.5	1	1.5		Equality item 1	Equality item 2	Equality item 3
													Self	2.5	4.5	4.5
Lower self value	Co-worker 1	6	5.5	5	**4.5**	4	3.5	3	2.5	2	1.5	1		2.5	4.5	4.5
Self = 4.5	Co-worker 2	8	7.5	7	6.5	6	5.5	5	**4.5**	4	3.5	3		2.5	4.5	4.5
													Self	4.5	4.5	8.5
Higher self value	Co-worker 1	8	7.5	7	**6.5**	6	5.5	5	4.5	4	3.5	3		4.5	4.5	8.5
Self = 6.5	Co-worker 2	10	9.5	9	8.5	8	7.5	7	**6.5**	6	5.5	5		4.5	4.5	8.5
Vacation (Days/ year)																
	Difference value (self minus Co-worker 2)	-14	-12	-10	**-8**	-6	-4	-2	**0**	2	4	6		Equality item 1	Equality item 2	Equality item 3
													Self	7	15	23
Lower self value	Co-worker 1	21	19	17	**15**	13	11	9	7	5	3	1		7	15	23
Self = 15	Co-worker 2	29	27	25	23	21	19	17	**15**	13	11	9		7	15	23
													Self	17	25	33
Higher self value	Co-worker 1	31	29	27	**25**	23	21	19	17	15	13	11		17	25	33
Self = 25	Co-worker 2	39	37	35	33	31	29	27	**25**	23	21	19		17	25	33

Cells highlighted blue indicate decision items in which one peer's value is equal to ones own (bolded). Each column represents a different rating item. Items to the left are decision items generated in the same form as Study 1. Items to the right correspond to equality for self and two Co-workers. *Note:* The grey items in the attractiveness attribute overlapped between the two levels. These items were only presented once and used for both levels in analysis.

3.2. Results

3.2.1. Pre-registered Analysis

Social Utility Curves.

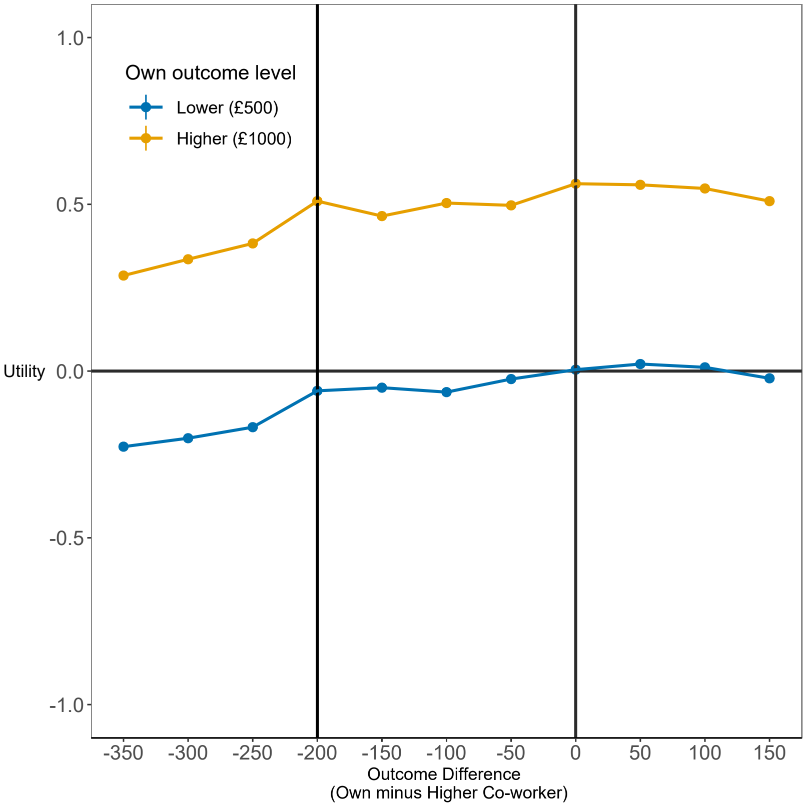
Figure 7 (left column; i) plots mean social utility curves for each attribute, and suggests a broadly similar pattern across attributes.[8] These curves appear flatter than those for Study 1 (Figure 3), with a more muted peak at points of parity with individual co-workers. Visually, these curves seem largely consistent with an aggregate concern for absolute value, with the difference between the lines being more prominent than any variation within the lines. The right column (ii) of the figure shows satisfaction elicited for each equal outcome item. Satisfaction increases as a function of increasing outcome, again consistent with a concern for absolute value.

Each of the two "yourself" level values (each corresponding to a line in the social utility curve) was also offered to all individuals in the equality outcomes set of items. Synthesising the social utility curve and equal outcome figure plotted for each attribute, each "yourself" value elicited in both sets of items returns the highest satisfaction in the equality of outcomes item. For example, the utility rating associated with the equality item at $1000 is higher than any point on the corresponding level in the social utility curve. That is, individuals prefer making $1000 when their peers are allocated the same outcome, even in comparison to the option of making more than peers.

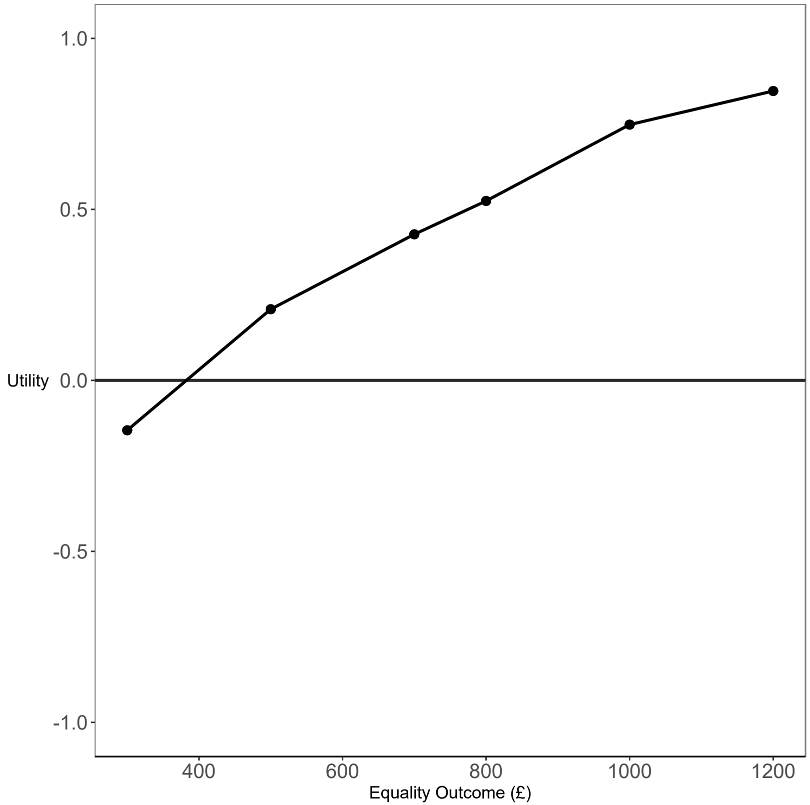
[8] Individual social utility curves, grouped by best fitting model, are available in the Supplementary Materials located on the OSF.

Figure 7: Mean Social Utility Curves by Scenario in Study 2., illustrating utility as a function of difference in outcomes. The grey horizontal line marks the midpoint of neutral (dis)satisfaction. Each grey vertical line marks an outcome difference value of zero relative to each respective peer. Social utility curves (left hand side) are plotted separately for each of the two own outcome levels. Satisfaction with equal outcomes (right-hand side) are plotted jointly for the two outcome levels.

(a) Income (N =234)



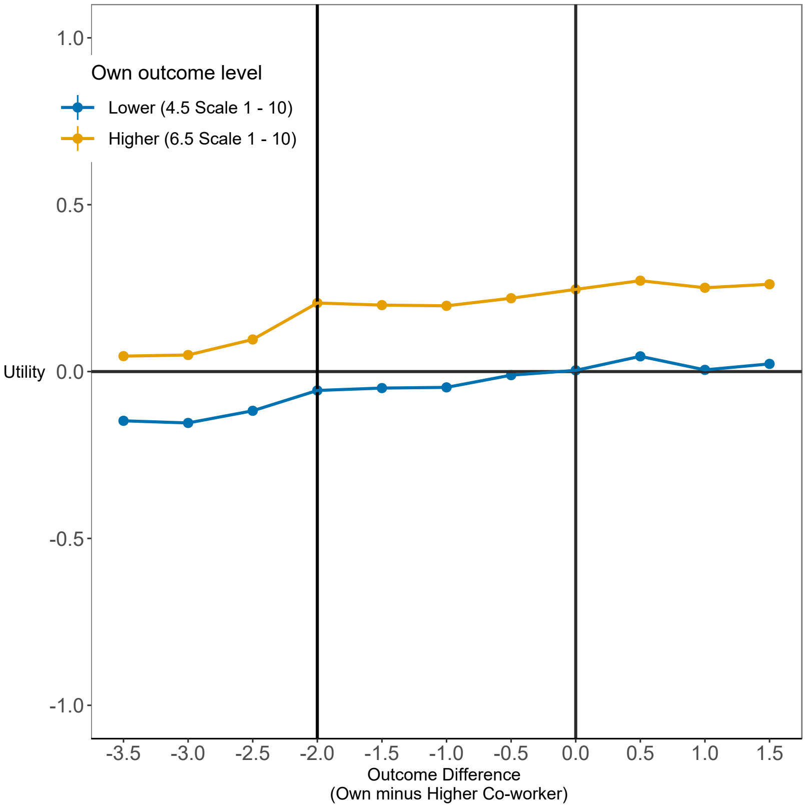
(i) Social utility curve



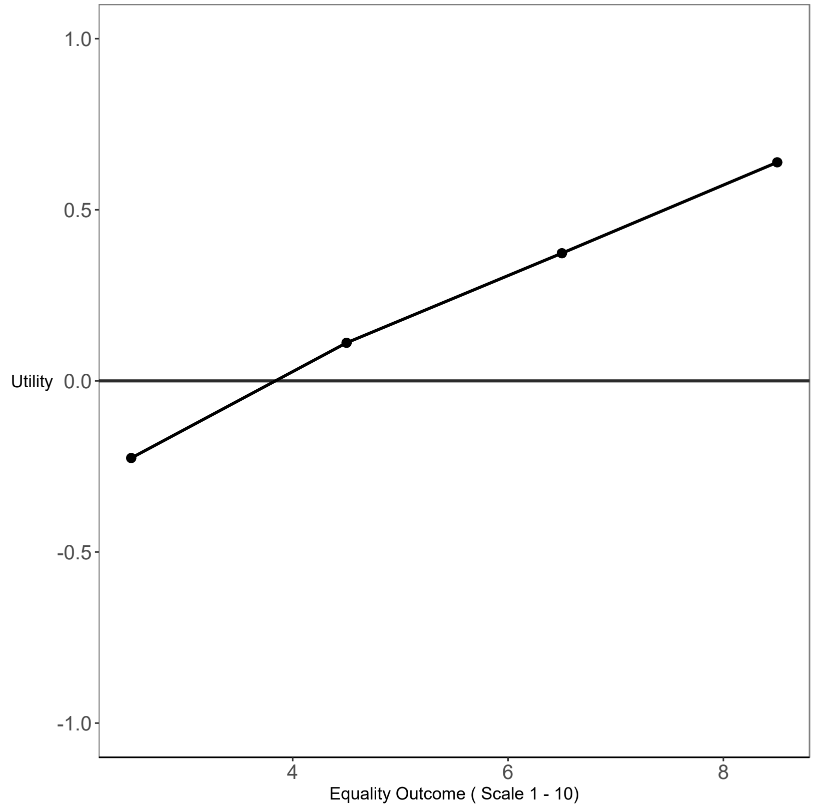
(ii) Satisfaction with equal outcomes

Figure 7: *Cont.*

(b) Attractiveness (N =234)



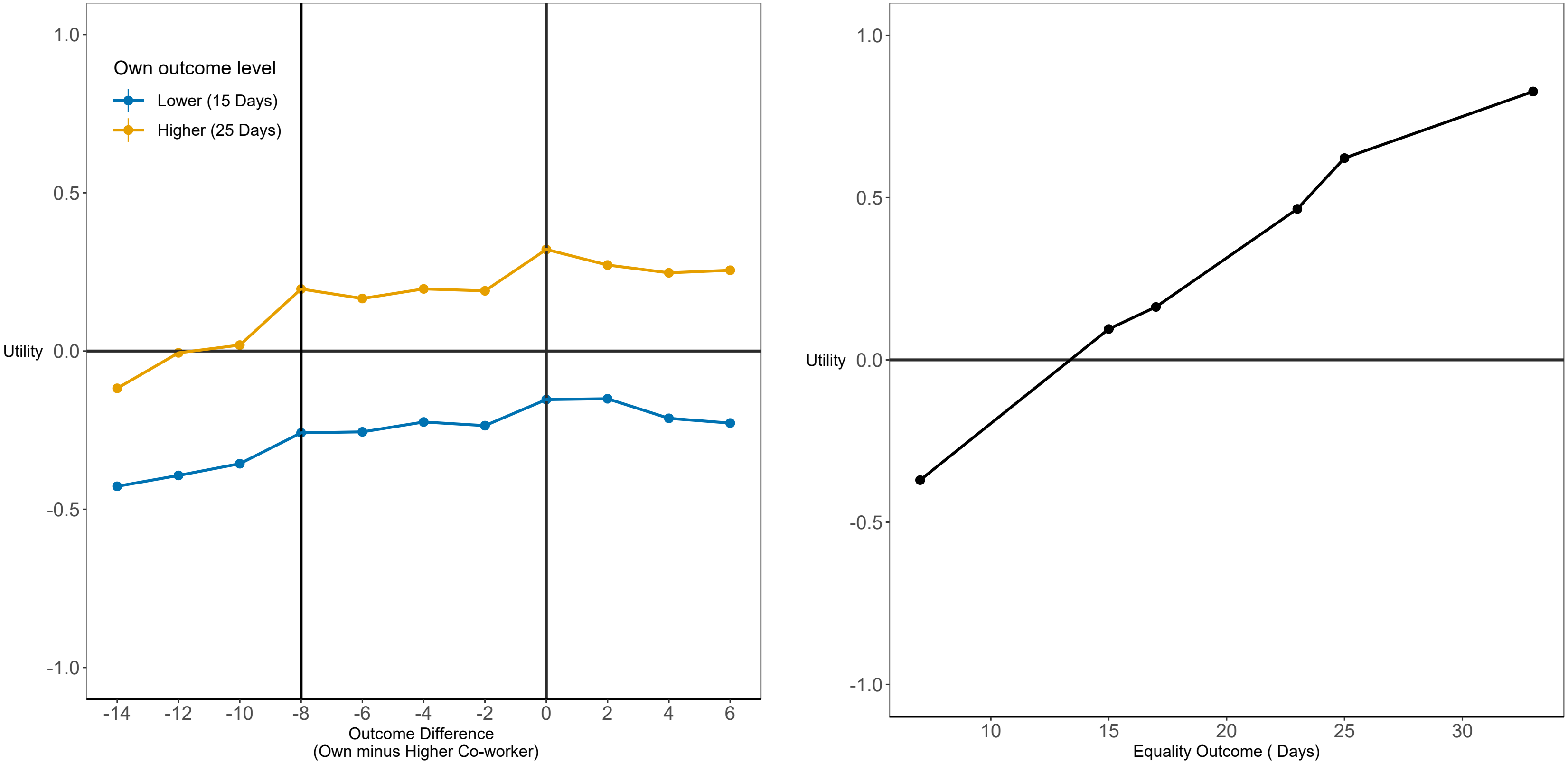
(i) Social utility curve



(ii) Satisfaction with equal outcomes

Figure 7: *Cont.*

(c) Vacation (N =234)



(i) Social utility curve

(ii) Satisfaction with equal outcomes

Bayesian Model Selection.

Parameter Estimates.

As in Study 1, we performed Bayesian model comparison for each participant individually, estimating a marginal likelihood for each combination of attribute and key models of social preference. Several forms of the social utility curves were evaluated for model selection; these models include those listed in Study 1, as well as an additional model of fairness based upon comparison to the mean (representing ERC: Bolton & Ockenfels, 2000). As per Study 1 we determined the best fitting model for each individual in each attribute by calculating a Bayes factor (BF) indicating evidence for the best fitting model, relative to the alternative models. We then consider the relative strength of evidence for this model fit.

Table 6 details the proportion of individuals best fit by each model, applying a threshold of BF >3. Here, again, we see a consistent overall preference for the piecewise linear form of the FS model. We find total absence of preference for the mean-referenced inequality model (e.g., ERC), and infrequent preference for the two rank-based models. Relative to Study 1, however, we also see the emergence of popular preference for self-interest, consistent with the flatness of the mean level functions in Figure 7.

A substantial proportion of people were not substantially well fit (BF >3) by any model considered, including the baseline model: 41% in the income attribute, 42% attractiveness, and 37% vacation. This indicates that for many, social preferences are not strong (i.e., do not meet BF >3 threshold). Where social preferences are evidenced, overall, they are consistent with inequality aversion.

To test the role of FS model flexibility as in Study 1, we re-ran the model selection analysis, fixing the FS parameters to default values (α = 1/attribute range, β = 0.5/attribute range). To briefly summarise these results[9], the two forms of FS model together still fit approximately the same proportion of individuals, across each attribute. However the preferred functional form is inverted; the piecewise linear form of the FS model now accounts for a relatively low number of individuals, while the quadratic form accounts for a much greater proportion of preferences. The difference between the form of FS fits between the estimated and fixed parameter analysis suggests that the performance of the FS model in the standard model fitting procedure is potentially related to the relative flexibility of this model. Together, however, the FS models continue to perform well without the flexibility afforded by free parameters.

Table 6: Best Relative Model Fits (BF >3) in Study 2.

	Income	Attractiveness	Vacation
Fehr & Schmidt (Linear)	25 %	22 %	26 %
Fehr & Schmidt (Quadratic)	12 %	10 %	18 %
Strict Rank	3 %	3 %	1 %
General Rank	3 %	2 %	3 %
Self-interest	15 %	12 %	13 %
Baseline	1 %	11 %	1 %
Mean comparison	0 %	0 %	0 %
Not fit (i.e., BF $\leq$ 3)	41 %	42 %	37 %
Total N	234	234	234

3.2.2. Analyses Not Pre-registered

Individual Differences in Model Parameters, and Violations of Model Assumptions.

The estimated Fehr and Schmidt (1999) model α and β parameters are illustrated (for each participant, regardless of best model fit) in Figure 8. There were substantial individual differences in estimated parameter values, similar to Study 1 and Beranek et al. (2015). As in Study 1, there is a noticeable trend to slightly positive α and β estimates, corresponding to slight disutilities associated with both advantageous and disadvantageous inequality. As in Study 1, however, there are a number of people with estimated β <0, indicating utility associated with advantageous inequality.

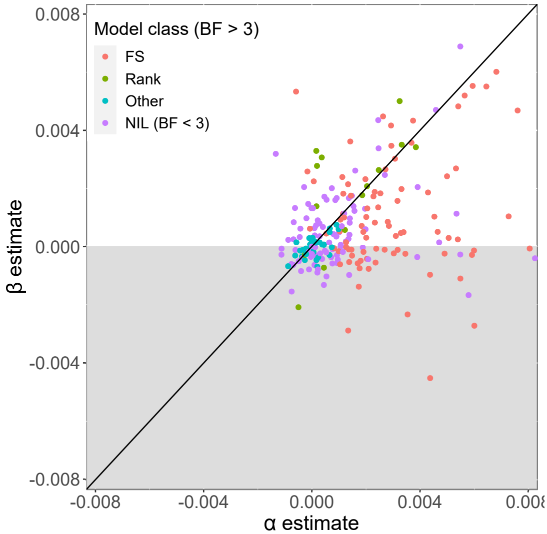
[9]full details of this analysis can be found in the Supplementary Materials on the OSF

Focusing on individuals best fit by the FS class of models, a similar proportion (38% in income; 45% attractiveness, 34% vacation) return estimates such that $\beta \geq 0$. Table 7 details the full proportion of all participants who conform to the assumptions made in the FS paper. Violations of both assumptions are broadly consistent among attributes considered, but are slightly higher than those estimated in Study 1 and Beranek et al. (2015).

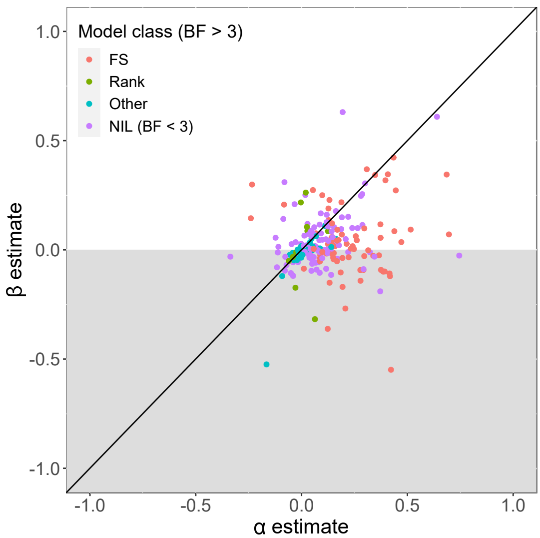
Table 7: Fehr and Schmidt's (1999) Assumption Violations in Study 2.

	Income	Attractiveness	Vacation
Violates $\alpha \geq \beta$ assumption	31 %	29 %	36 %
Violates $\beta \geq 0$ assumption	42 %	47 %	32 %
Violates either (or both) FS assumptions	68 %	69 %	65 %

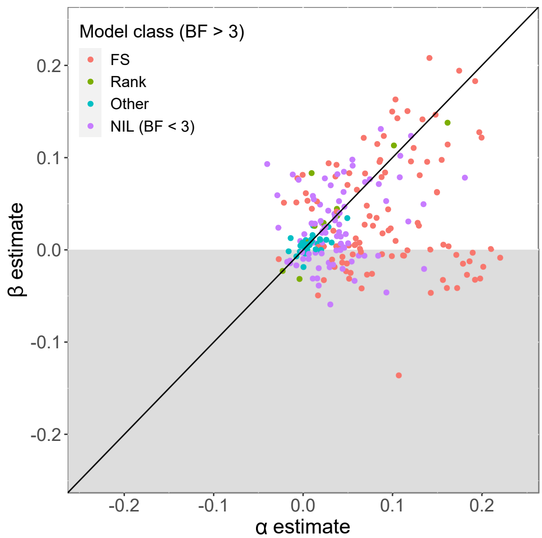
Figure 8: α and β Parameters Estimated in Study 2. Colour of points correspond to best fitting model class (BF >3). Points on the top-left side of the of $\alpha = \beta$ line violate the assumption that $\alpha \geq \beta$. Points within the grey shaded area of $\beta < 0$ violate the assumption that there is disutility (and not utility) in doing better than others. To account for differences in the magnitude of values presented in each attribute, plot axes limits are determined based on the range of values shown in a given attribute (10/attribute range).



(a) Income (N =234)



(b) Attractiveness (N =234)



(c) Vacation (N =234)

3.3. Discussion

Study 2 was undertaken in order to explore social preferences in reference to two distinct peers. Overall, the results were similar across all attributes considered, and relatively flat. There were, however, minor peaks at points of equality with either peer. Comparing the social utility curves with the "equal outcomes" curves, indicates that people rated identical own outcomes higher when others are equal, than in conditions of inequality (either advantageous or disadvantageous).

Individual model fits indicated common FS equality concerns amongst individuals, in all attributes investigated. The form of this inequality aversion again departed somewhat from that specified by Fehr and Schmidt (1999), as we see only a minority of participants meet both assumptions of the model. We see notable violations of the $\beta \geq 0$ assumption in particular, suggesting positive utility (rather than disutility as expected) is associated with outdoing peers for a sizable portion of individuals, including those best fit by the FS models.

Self-interest concerns, however, were slightly more frequent than either instantiation of the FS model in the domains of attractiveness and vacation, and were also high in the income attribute. This suggests that people may focus less on the outcomes of others as the reference group expands in some domains. We did not find any individuals were best fit by the mean reference form of inequality aversion concern. Compared to Study 1, we found a lower frequency of status comparison preferences, and overall little evidence of either form of rank-based status concern despite the attempt to make competitive social concerns more salient by having multiple comparators.

Notably, the attractiveness domain also elicits a high proportion of "baseline" ratings indicating essentially flat curves. Examining plots of individual's responses did indicate that the curves produced were somewhat irregular, indicating some degree of noise in people's responding. One possibility might be that the random ordering of questions meant that participants were not fully engaged with the task, or did not benefit from carry-over of information between responses.

4. General Discussion

In this paper we sought to better understand the contribution of both concern with equality and status competition to evaluation of options. We adapted existing preference elicitation paradigms and directly compared key models of social preference on social preference in a number of personal characteristics such as income and attractiveness. In Study 1 we use a series of satisfaction ratings to estimate social utility curves as a function of the difference between oneself and a single reference value. In Study 2 we adapt this methodology in order to explore satisfaction as a function of payoffs to oneself and two reference points.

4.1. Overview of Key Findings

While there was evidence for individual differences in preference (as previously described by others e.g., Kerschbamer, 2015; Solnick & Hemenway, 1998), the most consistent finding across all studies in this paper was the prevalence of preferences in line with a concern for equality. In each of the "evolutionarily relevant" attributes (i.e., excluding the attribute of vacation time), the plurality of participants were best fit by the piecewise linear instantiation of the FS model, relative to other models of social preference considered. Thus, the FS model of fairness provides the strongest account of satisfaction with economic outcomes for the most amount of people (compared to models of mean-reference fairness and rank-status).

The precise form of such inequality aversion concerns captured in Studies 2 and 3 of this paper, while consistent with the general form of the model, was not entirely consistent with that assumed in Fehr and Schmidt (1999). We found widespread violation of Fehr and Schmidt's (1999) assumed bounds associated with parameters of advantageous inequality (that $\beta \geq 0$) and disadvantageous inequality ($\alpha \geq \beta$). Consistently, we found that only approximately one third of individuals meet both assumptions.

Overall, the frequency of such violations are approximately 10% greater than those found by Beranek et al. (2015) in their partial replication of Loewenstein et al. (1989). There is no clear reason as to why we elicited a higher proportion of assumption violations than Beranek et al. (2015), who included separate UK and Internet-sourced samples, in our UK-based Internet-sourced samples. Notably, for approximately 1/3 of our participants the disutility associated with advantageous inequality was greater than that for disadvantageous inequality (i.e., violating the assumption $\alpha \geq \beta$). It appears that this sizable minority actually preferred to be behind, rather than ahead of, others. This is inconsistent with Li et al. (2018), for example, who found behavioural and psycho-physiological evidence for disadvantageous, but not advantageous, inequality aversion in payout judgements.

We also found that somewhere between 25% to 50% of all participants, and 20% to 45% of inequality-averse participants, violated the assumption that there is disutility associated with advantageous inequality (i.e., violating the assumed bounds $\beta > 0$). That is, a small number of participants have a preference for being ahead. The social utility curves of such individuals would not resemble the distinctive FS "tent-shape" (declining utility as a function of increasing inequality), but instead demonstrate increasing satisfaction as a function of better relative outcome. Such a utility function is arguably consistent with a status preference, but differs in the functional form. The β-assumption-violating FS participants generate a constantly increasing function indicating that individuals care not just about being ahead, but about how much they are ahead, contrasts with the step function of the rank position model. This highlights the importance of adequately capturing and differentiating between different functional forms—with different psychological implications—describing some people's concern with being ahead.

With regard to rank-based preference, we found that overall the status-rank models perform fairly poorly. Specifically, the standard form of the status-rank model (which we refer as "strict rank") was generally outperformed by the FS model over this series of studies. The results of this paper, therefore, differ from a number of papers that have found that rank-status describes well a range of economic preferences and individual well-being measures (e.g., Boyce et al., 2010; A. M. Wood et al., 2012). One way to reconcile such findings with those in the current paper would be to test the strength of rank-status fits in direct comparison to FS inequality aversion on those other data, as we have done here. One qualification is that some participants in our studies were best captured by a rank-based model, and it may be that the extent to which people express such preferences depends on some nature of the task that differed between the studies here and those cited above.

4.2. Noise and follow-up analyses

To address the notable noise evident in Study 1 and especially in Study 2 (see model fits as well as individual social utility curves in Supplementary Materials), we ran a follow-up to Study 2 where value combinations were presented in descending order (e.g., the values of co-workers each incrementally decreasing). These data also produced noisy, saw-toothed individual social utility curves. Interested readers can find those data and analyses in the Supplementary Material on the Open Science Framework. Further, Beranek et al. (2015) also kindly provided data from their partial replication of Loewenstein et al. (1989). Re-analysing those data we found similar noisiness in individual social utility curves. This indicates that noisy response patterns are not a phenomenon unique to Study 2, and may represent a common pattern that is obscured by examination of aggregate functions. Whether such noisiness reflects a "trembling hand" (Loomes et al., 2002) or noisiness in decision-making itself (Rieskamp, 2008) is an interesting question for future research.

4.3. Limitations and Future Directions

This study has demonstrated the utility of model selection in identifying discrete individual differences in social preferences, however, some consideration should be given to the fact that we have relied on an Internet sourced convenience sample. Online studies may produce more pro-social behaviour than those in the lab (Hergueux & Jacquemet, 2015). Beranek et al. (2015) used a paradigm based on Loewenstein et al. (1989), which we adopted for the two studies presented here, and estimated that a greater proportion of their online sample obey the assumption $\beta \geq 0$ than their Turkish and English university-based samples (see Beranek et al., 2015 Supplementary Materials). This indicates that more of the online sample may be averse to advantageous inequality than the in-person samples. Therefore, there is the potential that the current set of online studies may be overestimating the extent of fairness concerns. The differences documented by Beranek et al. (2015), however, are relatively small (32% violate the $\beta \geq 0$ assumption in Turkish, and 35% in English lab samples respectively, compared to 24% violating the same assumption online; a difference of 8–11%), and it is not likely to be the case that the mixture of parameter violations estimated in the current Online studies will be radically different in an in-lab setting.

Relatedly, there are cross-cultural differences in the expression of status competition (Baldwin & Mussweiler, 2018; Grolleau & Saïd, 2008; Solnick et al., 2007). Interpretation of findings in the social preference literature should therefore be considered in the cultural context of the sample (in this paper, UK residents) and replicated cross-culturally.

Another obvious limitation with eliciting social preferences through idiosyncratic economic paradigms is that of ecological validity; the question of whether these results can be generalised to real-world economic and social behaviours (e.g., Levitt & List, 2007). Specifically, all decisions in the current study were made regarding both hypothetical resources, as well as hypothetical peers. While incentives do not influence all types of behaviour in economic games, there is evidence that incentives do result in less socially desirable behaviour, such as generosity, in distribution games (Camerer & Hogarth, 1999). Bühren and Kundt (2013) tested the difference between incentivised and hypothetical decisions in a series of dictator games with binary outcome options (e.g., Fehr et al., 2008). They found fewer incentivised participants were classified in-line with inequality aversion than those in the hypothetical condition, and conversely more incentivised than non-incentivised participants were classified as "spiteful"—a preference for outdoing others consistent with rank-status preference.

Therefore, the hypothetical nature may not only limit the ecological validity of the current series of studies, but as a result over-estimate inequality-averse preferences. Exploration of panel data sets provide one avenue in which to examine satisfaction and well being as a function of one's real income as experienced personally (e.g., Boyce et al., 2010; G. D. A. Brown et al., 2008). Field studies (e.g., Amato et al., 2020; Bernard et al., 2020) or natural experiments (e.g., Buell, 2021) and incentivised experimental tasks (such as the "money burning" paradigm; Zizzo & Oswald, 2001) are another avenue for examining consequential choice behaviour.

In exploring social preferences we consider only a limited number of domains we believed salient to daily life. There is undoubtedly a range of other attributes in which social preferences may be explored. Most notably we only considered a single leisure domain. We also considered only attributes that may be considered "private goods". Others have explored status versus self-interest preferences in private bads (such as being berated by a teacher or critisised by a mentor), and public goods and bads (such as national triumphs or disasters; Grolleau & Saïd, 2008; Solnick & Hemenway, 2005). These may warrant further exploration given the results of the current paper indicate a preference for equality may trump both rank-status and self-interest.

Finally, we also consider values only in the domain of gains. Given that losses and gains are treated differently in other forms of judgement and decision-making such as risk (e.g., prospect theory; Kahneman & Tversky, 1979), it is not necessarily the case that the results of this study generalise to the judgement of negative outcomes such as debts. Negative outcomes are presumed to be less positional (e.g., Mishra, 2014, see also empirical work from Hill and Buss, 2010) and therefore may also elicit higher proportions of self-interest strategies. However, Beranek et al. (2015) and Loewenstein et al. (1989) did consider income in situations of mutual loss, or mixed outcomes where one party has a positive outcome and the other a loss. In both, they found that mean responses continued to reflect social preferences regarding equality. Similarly, Walasek and Stewart (2019) find some effect of rank-based judgements in evaluation of lottery stakes, both wins and losses. Thus, there is some prior evidence for social preference in considering negative outcomes in financial attributes. Future work could extend the current model selection framework to the consideration of losses, at least in the financial attribute.

4.4. Implications

Understanding individual social preferences and their mixture in populations is important as the prevalence and strength of other motivated preferences has important economic consequences (e.g., Aronsson & Johansson-Stenman, 2020; Aronsson et al., 2016; Fehr & Fischbacher, 2002; Støstad & Cowell, 2021) including implications for government policies with potential redistributive consequences (e.g., taxation, social welfare, unemployment benefits; Ackert et al., 2007; Hopkins & Kornienko, 2004, 2009). There is some evidence that popular endorsement of redistributive policy is associated with fairness-based social preferences within a given population. People who indicate greater concern for fairness endorse wealth redistribution to a greater degree than their self-interested counterparts in German (Kerschbamer & Müller, 2020) and Swiss samples (Epper et al., 2020). Thus, as policy that may be considered "optimal" is contingent upon the distributional preferences of voters and taxpayers (Saez & Stantcheva, 2013), an exploration of social preferences can assist in identifying optimal policy.

The substantial individual differences noted in this study indicate that no given approach to economic policy is likely to satisfy all citizens. Results from this series of studies do indicate, however, that the greatest proportion of individuals prefer equality. This is somewhat consistent with evidence that popular endorsement of progressive social welfare policy and preferred income tax schedules do diverge from pure self-interest concerns and reflect widespread regard for simple social motives such as "merit" and "fairness" (Fong, 2001; Seidl & Traub, 2001). Additionally, people express broad aversion to inequality in deciding between alternative tax structures, even when this requires a small personal sacrifice (Ackert et al., 2007; Durante et al., 2014; Tyran & Sausgruber, 2006). If findings like these can be extended to establish that the general public expresses concerns beyond purely selfish preferences, and that such preferences demonstrate a preoccupation with equality, (re)distributive policies may not prove as unpopular as conventionally considered.

4.5. Conclusion

Through a series of studies, we sought to investigate competing social preferences, with the aim of directly differentiating preferences regarding equality and status competition. We show that mean social preference measures fail to capture important aspects of individual difference where individuals demonstrate a number of distinct strategies. Aggregating over several distinct (sometimes oppositional) strategies means that aggregate measures of social preference fail to capture the behaviour of any one group, and may therefore be a misleading index of social preference. We establish considerable individual differences in social preference regarding satisfaction with hypothetical resource allocation over a number of personal attributes. Overall, however, the highest proportion of elicited concerns were best fit by the Fehr and Schmidt (1999) inequality aversion model. Challenging the social preference literature regarding preference for status over self-interest, our results support other work suggesting that individuals seek equality above both, when the preference elicitation method distinguishes between the three forms of social preference.

Acknowledgments. This paper is based on a study from the first author's PhD Thesis (Chapter 3, Studies 2 and 3; full text repository: https://doi.org/10.26182/6axh-v442).

Funding Statement. B.C. was supported by an Australian Government Research Training Program (RTP) Scholarship from the University of Western Australia.

Competing Interests. None

Data Availability Statement. Materials, analysis scripts, data, pre-registration and deviation of disclosure can be found on the Open Science Framework (Study 1 osf.io/f3xw9/; Study 2 osf.io/euxj8/).

Ethical Standards. The research meets all ethical guidelines, including adherence to the legal requirements of the study country. The reported research involving human data was approved by the University of Western Australia Human Research Ethics Committee. Approval #:RA/4/1/9062.

Author Contributions. Conceptualization: S.F; B.C; M.H. Data Curation: B.C. Formal Analysis: B.C; S.F. Investigation: B.C; S.F.; M.H. Methodology: B.C; S.F.; M.H. Project Administration: B.C; S.F. Resources: B.C; S.F. Software: S.F; B.C. Supervision: S.F; M.H. Visualization: B.C. Writing – Original Draft Preparation: B.C. Writing – Review & Editing: S.F; M.H. All authors approved the final submitted draft.

References

Ackert, L. F., Martinez-Vazquez, J., & Rider, M. (2007). Social preferences and tax policy design: Some experimental evidence. *Economic Inquiry*, *45*(3), 487–501. https://doi.org/10.1111/j.1465-7295.2007.00048.x

Amato, C., Gino, F., Montinari, N., & Sacco, P. (2020). Cheating, inequality aversion, and appealing to social norms. *Journal of Economic Behavior & Organization*, *179*, 767–776. https://doi.org/10.1016/j.jebo.2019.11.016

Anderson, C., Hildreth, J. A. D., & Howland, L. (2015). Is the desire for status a fundamental human motive? A review of the empirical literature. *Psychological Bulletin*, *141*(3), 574–601. https://doi.org/10.1037/a0038781

Andreoni, J., & Miller, J. (2002). Giving According to GARP: An Experimental Test of the Consistency of Preferences for Altruism. *Econometrica*, *70*(2), 737–753. https://doi.org/10.1111/1468-0262.00302

Aronsson, T., & Johansson-Stenman, O. (2020). Optimal Second-Best Taxation When Individuals Have Social Preferences. http://www.usbe.umu.se/ues/ues973.pdf

Aronsson, T., Johansson-Stenman, O., & Wendner, R. (2016). Redistribution Through Charity and Optimal Taxation When People Are Concerned with Social Status. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2713067

Baldwin, M., & Mussweiler, T. (2018). The culture of social comparison. *Proceedings of the National Academy of Sciences*, *115*(39), E9067–E9074. https://doi.org/10.1073/pnas.1721555115

Becker, G. S., Murphy, K. M., & Werning, I. (2005). The Equilibrium Distribution of Income and the Market for Status. *Journal of Political Economy*, *113*(2), 282–310. https://doi.org/10.1086/427463

Bellemare, C., Kröger, S., & van Soest, A. (2008). Measuring Inequity Aversion in a Heterogeneous Population Using Experimental Decisions and Subjective Probabilities. *Econometrica*, *76*(4), 815–839. https://doi.org/10.1111/j.1468-0262.2008.00860.x

Beranek, B., Cubitt, R., & Gächter, S. (2015). Stated and revealed inequality aversion in three subject pools. *Journal of the Economic Science Association*, *1*(1), 43–58. https://doi.org/10.1007/s40881-015-0007-1

Bernard, K., Bonein, A., & Bougherara, D. (2020). Consumer inequality aversion and risk preferences in community supported agriculture. *Ecological Economics*, *175*, 106684. https://doi.org/10.1016/j.ecolecon.2020.106684

Blanco, M., Engelmann, D., & Normann, H.-T. (2010). A Within-Subject Analysis of Other-Regarding Preferences. http://hdl.handle.net/10419/41419

Bolton, G. E., & Ockenfels, A. (1998). Strategy and Equity: An ERC-Analysis of the Güth–van Damme Game. *Journal of Mathematical Psychology*, *42*(2-3), 215–226. https://doi.org/10.1006/jmps.1998.1211

Bolton, G. E., & Ockenfels, A. (2000). ERC: A Theory of Equity, Reciprocity, and Competition. *The American Economic Review*, *90*(1), 166–193. https://doi.org/10.1257/aer.90.1.166

Bolton, G. E., & Ockenfels, A. (2008). Chapter 59 Self-centered Fairness in Games with More Than Two Players. In C. R. Plott & V. L. Smith (Eds.), *Handbook of experimental economics results* (pp. 531–540, Vol. 1). Elsevier. https://doi.org/10.1016/S1574-0722(07)00059-5

Boyce, C. J., Brown, G. D., & Moore, S. C. (2010). Money and Happiness: Rank of Income, Not Income, Affects Life Satisfaction. *Psychological Science*, *21*(4), 471–475. https://doi.org/10.1177/0956797610362671

Brandts, J., Fatas, E., Haruvy, E., & Lagos, F. (2015). The impact of relative position and returns on sacrifice and reciprocity: An experimental study using individual decisions. *Social Choice and Welfare*, *45*(3), 489–511. https://doi.org/10.1007/s00355-014-0818-7

Brown, G. D. A., Gardner, J., Oswald, A. J., & Qian, J. (2008). Does Wage Rank Affect Employees' Well-Being? *Industrial Relations*, *47*(3), 355–389. https://doi.org/10.1111/j.1468-232X.2008.00525.x

Brown, G. D. A., Gathergood, J., & Weber, J. (2017). Relative Rank and Life Satisfaction: Evidence from US Households. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2912892

Brown, J. D., Novick, N. J., Lord, K. A., & Richards, J. M. (1992). When Gulliver travels: Social context, psychological closeness, and self-appraisals. *Journal of Personality and Social Psychology*, *62*(5), 717–727. https://doi.org/10.1037/0022-3514.62.5.717

Bruhin, A., Fehr, E., & Schunk, D. (2019). The many Faces of Human Sociality: Uncovering the Distribution and Stability of Social Preferences. *Journal of the European Economic Association*, *17*(4), 1025–1069. https://doi.org/10.1093/jeea/jvy018

Buckingham, J. T., & Alicke, M. D. (2002). The influence of individual versus aggregate social comparison and the presence of others on self-evaluations. *Journal of Personality and Social Psychology*, *83*(5), 1117–1130. https://doi.org/10.1037/0022-3514.83.5.1117

Buell, R. W. (2021). Last-Place Aversion in Queues. *Management Science*, *67*(3), 1430–1452. https://doi.org/10.1287/mnsc.2020.3619

Bühren, C., & Kundt, T. C. (2013). Imagine Being a Nice Guy: A Note on Hypothetical vs. Incentivized Social Preferences. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2487072

Buunk, B. P., & Mussweiler, T. (2001). New directions in social comparison research. *European Journal of Social Psychology*, *31*(5), 467–475. https://doi.org/10.1002/ejsp.77

Cabrales, A., Miniaci, R., Piovesan, M., & Ponti, G. (2010). Social Preferences and Strategic Uncertainty: An Experiment on Markets and Contracts. *The American Economic Review*, *100*(5), 2261–2278. https://doi.org/10.1257/aer.100.5.2261

Cabrales, A., & Ponti, G. (2015). Social Preferences (M. Muñoz-Herrera, Trans.). In P. Branas-Garza & A. Cabrales (Eds.), *Experimental Economics* (pp. 87–104, Vol. 1: Economic Decisions). Palgrave Macmillan UK. https://doi.org/10.1057/9781137538192

Camerer, C. F., & Hogarth, R. M. (1999). The Effects of Financial Incentives in Experiments: A Review and Capital-Labor-Production Framework. *Journal of risk and uncertainty*, *19*(1), 7–48. https://doi.org/10.1023/A:1007850605129

Charness, G., & Rabin, M. (2000). Social Preferences: Some Simple Tests and a New Model. https://escholarship.org/uc/item/46j0d6hb

Charness, G., & Rabin, M. (2002). Understanding social preferences with simple tests. *The Quarterly Journal of Economics*, *117*(3), 817–869. https://doi.org/10.1162/003355302760193904

Chen, F., & Fischbacher, U. (2020). Cognitive processes underlying distributional preferences: A response time study. *Experimental Economics*, *23*(2), 421–446. https://doi.org/10.1007/s10683-019-09618-x

Clark, A. E., Kristensen, N., & Westergård-Nielsen, N. (2009). Economic Satisfaction and Income Rank in Small Neighbourhoods. *Journal of the European Economic Association*, *7*(2-3), 519–527. https://doi.org/10.1162/JEEA.2009.7.2-3.519

Conrath, D. W., & Deci, E. L. (1969). The determination and scaling of a bivariate utility function. *Behavioral Science*, *14*(4), 316–327. https://doi.org/10.1002/bs.3830140406

Cooper, D. J., & Kagel, J. H. (2016). Other-Regarding Preferences A Selective Survey of Experimental Results. In J. H. Kagel & A. E. Roth (Eds.), *The Handbook of Experimental Economics, Volume Two* (pp. 217–289). Princeton University Press. https://doi.org/10.1515/9781400883172-005

Daly, M., Boyce, C., & Wood, A. (2015). A social rank explanation of how money influences health. *Health Psychology*, *34*(3), 222–230. https://doi.org/10.1037/hea0000098

Durante, R., Putterman, L., & van der Weele, J. (2014). Preferences for Redistribution and Perception of Fairness: An Experimental Study. *Journal of the European Economic Association*, *12*(4), 1059–1086. https://doi.org/10.1111/jeea.12082

Elgar, F. J., De Clercq, B., Schnohr, C. W., Bird, P., Pickett, K. E., Torsheim, T., Hofmann, F., & Currie, C. (2013). Absolute and relative family affluence and psychosomatic symptoms in adolescents. *Social Science & Medicine*, *91*, 25–31. https://doi.org/10.1016/j.socscimed.2013.04.030

Engelmann, D., & Strobel, M. (2004). Inequality Aversion, Efficiency, and Maximin Preferences in Simple Distribution Experiments. *American Economic Review*, *94*(4), 857–869. https://doi.org/10.1257/0002828042002741

Epper, T., Fehr, E., & Senn, J. (2020). Other-Regarding Preferences and Redistributive Politics. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3526809

Falk, A., & Fischbacher, U. (2006). A theory of reciprocity. *Games and Economic Behavior*, *54*(2), 293–315. https://doi.org/10.1016/j.geb.2005.03.001

Fehr, E., Bernhard, H., & Rockenbach, B. (2008). Egalitarianism in young children. *Nature*, *454*(7208), 1079–1083. https://doi.org/10.1038/nature07155

Fehr, E., & Fischbacher, U. (2002). Why social preferences matter–the impact of non-selfish motives on competition, cooperation and incentives. *The economic journal*, *112*(478), C1–C33. https://doi.org/10.1111/1468-0297.00027

Fehr, E., & Schmidt, K. (2001). Theories of fairness and reciprocity - evidence and economic applications. https://doi.org/10.3929/ethz-a-004373709

Fehr, E., & Schmidt, K. M. (1999). A theory of fairness, competition, and cooperation. *Quarterly journal of Economics*, *114*(3), 817–868. https://doi.org/10.1162/003355399556151

Fehr, E., & Schmidt, K. M. (2006). Chapter 8 The Economics of Fairness, Reciprocity and Altruism – Experimental Evidence and New Theories. In S.-C. Kolm & J. M. Ythier (Eds.), *Handbook of the Economics of Giving, Altruism and Reciprocity* (pp. 615–691, Vol. 1). Elsevier. https://doi.org/10.1016/S1574-0714(06)01008-6

Festinger, L. (1954). A theory of social comparison processes. *Human relations*, *7*(2), 117–140. https://doi.org/10.1177/001872675400700202

Fong, C. (2001). Social preferences, self-interest, and the demand for redistribution. *Journal of Public Economics*, *82*(2), 225–246. https://doi.org/10.1016/S0047-2727(00)00141-9

Friedman, M. (1970). *Essays in Positive Economics*. University of Chicago Press. https://archive.org/details/essaysinpositive00milt (Original work published 1953)

Geiselman, R., Haight, N. A., & Kimata, L. G. (1984). Context effects on the perceived physical attractiveness of faces. *Journal of Experimental Social Psychology*, *20*(5), 409–424. https://doi.org/10.1016/0022-1031(84)90035-0

Grolleau, G., Mzoughi, N., & Saïd, S. (2012). Do you believe that others are more positional than you? Results from an empirical survey on positional concerns in France. *The Journal of Socio-Economics*, *41*(1), 48–54. https://doi.org/10.1016/j.socec.2011.10.001

Grolleau, G., & Saïd, S. (2008). Do You Prefer Having More or More than Others? Survey Evidence on Positional Concerns in France. *Journal of Economic Issues*, *42*(4), 1145–1158. https://doi.org/10.1080/00213624.2008.11507206

Henry, P. J. (2009). Low-status compensation: A theory for understanding the role of status in cultures of honor. *Journal of Personality and Social Psychology*, *97*(3), 451–466. https://doi.org/10.1037/a0015476

Hergueux, J., & Jacquemet, N. (2015). Social preferences in the online laboratory: A randomized experiment. *Experimental Economics*, *18*(2), 251–283. https://doi.org/10.1007/s10683-014-9400-5

Hill, S. E., & Buss, D. M. (2010). Risk and relative social rank: Positional concerns and risky shifts in probabilistic decision-making. *Evolution and Human Behavior*, *31*(3), 219–226. https://doi.org/10.1016/j.evolhumbehav.2010.01.002

Hirschman, A. O. (1977). *The passions and the interests: Political arguments for capitalism before its triumph*. Princeton University Press. https://archive.org/details/princeton-classic-editions-hirschman-albert-o-the-passions-and-the-interests-pol

Hopkins, E., & Kornienko, T. (2004). Running to Keep in the Same Place: Consumer Choice as a Game of Status. *American Economic Review*, *94*(4), 1085–1107. https://doi.org/10.1257/0002828042002705

Hopkins, E., & Kornienko, T. (2009). Status, affluence, and inequality: Rank-based comparisons in games of status. *Games and Economic Behavior*, *67*(2), 552–568. https://doi.org/10.1016/j.geb.2009.02.004

Hounkpatin, H. O., Wood, A. M., Brown, G. D. A., & Dunn, G. (2015). Why does Income Relate to Depressive Symptoms? Testing the Income Rank Hypothesis Longitudinally. *Social Indicators Research*, *124*(2), 637–655. https://doi.org/10.1007/s11205-014-0795-3

Hounkpatin, H. O., Wood, A. M., & Dunn, G. (2016). Does income relate to health due to psychosocial or material factors? Consistent support for the psychosocial hypothesis requires operationalization with income rank not the Yitzhaki Index. *Social Science & Medicine*, *150*, 76–84. https://doi.org/10.1016/j.socscimed.2015.12.008

Jeffreys, H. (1998). *Theory of probability* (3rd ed). Oxford University Press. https://archive.org/details/in.ernet.dli.2015.2608

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica: Journal of the econometric society*, *47*(2), 263–292. https://doi.org/10.2307/1914185

Kerschbamer, R. (2015). The geometry of distributional preferences and a non-parametric identification approach: The Equality Equivalence Test. *European Economic Review*, *76*, 85–103. https://doi.org/10.1016/j.euroecorev.2015.01.008

Kerschbamer, R., & Müller, D. (2020). Social preferences and political attitudes: An online experiment on a large heterogeneous sample. *Journal of Public Economics*, *182*, 104076. https://doi.org/10.1016/j.jpubeco.2019.104076

Kifle, T. (2014). Do Comparison Wages Play a Major Role in Determining Overall Job Satisfaction? Evidence from Australia. *Journal of Happiness Studies*, *15*(3), 613–638. https://doi.org/10.1007/s10902-013-9439-6

Kirchsteiger, G. (1994). The role of envy in ultimatum games. *Journal of Economic Behavior & Organization*, *25*(3), 373–389. https://doi.org/10.1016/0167-2681(94)90106-6

Klein, W. M. (2003). Effects of Objective Feedback and "Single Other" or "Average Other" Social Comparison Feedback on Performance Judgments and Helping Behavior. *Personality and Social Psychology Bulletin*, *29*(3), 418–429. https://doi.org/10.1177/0146167203251195

Krawczyk, M. W. (2011). A model of procedural and distributive fairness. *Theory and Decision*, *70*(1), 111–128. https://doi.org/10.1007/s11238-009-9189-4

Lee, M. D., & Wagenmakers, E.-J. (2014). *Bayesian Cognitive Modeling: A Practical Course*. Cambridge University Press. https://archive.org/details/manualzilla-id-5883105

Lerner, M. J. (1977). The justice motive: Some hypotheses as to its origins and forms. *Journal of Personality*, *45*(1), 1–52. https://doi.org/10.1111/j.1467-6494.1977.tb00591.x

Levitt, S. D., & List, J. A. (2007). What Do Laboratory Experiments Measuring Social Preferences Reveal About the Real World? *Journal of Economic Perspectives*, *21*(2), 153–174. https://doi.org/10.1257/jep.21.2.153

Li, O., Xu, F., & Wang, L. (2018). Advantageous Inequity Aversion Does Not Always Exist: The Role of Determining Allocations Modulates Preferences for Advantageous Inequity. *Frontiers in Psychology*, *9*, 749. https://doi.org/10.3389/fpsyg.2018.00749

Little, A. C., & Mannion, H. (2006). Viewing attractive or unattractive same-sex individuals changes self-rated attractiveness and face preferences in women. *Animal Behaviour*, *72*(5), 981–987. https://doi.org/10.1016/j.anbehav.2006.01.026

Locke, K. D. (2007). Personalized and Generalized Comparisons: Causes and Consequences of Variations in the Focus of Social Comparisons. *Personality and Social Psychology Bulletin*, *33*(2), 213–225. https://doi.org/10.1177/0146167206293492

Loewenstein, G., Thompson, L., & Bazerman, M. (1989). Social utility and decision making in interpersonal contexts. *Journal of Personality and Social Psychology*, *57*(3), 426–441. https://doi.org/10.1037/0022-3514.57.3.426

Loomes, G., Moffatt, P. G., & Sugden, R. (2002). A Microeconometric Test of Alternative Stochastic Theories of Risky Choice. *The Journal of Risk and Uncertainty*, *24*(2), 103–130. https://doi.org/doi.org/10.1023/A:1014094209265

Lurie, S. (1987). A Parametric Model of Utility for Two-Person Distributions. *Psychological Review*, *94*(1), 2–60. https://doi.org/10.1037/0033-295X.94.1.42

Maccrimmon, K. R., & Messick, D. M. (1976). A framework for social motives. *Behavioral Science*, *21*(2), 86–100. https://doi.org/10.1002/bs.3830210203

Mansbridge, J. (1990). Self-Interest in Political Life. *Political Theory*, *18*(1), 132–153. https://doi.org/10.1177/0090591790018001007

Messick, D. M., & Sentis, K. P. (1985). Estimating social and nonsocial utility functions from ordinal data. *European Journal of Social Psychology*, *15*(4), 389–399. https://doi.org/10.1002/ejsp.2420150403

Mishra, S. (2014). Decision-Making Under Risk Integrating Perspectives From Biology, Economics, and Psychology. *Personality and Social Psychology Review*, *18*(3), 280–307. https://doi.org/10.1177/1088868314530517

Morey, R. D., & Rouder, J. N. (2018). BayesFactor: Computation of bayes factors for common designs. *R package version 0.9.12-4.2*. https://CRAN.R-project.org/package=BayesFactor

Mueller, D. C. (1986). Rational egoism versus adaptive egoism as fundamental postulate for a descriptive theory of human behavior. *Public Choice*, *51*(1), 3–23. https://doi.org/10.1007/BF00141682

Parducci, A. (1965). Category judgment: A range-frequency model. *Psychological Review*, *72*(6), 407–418. https://doi.org/10.1037/h0022602

Parducci, A. (1995). *Happiness, pleasure, and judgment the contextual theory and its applications*. Lawrence Erlbaum Associates, Inc.

Powdthavee, N. (2009). How important is rank to individual perception of economic standing? A within-community analysis. *The Journal of Economic Inequality*, *7*(3), 225–248. https://doi.org/10.1007/s10888-008-9076-1

Rablen, M. D. (2008). Relativity, Rank and The Utility of Income. *The Economic Journal*, *118*(528), 801–821. https://doi.org/10.1111/j.1468-0297.2008.02143.x

Raftery, A. E. (1995). Bayesian Model Selection in Social Research. *Sociological Methodology*, *25*, 111–163. https://doi.org/10.2307/271063

Rawls, J. (1971). *A theory of justice*. Harvard University Press. https://archive.org/details/theoryofjustice00rawl

Rieskamp, J. (2008). The probabilistic nature of preferential choice. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *34*(6), 1446–1465. https://doi.org/10.1037/a0013646

Robson, A. J. (1992). Status, the Distribution of Wealth, Private and Social Attitudes to Risk. *Econometrica*, *60*(4), 837–857. https://doi.org/10.2307/2951568

Rouder, J. N., & Morey, R. D. (2012). Default Bayes Factors for Model Selection in Regression. *Multivariate Behavioral Research*, *47*(6), 877–903. https://doi.org/10.1080/00273171.2012.734737

Rouder, J. N., Morey, R. D., Verhagen, J., Province, J. M., & Wagenmakers, E.-J. (2016). Is There a Free Lunch in Inference? *Topics in Cognitive Science*, *8*(3), 520–547. https://doi.org/10.1111/tops.12214

Saez, E., & Stantcheva, S. (2013). Generalized social marginal welfare weights for optimal tax theory. http://www.nber.org/papers/w18835

Schwarz, G. (1978). Estimating the dimension of a model. *The Annals of Statistics*, *6*(2), 461–464.

Scott, R. H. (1972). Avarice, Altruism, and Second Party Preferences. *The Quarterly Journal of Economics*, *86*(1), 1–18. https://doi.org/10.2307/1880490

Segal, U., & Sobel, J. (2007). Tit for tat: Foundations of preferences for reciprocity in strategic settings. *Journal of Economic Theory*, *136*(1), 197–216. https://doi.org/10.1016/j.jet.2006.07.003

Seidl, C., & Traub, S. (2001). Taxpayers' attitudes, behavior, and perception of fairness. *Pacific Economic Review*, *6*(2), 255–267. https://doi.org/10.1111/1468-0106.00131

Sen, A. (1977). Rational Fools: A Critique of the Behavioral Foundations of Economic Theory. *Philosophy & Public Affairs*, *6*(4), 317–344.

Sen, A. (2004). *Rationality and Freedom*. Harvard University Press. https://archive.org/details/rationalityfreed00amar

Smith, R. H., Diener, E., & Wedell, D. H. (1989). Intrapersonal and Social Comparison Determinants of Happiness: A Range-Frequency Analysis. *Journal of Personality and Social Psychology*, *56*(3), 317–325. https://doi.org/10.1037/0022-3514.56.3.317

Solnick, S. J., & Hemenway, D. (1998). Is more always better?: A survey on positional concerns. *Journal of Economic Behavior & Organization*, *37*(3), 373–383. https://doi.org/10.1016/S0167-2681(98)00089-4

Solnick, S. J., & Hemenway, D. (2005). Are positional concerns stronger in some domains than in others? *The American Economic Review*, *95*(2), 147–151. https://doi.org/10.1257/000282805774669925

Solnick, S. J., Hong, L., & Hemenway, D. (2007). Positional goods in the United States and China. *The Journal of Socio-Economics*, *36*(4), 537–545. https://doi.org/10.1016/j.socec.2006.12.012

Stewart, N. (2009). EPS Prize Lecture: Decision by sampling: The role of the decision environment in risky choice. *Quarterly Journal of Experimental Psychology*, *62*(6), 1041–1062. https://doi.org/10.1080/17470210902747112

Stewart, N., Chater, N., & Brown, G. D. (2006). Decision by sampling. *Cognitive Psychology*, *53*(1), 1–26. https://doi.org/10.1016/j.cogpsych.2005.10.003

Støstad, M., & Cowell, F. (2021). Inequality as an Externality: Consequences for Tax Design. https://halshs.archives-ouvertes.fr/halshs-03495989

Suls, J., Martin, R., & Wheeler, L. (2002). Social Comparison: Why, With Whom, and With What Effect? *Current Directions in Psychological Science*, *11*(5), 159–163. https://doi.org/10.1111/1467-8721.00191

Suls, J. M., Wheeler, L., & Collins, R. L. (Eds.). (2020). *Social comparison, judgment, and behavior*. Oxford University Press.

Tyran, J.-R., & Sausgruber, R. (2006). A little fairness may induce a lot of redistribution in democracy. *European Economic Review*, *50*(2), 469–485. https://doi.org/10.1016/j.euroecorev.2004.09.014

Wagenmakers, E.-J. (2007). A practical solution to the pervasive problems ofp values. *Psychonomic Bulletin & Review*, *14*(5), 779–804. https://doi.org/10.3758/BF03194105

Walasek, L., & Stewart, N. (2019). Context-dependent sensitivity to losses: Range and skew manipulations. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *45*(6), 957–968. https://doi.org/10.1037/xlm0000629

Wedell, D. H., Parducci, A., & Geiselman, R. E. (1987). A formal analysis of ratings of physical attractiveness: Successive contrast and simultaneous assimilation. *Journal of Experimental Social Psychology*, *23*(3), 230–249. https://doi.org/10.1016/0022-1031(87)90034-5

Wheeler, L., & Miyake, K. (1992). Social comparison in everyday life. *Journal of Personality and Social Psychology*, *62*(5), 760–773. https://doi.org/10.1037/0022-3514.62.5.760

Winship, C., & Rosen, S. (1988). Introduction: Sociological and Economic Approaches to the Analysis of Social Structure. *American Journal of Sociology*, *94*, S1–S16. https://doi.org/10.1086/228940

Wood, A. M., Boyce, C. J., Moore, S. C., & Brown, G. D. (2012). An evolutionary based social rank explanation of why low income predicts mental distress: A 17 year cohort study of 30,000 people. *Journal of Affective Disorders*, *136*(3), 882–888. https://doi.org/10.1016/j.jad.2011.09.014

Wood, J. V. (1996). What is social comparison and how should we study it. *Personality and Social Psychology Bulletin*, *22*(5), 520–537. https://doi.org/10.1177/0146167296225009

Zell, E., & Alicke, M. D. (2010). The Local Dominance Effect in Self-Evaluation: Evidence and Explanations. *Personality and Social Psychology Review*, *14*(4), 368–384. https://doi.org/10.1177/1088868310366144

Zizzo, D. J., & Oswald, A. J. (2001). Are people willing to pay to reduce others' incomes? *Annales d'Economie et de Statistique*, 39–65. https://doi.org/10.2307/20076295