Stated Preferences for Inequality Aversion and Rank-Status

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Abstract
A number of social preference models have been proposed to account for the effect of social context on economic decision-making. To better differentiate these preferences at the individual level, we developed an adaptive binary-choice procedure based upon the Parameter Estimation by Sequential Testing (PEST) algorithm to estimate indifference points for scenarios of equality and inequality. We combined elicited indifference points in scenarios where the inequalities posed were advantageous and those where inequalities were disadvantageous to represent underlying motives of preference in two dimensional choice space (N = 83). We also explored the relationship between preference and leisure (vacation time) versus non-leisure (low income, high income, attractiveness, intelligence, and praise) attributes. We find considerable heterogeneity in preferences for leisure and non-leisure characteristics. Overall, a consistent plurality of participants fall into space characterised as "equality seeking", followed by "status avoiding" and "relative advantage" preference archetypes. Self-interest preferences were strongest in low income and vacation attributes. Concern with advantageous inequality was correlated across domains, as was concern with disadvantageous inequality. The results highlight both discrete and continuous individual differences in social preference.

1. Introduction

One of the most compelling descriptions of concern with status derives from a thought experiment posed by Robert Frank:

> Someone whose close associates all earn \$50,000 a year is likely to feel actively dissatisfied with [their] material standard of living if [their] own salary is only \$40,000... Yet that same person would likely be content if [their] closest associates earned not \$50,000 but \$30,000 a year. (Frank, 1985, p. 9)

This intuitive example has been empirically tested in the alternate-worlds task (Solnick & Hemenway, 1998) a binary forced-choice task which asks participants to indicate their preference between living in two hypothetical "worlds", each with a unique distribution of resources to the decision-maker and the average other in society. For example:

A : Your current yearly income is \$50,000; others earn \$25,000.
B : Your current yearly income is \$100,000; others earn \$200,000.

By selecting World A, the decision-maker gains a relative advantage over others (i.e., a higher income than the societal average). The decision-maker's situation in World B is better than World A in an absolute sense, but worse when considered relative to others in World B. People who act consistently with standard economic theory —pursuing their self-interest by seeking to maximise their own expected utility with no regard for the outcomes of others (Friedman, 1953/1970; Hirschman, 1977; Mueller, 1986; Sen, 2004; Winship & Rosen, 1988) —will prefer the world which offers the highest income, regardless of the outcomes of others (World B). Selection of World A indicates a concern with one's position relative to others with a psychological significance enough to outweigh the cost of a lower monetary outcome.

The psychological importance of relative success is reflected in the construct of social status; 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 innately driven to improve their social standing (Anderson et al., 2015; Becker et al., 2005). The rank-comparison account of economic decision-making (e.g. Rablen, 2008; Robson, 1992) describes the utility of economic outcomes 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 one is better than. Judgement of a given outcome is determined by the proportion of payoffs to others below this outcome in the relevant attribute. As individuals gain utility from occupying a higher ranked position within a given outcome distribution, they seek to improve their relative standing within a given group of peers.

Returning to the alternate-worlds task, in studies using this single question task, a preference for an income which is higher relative to others (consistent with status seeking motives), over an absolute higher income (consistent with self-interest) has been observed in approximately 50% of individuals (Carlsson & Qin, 2010; Carlsson et al., 2007; Solnick & Hemenway, 1998; Solnick et al., 2007), and sometimes substantially higher (e.g., 88% of women in Hill & Buss, 2006). Such results are interpreted to reflect a substantial proportion of people holding a competitive status social motivation over a narrow self-interest (Solnick & Hemenway, 1998).

While the alternate worlds task is useful in distinguishing status preferences from self-interest, it is not able to adequately distinguish between different forms of social preference, in particular, status preferences and inequality-averse preferences. The latter have come to dominate the social preference literature based on the observation that people typically seek to minimise inequalities, leading them to make decisions that achieve equal (or more equal) resource distributions (Bolton & Ockenfels, 2000; Fehr & Schmidt, 1999). Formal models of inequality aversion, such as the Fehr-Schmidt (FS) model (Fehr & Schmidt, 1999), accommodate this result by assuming that, in addition to material self-interest, an individual's utility is comprised of a component regarding the fairness of outcomes for others. The alternate worlds task pits a preference for absolute advantage against that for relative advantage but does not account for inequality-averse preferences, which may mimic a concern with status (Brown et al., 2008).[1]

To differentiate the competing preferences of status and inequality aversion, Celse (2012) extended the alternative worlds design, adding a third option: participants were required to indicate their preference between relative advantage, absolute advantage, and identical outcomes for all parties. Thus, status and equality preferences are differentiable: participants with a preference for status were able to select the hypothetical world conferring relative advantage, whilst those with inequality averse preferences would presumably select the world with uniform outcomes. With status and equality preferences disentangled, Celse (2012) found that a plurality of respondents (41%) preferred the equality world state. This indicates

[1]For the alternate-worlds task as described, and following Equation 2 of Fehr and Schmidt (1999), the FS model predicts the relatively advantageous world will be preferred if the following is satisfied:

$$(1-\beta)x_i(\text{rel}) + \beta x_j(\text{rel}) > (1+\alpha)x_i(\text{abs}) - \alpha x_j(\text{abs}), \tag{1.1}$$

where "abs" indicates the absolutely advantageous world (relatively disadvantageous), and "rel" indicates the relatively advantageous world. For the rooms example given in Solnick and Hemenway (2005) this means that the relatively advantageous world will be preferred if $\beta > \frac{3}{2}\alpha - 1$.

that a substantial proportion of individuals are inequality averse, and that more refined methods than the basic alternate-worlds task are necessary to disentangle distinct social preferences.

Another extension of the basic alternate single item worlds task is Kerschbamer's (2015) Equality Equivalence Test (EET). In the EET participants complete a number of (pre-determined) binary choice questions, each featuring an equal outcome option and an unequal outcome alternative. In some trials, the unequal outcome confers advantageous inequality, whereas in others the inequality is disadvantageous. The unequal outcomes offered are systematically incremented within a trial, while the equal outcome option remains fixed between successive decisions. The EET assumes individuals initially prefer equality-producing outcomes, selecting the equal outcome option for several decisions, but that at some point as the inequality presented increases, this preference shifts in favour of the unequal allocation option. This can be used to estimate the point of indifference: the point at which an individual is equally satisfied by equality and inequality options. If an individual rejects an unequal allocation of 10|20 at decision one but accept 15|20 at decision two, the threshold at which these preferences reverse lies at some point within these sets of values. The coordinates at which these switches occur in the domains of advantageous and disadvantageous inequality can then be used to categorise the overall social preferences elicited from individuals.

Using this paradigm, Kerschbamer (2015) found that the majority of their student sample (66%) expressed concerns consistent with pure altruism, while less than a quarter expressed egocentric inequality averse preferences. Conversely, using the same tool with a broader Internet panel, Kerschbamer and Müller (2020) found a predominant concern consistent with inequality aversion. Few people in either study responded in a way consistent with status seeking (9%), directly challenging evidence from the simple alternate-worlds task (e.g. Solnick & Hemenway, 1998). While people may prefer advantageous inequality to absolute advantage, when equality between individuals is an option this will be preferred even more.

1.1. Current study

The objective of this study was to provide further evidence for concerns with equality and status seeking social preferences at an individual level. We further adapt the alternate-worlds task, employing the computer adaptive psychophysics procedure Parameter Estimation by Sequential Testing (PEST; Taylor & Creelman, 1967) to estimate the point of indifference between equality and status inducing options. Developed to estimate perceptual thresholds in psychophysics, this algorithm begins with easily discriminable choices and then adjusts towards less clear choices. This is achieved by sequentially making the previously non-preferred world more attractive in the subsequent decision, relative to the initially preferred world. Over a given trial, this procedure narrows sequentially presented values in order to identify the combination of worlds which equally satisfy a given person.

From the estimated points of indifference, we can determine the proportion of individuals who express competitive status, inequality averse, and self-interested preferences in a given domain. 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) and people do seem to differ in the importance accorded to social comparisons, and the frequency with which they seek out comparative information (Buunk et al., 2020; Gibbons & Buunk, 1999; Schneider & Schupp, 2014; Wheeler, 2000). Beyond individual differences in the *type* of a given preference, there are also individual differences in the *strength* of such preferences (Blanco et al., 2010; Cabrales et al., 2010). Thus, we additionally use these indifference points to estimate not only the type of preference elicited, but the strength of this preference on an individual level.

A key concern in the work of Solnick and Hemenway in the original alternate-worlds task was not just to examine the overall concern with status, but also how that varied across different domains. In addition to income, a preference for status has been further explored in a number of personal characteristics. High proportions of individuals have been found to prefer relative advantage in domains of "goods" such as praise and intelligence (Solnick & Hemenway, 1998). Similarly, judgements of one's attractiveness is highly status oriented for women, while the absolute length of one's (happy) marriage is preferred by the vast majority of individuals (Hill & Buss, 2006). The vast majority of people (approximately 90%) prefer to have a lower absolute level of bads, such as unhealthy air quality or length of illness (Solnick & Hemenway, 2005). Thus, status concerns are likely domain sensitive.

Accounts regarding the evolutionary or biological basis of risk-taking suggests a preference for status is expressed most strongly in relation to attributes of evolutionary importance (e.g. Frank, 2007; Hill & Buss, 2006). There is indeed substantial evidence supporting the notion that people care more about some attributes than others when making relative judgements(e.g. Solnick & Hemenway, 2005); judgements regarding income (e.g. Carlsson et al., 2007; Solnick & Hemenway, 1998; Solnick et al., 2007) praise, intelligence and attractiveness (Hillesheim & Mechtel, 2013; Solnick & Hemenway, 1998) all seem to be highly dependent upon relative outcomes of others. Leisure concerns such as holiday time, on the other hand, may be free from relative outcome considerations (Carlsson et al., 2007; Frank, 2007; Solnick & Hemenway, 1998, 2005).

This study investigates the relative frequency and strength of social preferences separately for a number of personal attributes. Based on previous work, when considering attributes of (presumed) evolutionary status importance (namely, income, attractiveness, intelligence, praise) participants are expected to respond with stronger preferences for outdoing peers than when considering attributes related to leisure (namely, vacation time).[2]

2. Method

2.1. Participants

Participants (n = 104) were recruited using Prolific (prolific.co) to participate in the 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).

Five participants failed to complete at least 80% of the scenario trials (15 of the 18 total) and were excluded from analysis. Participants who repeatedly (>3 out of 6 catch trials) indicated a preference which actively disadvantaged themselves (without benefiting others) departed substantially from the utility-based models under consideration and may therefore have misunderstood the task or completed it inattentively. An additional 16 participants were excluded from analysis for this reason, resulting in a final N of 83. No further participant exclusions were applied.

2.2. Task

To estimate the relative preference for status and equality (in terms of both preference type and strength), individual social preferences were elicited using a forced choice task (e.g. Solnick & Hemenway, 1998). Participants were presented with two hypothetical "worlds" with different allocations of attributes such as income. One world, the "equality option", offered a single uniform value for "everyone" (e.g., Celse, 2012). The alternative world offered separate values for "yourself" and the average "other" in society. This second world was designed to present participants with unequal outcomes. The direction of inequality presented in this world, advantageous or disadvantageous, differed between trials. Participants were asked to select their preference between the two worlds presented. A tendency to choose the first answer because it is presented first has been found in similar studies (e.g., Solnick & Hemenway, 1998, 2005). To mitigate these order effects, the world presented on the left in each comparison was allocated randomly at the beginning of each scenario (remaining consistent within scenarios). Figure 1 illustrates

[2]The full pre-registration and disclosure of deviations can be found on the Open Science Framework (osf.io/3u9gs/). Information regarding method (e.g., defined range of precision for each attribute), copy of materials, analysis scripts and data can also be found in this repository.

an example of an item in which people are asked to choose between a world in which all have equal outcomes, and a world in which the decision-maker receives the advantageous end of unequal outcomes.

Figure 1: Income Low AF Starting Scenario, with equality world on the left, and relative advantage world on the right.

Following this first decision, participants were asked to make another, indicating their preference between two worlds again, with slightly shifted values presented. Each trial consisted of several such decisions. The value of worlds presented to a participant in each decision was determined by previously elicited evaluations within that trial. In response to the pattern of preferences indicated by a participant, one option retained the initial values, while the values corresponding to the other world iteratively shifted. The specific world which shifted was determined by the form of inequality faced; in advantageous inequality trials both the "others" and "yourself" values within the "inequality option" shifted. In disadvantageous inequality trials, the values presented to "everyone" in the "equality option" shifted.

The values presented in consecutive decisions were adjusted using the PEST algorithm (for the rules determining consecutive values presented see Taylor & Creelman, 1967). The precise number of questions participants were required to complete for a given trial was determined by the pattern of their responses required to reach the pre-determined indifference threshold, in accordance with the PEST procedure.[3] Theoretically, the minimum possible number of decisions to reach this point was four. A cap of 30 decisions was set (as values offered could potentially increase infinitely), at which point the trial would terminate without reaching the indifference point.

Participants completed a trial for each of two forms of each attribute: one in which the inequality offered was advantageous, and the other in which it was disadvantageous. In the advantageous inequality form (AF) of scenarios the value corresponding to "yourself" was larger than "others" (Figure 1 presented above). Conversely in the disadvantageous inequality form (DF) of scenarios the value corresponding to "yourself" was less than that of "others" (Figure 2).

Figure 2: Income Low DF Starting Scenario. Equality world on the right, and the relative disadvantage world on the left.

[3]In practice, the point of indifference is not an exact point, but a range of arbitrary precision within which preferences between the two worlds reverse. Therefore, the worlds offered do not need to be exactly identically satisfying, simply below the difference threshold we determined as a "meaningful" difference. For the specification of this threshold see Table 1.

Participants completed this procedure for a series of six hypothetical attributes: two income levels, low and high (based upon the 20% and 80% UK income percentiles respectively; Office for National Statistics, 2017); attractiveness; intelligence; praise; and vacation time. Table 1 contains, for each attribute, the values used to calculate iterative trials and trial termination conditions as per the PEST algorithm (Taylor & Creelman, 1967):

A. The *starting values* presented to participants in the initial scenario for each attribute, and to which participants make their first preference responses;
B. The *upper and lower bounds* values may take (responses which result in subsequent stimuli exceeding these bounds resulted in trial termination);
C. The *step size* governing iterative stimuli presentation; and
D. The *thresholds* for convergence at which successively presented stimuli would be classified as meeting the criteria for indifference.

These values were determined with an attempt to ensure interpretable scenarios for participants (e.g., the convergence threshold was set to 1 vacation day, as the smallest meaningful unit of time for a holiday; minimum values were largely set to zero, as the meaning of negative IQ points or instances of praise is likely unclear to participants).

There were an additional six single-question catch trials. Here the single "equal" value was identical to the "others" alternative, and both were greater than the value to "yourself". Participants who actively prefer their own disadvantage (i.e., those selecting the other/yourself option) diverge significantly from economic models—either through inattention or genuine preference—were not of interest in this paper.

The order of attributes was randomly determined for each participant, with the exception that the advantageous inequality form of a attribute could not immediately follow the disadvantageous inequality form of the same attribute (or vice versa). Additionally, no two income scenarios (of any income or advantage level) were allowed to immediately follow one another.

Table 1: Scenario values for each attribute

Scenario	Starting values		Max Value	Min Value	Step size	Convergence threshold
	AF	DF				
Income Low (GBP/week)	Everyone: 310 Yourself: 310, Others: 155	Everyone: 310 Yourself: 310, Others: 620	1000000	0	50	<20
Income High (GBP/week)	Everyone: 1020 Yourself: 1020, Others: 510	Everyone: 1020 Yourself: 1020, Others: 2040	10000000	0	60	<30
Attractiveness (Scale 1-10)	Everyone: 5 Yourself: 5, Others: 3	Everyone: 5 Yourself: 5, Others: 7	10	1	0.5	<0.1
Intelligence (IQ points)	Everyone: 100 Yourself: 100, Others: 90	Everyone: 100 Yourself: 100, Others: 110	200	0	5	<2
Praise (Instances)	Everyone: 30 Yourself: 30, Others: 24	Everyone: 30 Yourself: 30, Others: 40	600	0	5	<1
Vacation (Days/year)	Everyone: 20 Yourself: 20, Others: 16	Everyone: 20 Yourself: 20, Others: 24	200	0	3	<1

Note: AF = advantageous form of attribute scenario, DF = disadvantageous form.

2.3. Preference Categorisation

The reported dependent variable is Δ, the difference between the values corresponding to an individual in each of the two worlds at termination. This was calculated by subtracting the value offered to "yourself" in the inequality option from the value offered to "everyone" in the equality option after convergence of the PEST algorithm ($unscaled\Delta = everyone - yourself$). As the point of indifference indicates where participants are effectively equally satisfied with the two possible outcomes, the difference in values presented (Δ) reflects how much participants are (hypothetically) willing to forgo (in absolute dollars, vacation days etc.) in order to outdo or give to their peers. Therefore, we can quantify the acceptable cost of status preference.

As the starting values and scenario limits (see Table 1) allowed greater movement to higher values (before meeting the maximum value limit) than lower values (before meeting the minimum value limit), we then scaled these raw distance values in reference to the range of possible movement from the starting values presented. For each form of inequality (advantageous and disadvantageous inequality) the proportional Δ *values* communicate relative preference, where -1 corresponds to a strong preference for equality, 0 a preference for absolute value (no concern with outcome for others), and 1 indicates a preference for that form of inequality. Preference for the uniform “everyone” option will result in a negative Δ value. Preference for the unequal alternative is reflected in a positive Δ value (i.e., a larger “everyone” value is necessary for equal satisfaction between the two options). Larger values in either direction correspond to a stronger preference.

Δ values were calculated separately for each advantage–attribute combination and for each participant. Therefore, for each attribute, participants provided one Δ value for the disadvantageous inequality form (“DF”); which we plot horizontally in this space, and another for the advantageous inequality form (“AF”); which we plot vertically in this space. This yields a two-dimensional index of social preference intensity. Thus, participants responses can be categorised by the direction of the respective Δ values (i.e., positive, negative, zero) in the disadvantageous and advantageous forms of each scenario.

The possible responses to scenarios by delta values are illustrated in Figure 3. The corresponding classification of the possible responses elicited within nine “archetypes” of social preferences, are outlined in Table 2, with categories consistent with key social preferences bolded.

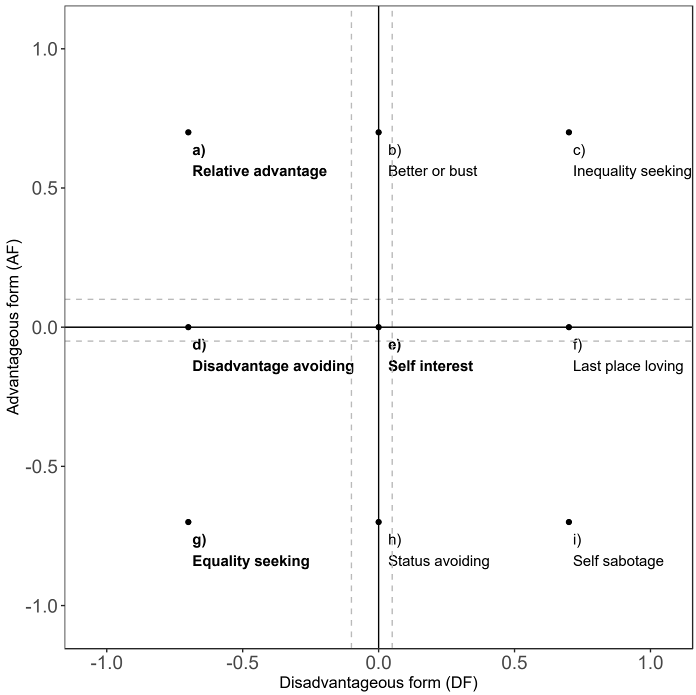


Figure 3: Mapping Social Preference Archetypes.
Note: Classification corresponding to Δ value for Advantageous Form (AF) within vertical space and Disadvantageous Form (DF) in horizontal space. Black axes correspond to Δ values of zero. Grey dashed lines are granularity thresholds indicating whether a given point can be distinguished from zero. Negative values within either space indicate a preference for equality

Table 2: Social Preference Archetypes

Preference	Description	Delta values
a) Relative advantage:	Prefers to do better than peers. Prefers Advantageous Inequality (AI) to equality. Prefers equality to Disadvantageous Inequality (DI).	Positive Δ in AF. Negative Δ in DF.
b) Better or bust:	Concerned with relative income only if able to outdo others. No preference where cannot outdo others. Prefers AI to equality. Indifferent between DI and equality.	Positive Δ AF. DF Δ ≈ 0.
c) Inequality seeking:	Prefers inequality regardless of whom it benefits (i.e., even at risk of harm to self). Prefers AI to equality. Prefers DI to equality.	Positive Δ AF. Positive Δ DF.
d) Disadvantage avoiding:	Primarily concerned with avoiding doing worse than others. Not concerned with doing better than others. Potentially consistent with FS model. Indifferent between equality and AI. Prefers equality to DI.	AF Δ ≈ 0. Negative Δ DF.
e) Self-interest:	Concerned with greatest outcome for self, indifferent to others outcomes. Prefers highest possible absolute value for self in both versions of scenarios.	AF Δ ≈ 0. DF Δ ≈ 0.
f) Last place loving:	Concerned with being worse than others when able. No concern regarding advantageous inequality. Indifferent between AI and equality. Prefers DI to equality.	AF Δ ≈ 0. Positive Δ DF.
g) Equality seeking:	Prefers equal outcomes for all. Potentially consistent with altruistic preferences. Prefers equality to AI. Prefers equality to DI.	Negative Δ AF. Negative Δ DF
h) Status avoiding:	Prefers not to do better than others, not concerned with doing worse. Prefers equality to AI. Indifferent between DI and equality.	Negative Δ AF. DF Δ ≈ 0.
i) Self sabotage:	Prefers worst possible outcome for self, regardless of whether this achieves higher outcomes for others *Note:* self sacrificing is not possible as values received by "self" are always tied to the outcomes of "others". Prefers equality to AI. Prefers DI to equality.	Negative Δ AF. Positive Δ DF.

Note: "AI" refers to advantageous inequality, in which own outcome is greater than others. "DI" refers to disadvantageous inequality, in which own outcome is less than others. "AF" refers to the advantageous form of a scenario. "DF" refers to the disadvantageous inequality form of a scenario.

3. Results

3.1. Convergence

The following analyses are conducted on the indifference points of individuals for the AF and DF version of each attribute. A single indifference point is determined for each scenario, defined by the point at which convergence occurred (within the experimenter determined threshold). There are two ways in which a trial may fail to converge upon an indifference point, both related to a failure to elicit a stable preference. Firstly, an individual may not reverse their preference frequently enough (or at all) and iterative values may surpass the minimum or maximum values allowed for each attribute. Secondly, an individual may fail to reverse preferences frequently enough to narrow the consecutive values presented within the pre-determined bounds within the maximum number of decisions per trial (30).

Table 3 details the number of participants who completed the task ($N = 83$) but did not converge upon an indifference point in each scenario. There were a total of 57 trials (over 29 participants) in which individuals breached the minimum allowed value (usually set at zero, to prevent negative values being offered), thus terminating the trial without converging on an indifference point. These trials are truncated at the respective minimum values and included in the following analysis (this truncation of extreme preference is consistent with Kerschbamer, 2015). Trials where participants exceed the maximum given value are also truncated at this maximum and included in the analysis (44 in total).[4]

An additional 14 trials (over 12 participants) remained within the boundaries set for presented values but did not otherwise converge, given the maximum number of decisions allowed (30 decisions per scenario). As this behaviour indicates possible uncertainty or inconsistency in responses, data from these trials are excluded from the following analysis. No further trial exclusions were applied.

[4]On the one hand, such truncated preferences may be treated as a conservative underestimate of the true preference value. That is, the true preference may be more extreme (i.e., higher than the truncated maximum or lower than the truncated minimum). On the other hand, the PEST algorithm is designed to allow, and recover from, participant error. Truncation at minimum or maximum thresholds, however, does not. Therefore, there remains the small possibility that though participants cross the specified thresholds, their true preference lies within, and if they continued with the task they may have drifted back and converged elsewhere within the minimum and maximum bounds.

Table 3: Non-convergence frequencies by scenario.

	Income Low AF	Income Low DF	Income High AF	Income High DF	Attractiveness AF	Attractiveness DF	Intelligence AF	Intelligence DF	Praise AF	Praise DF	Vacation AF	Vacation DF
Included in reported analyses												
Converged at minimum	0	18	0	18	1	22	0 9	0	20	0	6	
Converged at maximum	0	0	0	0	1	1	0	1	0	0	0	1
Truncated at minimum/ maximum and included in reported analyses												
Exceeded minimum	14	0	9	0	12	0	5	0	12	0	5	0
Exceeded maximum	3	0	2	0	14	0	11	0	11	0	3	0
Excluded from reported analyses												
Otherwise did not converge	2	0	2	0	0	0	4	0	5	0	1	0
Converged/Truncated N	81	83	81	83	83	82	79	83	78	83	82	83
Total N		81		81		82		79		78		82

Note: “Converged/Truncated N” indicates the number of participants with a reportable indifference point for each scenario. “Total N” indicates the number of participants with a reportable indifference point for both the AF and DF versions of an attribute.

3.2. Pre-registered Analysis

3.2.1. Bayesian Parameter Estimation

First, we examine aggregate preferences for the sample as a whole, before examining individual participant preferences. Aggregate preference for self-interest, equality or inequality were assessed using posterior estimates and credible intervals, calculated for the Δ values of each scenario. Posterior distributions were obtained through Markov Chain Monte Carlo (MCMC) estimation using the 'rjags' package (v4.10; Plummer et al., 2019). A Gaussian model was fit to the data. As we had no strong beliefs about parameter values, we used non-informative uniform priors: μ = U(-1,1), σ = U(0,100). The estimation procedure consisted of a burn-in period of 1000, with an additional 5000 samples to estimate the posterior distribution of each parameter; four chains were run with these values. The potential scale reduction factor did not flag any situations of inadequate convergence ($\hat{R}$ values <1.001). Table 4 details the posterior mean estimate and 95% Bayesian Credible Interval (specified as the Equal-Tailed Interval) of the mean (μ) and standard deviation (σ) for each scenario.

Table 4: Posterior Estimates and Credible Intervals ("CI")

Scenario	$Mean_\mu$ (95% CI)	$Mean_\sigma$ (95% CI)	Preference
Income Low AF	0.1 (0.02 to 0.18)	0.38 (0.32 to 0.44)	Inequality
Income Low DF	-0.3 (-0.38 to -0.22)	0.39 (0.34 to 0.46)	Equality
Income High AF	0.09 (0.02 to 0.16)	0.33 (0.28 to 0.39)	Inequality
Income High DF	-0.29 (-0.37 to -0.2)	0.4 (0.35 to 0.47)	Equality
Attractiveness AF	-0.08 (-0.21 to 0.05)	0.61 (0.52 to 0.71)	Self-interest
Attractiveness DF	-0.35 (-0.45 to -0.25)	0.47 (0.4 to 0.55)	Equality
Intelligence AF	-0.11 (-0.21 to 0)	0.47 (0.4 to 0.55)	Equality
Intelligence DF	-0.14 (-0.21 to -0.06)	0.34 (0.29 to 0.4)	Equality
Praise AF	0.02 (-0.1 to 0.14)	0.56 (0.48 to 0.66)	Self-interest
Praise DF	-0.33 (-0.42 to -0.24)	0.41 (0.35 to 0.48)	Equality
Vacation AF	0.03 (-0.04 to 0.1)	0.33 (0.28 to 0.38)	Self-interest
Vacation DF	-0.12 (-0.19 to -0.06)	0.3 (0.25 to 0.35)	Equality

Note: "AF" refers to the advantageous inequality form of the attribute. "DF" refers to the disadvantageous inequality form of the attribute.

Next, we assess whether the aggregate $Mean_\mu$ for a given scenario reflects a preference for equality or inequality. Indifference points identified are subject to the level of granularity required to satisfy convergence in the PEST procedure. This granularity threshold forms a range within which the "true" precise point of indifference lies. By placing thresholds either side of zero, we infer whether a given $Mean_\mu$ can be considered sufficiently different from zero. Credible intervals (around point estimates) which are non-zero but lie within (or overlap) the threshold cannot be distinguished from zero, as they lie within the convergence granularity around zero. Mean point estimates with credible intervals completely outside these thresholds are considered non-zero. On this basis we can then characterise the posterior $Mean_\mu$ as reflecting a preference for inequality (<0), equality (>0)—where distance from zero indicates strength of this preference—or self-interest (within threshold around 0). These aggregated sample preferences are summarised for each scenario in Table 4.

The aggregate estimates in DF scenarios generally reflect responses consistent with equality. There is greater variation between the aggregate estimates for scenarios in the AF of attributes. Intelligence was the only attribute with the identical categorisation for the AF and DF scenarios; a concern for equality in when facing both advantageous and disadvantageous inequality is consistent with models of "pure equality". The two income variables, however, indicate in aggregate an aversion to disadvantageous inequality, and a preference for advantageous inequality. This is consistent with relative advantage status concerns in addition to most "egocentric" inequality aversion models (e.g. Charness & Rabin, 2002; Fehr & Schmidt, 1999). The $Mean_\mu$ credible intervals for attractiveness, praise and vacation under AF, span over several classifications and are not differentiated from zero.

Overall, there is considerable uncertainty around the means (as indicated by credible interval estimates), as well as variation ($Mean_\sigma$) associated with each of the Δ value means. With this variation in mind, aggregate measures may be a misleading summary of social preferences within our sample. We next explore preferences at the individual level.

3.2.2. Individual Social Preference

Figure 4 plots individual Δ value combinations for each of the six scenarios in turn and the corresponding social preference classification of these points. Table 5 summarises classification frequency for each of the scenarios based upon these Δ value combinations. Overall, the "self-interest" category is predominant in the vacation attribute. "Equality seeking" was among the most frequent in all other attributes.

The spread of individual points within each attribute emphasises the high levels of variation in responses and supports our shift from aggregate to individual level analysis. For example, each attribute has a substantial proportion of respondents in the far top left and bottom left corners; indicating the strongest possible preference for relative advantage and equality seeking, respectively.

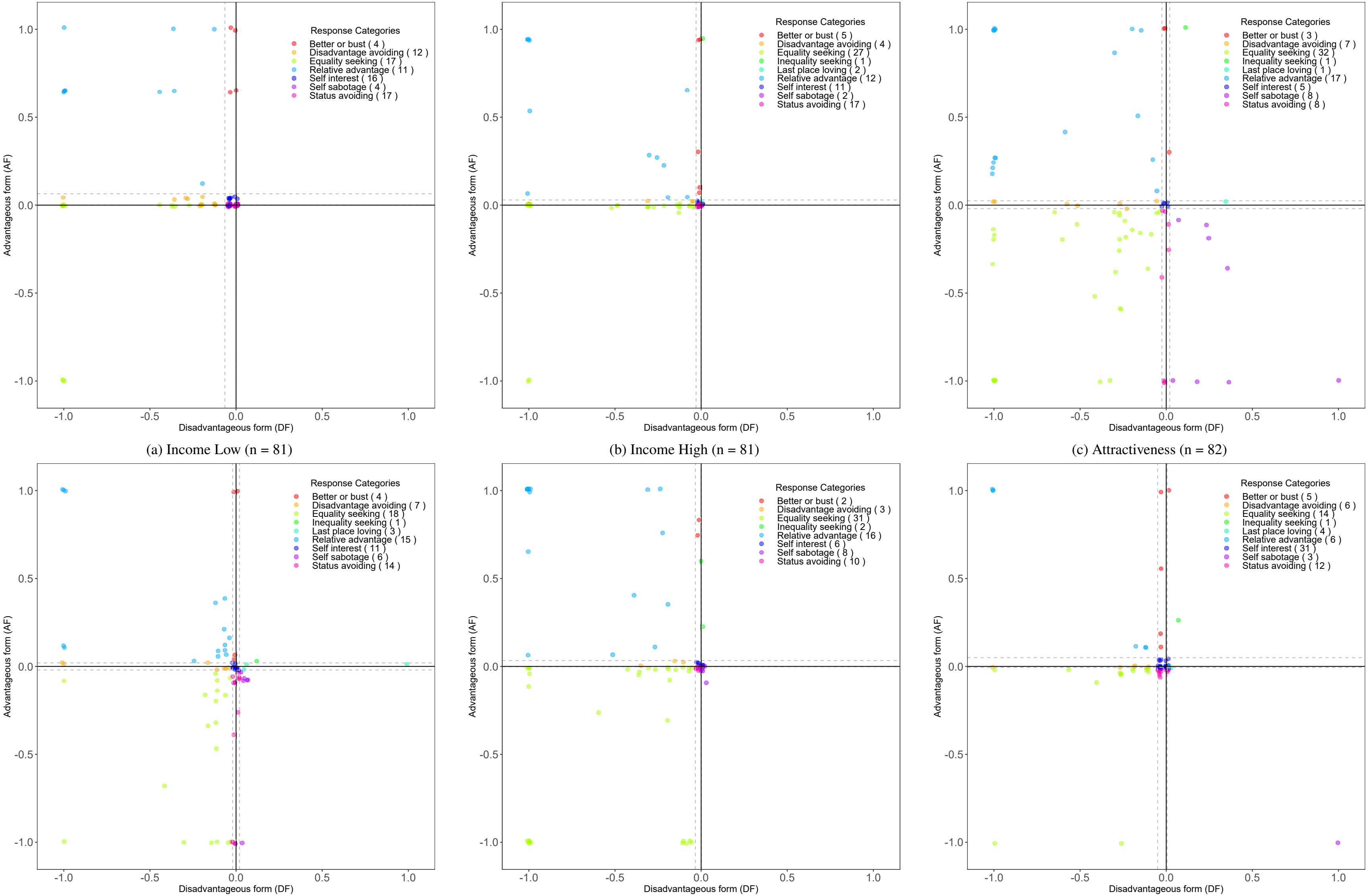
There is also substantial qualitative variation between attributes. In the two income level attributes, for example, the number of individuals classified as "equality seeking" is comparable to the frequency of other categories, but the distribution of scores within this category is quite different. Attractiveness and intelligence attributes in particular have a "spread" of scores within the "equality seeking" space. For the two income levels this distribution is more binary; respondents either barely meet the threshold for equality seeking, or they meet the most extreme possible point.

Figure 4 also highlights a striking commonality between attributes. Consistent with traditional economic and psychological theory, very few indifference points fall on the right hand side of the plot (corresponding to a preference for disadvantageous inequality). A minor departure is the spread of individuals in the attractiveness attribute and the few, though extreme responses, in the vacation attribute.

Table 5: Proportional Categorisation of Δ Values for each of the six attributes.

	Income Low	Income High	Attractiveness	Intelligence	Praise	Vacation
Relative advantage	14 %	15 %	21 %	19 %	21 %	7 %
Better or bust	5 %	6 %	4 %	5 %	3 %	6 %
Inequality seeking	0 %	1 %	1 %	1 %	3 %	1 %
Disadvantage avoiding	15 %	5 %	9 %	9 %	4 %	7 %
Self-interest	20 %	14 %	6 %	14 %	8 %	38 %
Last place loving	0 %	2 %	1 %	4 %	0 %	5 %
Equality seeking	21 %	33 %	39 %	23 %	40 %	17 %
Status avoiding	21 %	21 %	10 %	18 %	13 %	15 %
Self sabotage	5 %	2 %	10 %	8 %	10 %	4 %
Total N	81	81	82	79	78	82

Figure 4: Individual Indifference Points by Scenario.



(a) Income Low (n = 81)

(b) Income High (n = 81)

(c) Attractiveness (n = 82)

(d) Intelligence (n = 79)

(e) Praise (n = 78)

(f) Vacation (n = 82)

Figure 4: *Cont.*. Note: Black axes correspond to Δ values of zero. Grey dashed lines are granularity thresholds indicating whether a given point can be distinguished from zero. These thresholds reflect the level of granularity required scaled to the possible Δ range and are therefore different for different scenarios, and also for the different form of each scenario (i.e,. not equidistant from zero).

3.3. Analyses Not Pre-registered

3.3.1. Correlational Matrix

A consistent aversion to disadvantageous inequality (despite more heterogeneous responses to advantageous inequality) is also borne out in the results of an exploratory correlational matrix. We aimed to explore the degree to which a preference (e.g,. for equality) in one scenario is associated with similar preference in other scenarios. Of key interest is the notion that evolutionary status concerns (income, attractiveness, intelligence, praise) elicit different preferences from domains less relevant from an evolutionary perspective (vacation time).

The correlation matrix (Figure 5) shows the degree of association between the Δ values for each of the scenarios. As negative Δ values indicate a preference for equality in both AF and DF scenarios, a positive correlation indicates consistent preference regarding equality/inequality, regardless of inequality direction, whilst a negative relationship is indicative of differing equality preference between the two scenarios in question. The correlation matrix reveals no clear pattern of systematic relationships on the basis of potential evolutionary relevance. In addition, the relationships between the AF and DF scenarios of any one given attribute are among the smallest within the matrix; in other words, within domains, the strength of concern with advantageous inequality does not appear to correlate with concern with disadvantageous inequality. The correlation matrix does, however, reveal two main clusters showing that AF tends to correlate across domains, and that DF correlates across domains.

The above conclusions were supported by an exploratory Principal Components Analysis (PCA). A preliminary PCA was first run to determine the number of factors present. Evidence from several indices converged on a two factor solution.[5] Two factors were extracted (varimax rotation) on this basis.[6] The loading pattern (Table 6) indicates a simple structure with no substantial cross-loadings. This factor solution lends itself to an interpretation on the basis of advantageous versus disadvantageous forms of each attribute, rather than in terms of evolutionary attributes versus leisure attributes. The component loadings which defined the first component consisted of the disadvantageous form of each attribute. The component loadings which defined the second component consisted of the advantageous form of each attribute.

4. Discussion

In this study we adapted the standard binary choice alternate-worlds task, making it an adaptive repeated-decision task in order to estimate individual indifference points. The results indicate considerable heterogeneity in distributive preference. No single category accounted for an outright majority of participant preference in any one attribute. This level of individual difference is somewhat inconsistent with those of Kerschbamer (2015) via their broadly similar EET categorisation method. In contrast to the heterogeneity of preferences elicited here, Kerschbamer (2015) found an outright majority of

[5] While the Kaiser criterion (Kaiser, 1960) and Very Simple Structure (VSS; Revelle & Rocklin, 1979) complexity 2 criteria suggested three factors should be extracted, evidence from the scree plot (Cattell, 1966), acceleration factor and the optimal coordinates index (both Raîche et al., 2013), parallel analysis (Horn, 1965), VSS complexity 1, Minimum Average Partial test (Velicer, 1976) and comparison data technique (Ruscio & Roche, 2012) were all in favour of a two factor solution.

[6] PCA assumptions were satisfied, indicating that it was appropriate to use the factor analytic model on this set of data. The Kaiser-Meyer-Olkin measure of sampling adequacy was barely adequate (KMO = 0.64) with the AF form of Vacation having the lowest MSA of all items (MSA = 0.52). Bartlett's test of sphericity was satisfied $\chi(66) = 447.85$, $p = 0.00$.

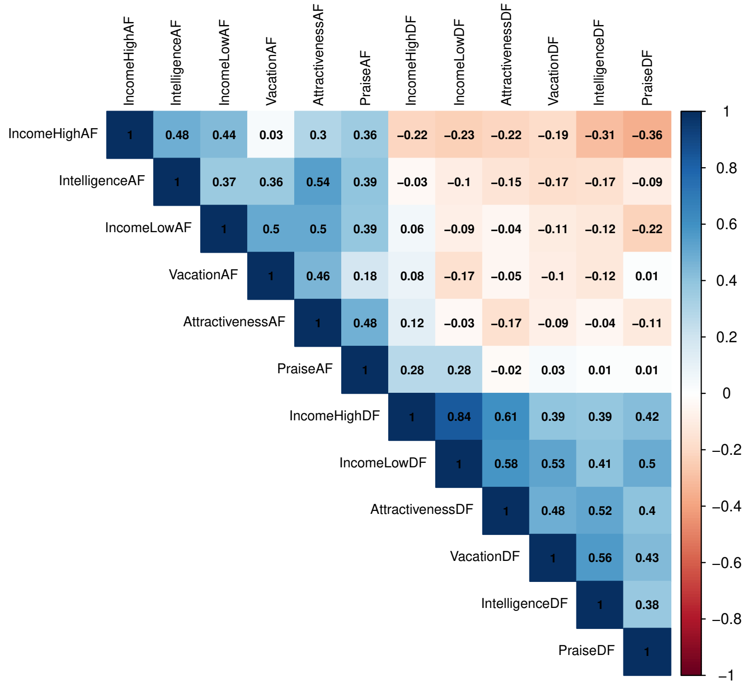


Figure 5: Correlation Coefficient Matrix for Scaled Δ Values.
Positive correlations are shown in blue, and negative correlations in red. Colour saturation corresponds with strength of coefficients. Note that as this is an exploratory analysis *p*-values are non-interpretable, and are therefore not included.

Table 6: Factor Solution for Exploratory PCA of Scenarios

	Factor1	Factor2	Communalities
Income Low DF	0.87		0.77
Income High DF	0.80		0.71
Attractiveness DF	0.75		0.58
Praise DF	0.67		0.48
Intelligence DF	0.65		0.43
Vacation DF	0.49		0.28
Attractiveness AF		0.82	0.67
Praise AF		0.70	0.52
Intelligence AF		0.64	0.44
Income High AF		0.63	0.46
Income Low AF		0.60	0.36
Vacation AF		0.55	0.31
Unrotated Eigenvalues	3.32	2.68	
Variance Acc.	0.27	0.23	

Note: Factor loadings <.3 are suppressed. "Variance Acc." is the proportion of variance accounted for by each factor.

participants fell within the "equality seeking" preferences decision space, consistent with inequality aversion.

The discrepancy in results is potentially due to differences in methodology. Firstly, the more flexible and robust PEST method in this study allows for the correction of inaccurate or inattentive responses, which is not accommodated by the pre-set item set of the EET. Secondly, the experimental parameters specified here provided us with a more fine-grained estimation of point of indifference, but did also demand more fine-grained judgements from individuals. Correspondingly, the method employed required multiple iterative judgements rather than a single response at preference reversal in the EET. Finally, unlike the EET, the entire design of this task was to elicit a preference for the unequal world at some stage (required to determine an indifference point). Thus, the design of this study allows participants the potential to reconsider or "moderate" their preferences, and makes it much less "convenient" to indicate an inequality aversion based preference.

Considering more broadly the consistency of this study with influential studies on social preferences, results from this adapted alternate-worlds task differ from those of the original task. Individuals expressing relative advantage preferences in alternate-world tasks (e.g. Solnick & Hemenway, 1998), would in the current study, be classified as "relative advantage seeking". However, the most frequent preference elicited in the non-leisure domains of this study was a preference for equality in both AF and DF scenarios. This equality seeking was the single most frequent strategy in four of the five evolutionary relevant domains, the exception being the low income rate (equal most common). The overall frequency of this preference is broadly consistent with Celse's (2012) results from their adaptation of the alternate-worlds task, and Kerschbamer and Müller's (2020) classification of their participants, suggesting that whilst relative advantage may be preferable over relative disadvantage, individuals' superordinate preference lies with equality.

In this study this coordinate space is defined by preference for equality when facing both advantageous and disadvantageous inequality. Most models of equality, however, do not assume "pure equality" but a "self-centred" form of equality where individuals avoid disadvantageous inequality, but are less concerned with inequality that is advantageous to themselves (e.g. Charness & Rabin, 2002; Fehr & Schmidt, 1999). Therefore, individuals who display a preference for equality in DF scenarios, but relative advantage in AF scenarios, would be considered as displaying equality-based concerns within these models of inequality aversion. Thus, in estimating equality preferences we used a strict definition of equality, and may be underestimating equality related preferences in comparison to other estimation methods.

In regards to the attributes of judgement considered, previous work using binary choice tasks (e.g. Solnick & Hemenway, 2005) has indicated that individuals act in self-interest in leisure domains, but with concern for status otherwise. We find some support for this notion as the proportion of self-interested individuals is highest in the vacation attribute. This leisure domain also elicited the lowest proportion of "relative advantage" responses. Evidence from the exploratory PCA, however, does not indicate that the leisure and status attributes comprise separate factors. This is likely a consequence of having only two items (over one attribute) for leisure in the PCA. Therefore, confirmatory factor analyses including additional domains of leisure might be conducted to corroborate this preliminary finding. There is undoubtedly a range of other attributes in which social preferences may be salient to daily life (e.g., time spent with family, on hobbies or relaxation).

The correlational analysis more generally reveals two interesting results. The first is that there are generally relatively high correlations between different domains in concern with (in)equality. While, for example, risk attitudes tend to be domain-specific (Weber et al., 2002), there seems to be some domain-generality to social preference (c.f. Solnick & Hemenway, 2005). However, a second finding was that correlations were primarily found within the AF and DF measures. This implies some independence in concerns with inequality that benefits oneself, and concern with inequality that harms oneself. Whether this is due to independence in attitudes, in use of information, or relationship with unobserved factors like past experience, this finding is consistent with Loewenstein et al.'s (1989) finding that situational aspects selectively influenced expressed concern with advantageous inequality, and highlights that "concern with equality" is unlikely to be a unitary construct.

In conclusion, in this study we sought to explore social preferences for resource distribution. We capture substantial individual differences across domains of judgement. As such researchers should note that aggregate social preference measures fail to capture important aspects of preferences where individuals demonstrate a number of distinct strategies (see Navarro et al., 2006). In judging vacation time, the greatest proportion express self-interested preferences, preferring greater days off for themselves. Across non-leisure domains, however, the plurality of participants express preferences consistent with strict equality, over self-interest and status competition.

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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.

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