LAST WORD NOT YET SPOKEN: LAST PLACE AND RANK REVERSAL AVERSION*

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Abstract

Preferences over social ranks have emerged as potential drivers of weaker than expected support for redistributive interventions among those closest to the bottom of the income distribution. We compare preferences for alterations of the income distribution affecting the decision maker's social rank, but not their income, and compare them with similar alterations leaving both rank and income unchanged. We find support for both a discontinuously greater disutility from occupying the last as opposed to higher ranks, thus affecting only those closest to the bottom of the distribution, and for a general dislike of rank reversals affecting most ranks. We moreover contribute to the replication literature by uncovering and correcting a potential reason for the failed replication of previous results. We discuss implications for policy design in both public finance and management science.

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1 Introduction

While it is established that income does not enter individuals' utility function in its absolute level only (relative comparisons matter: Duesenberry (1949); Blanchflower and Oswald (2004); Ferrer-i Carbonell (2005); Luttmer (2005)), how individuals' preferences over ranks (rank-preferences, henceforth) affect their behaviour, and why, remains poorly understood.[1] The disutilities and behavioural consequences induced by (changes in) societal rankings (e.g. immigration), but especially by policies explicitly addressing the shape of the income distribution, should be carefully accounted for. For instance, consistent with evidence that support for redistribution near the bottom of the income distribution is often lower than economic reasoning predicts (Fong, 2001; Gilens, 2009; Alesina et al., 2018)), basic income support closing the gap between the poorest and the immediately higher income bracket might impose a utility loss on the latter by *de facto* turning their rank into the last (Kuziemko et al., 2014). Similarly, the effect of rank-dependent remuneration and feedback might depend on individuals' (dis)taste for specific ranks (Card et al., 2012; Gill et al., 2018), potentially inducing desired as well as unwanted effects (e.g. job dissatisfaction).

This paper aims at better understanding rank-preferences and their interaction with income and preferences for (re)distribution schemes, in an environment removing the endogeneities plaguing this nexus. We ask whether support for lower ranked individuals is eroded by the mere fact of closing the income gap between the decision maker and the target individual, and whether such effect is distinctive of lower ranks or present over the whole income distribution. Answering such question would elucidate on whether rank-preferences can account for the poor's weak support for redistribution.

Kuziemko et al. (2014) (KBRN henceforth) show that individuals closest to the bottom of an income distribution avoid actions resulting in their rank being disadvantageously inverted with that of others (at constant income). They argue that the lowest rank might induce particularly large disutilities compared to higher ranks.[2] We believe this interpretation is premature: The design of individuals' choices confounds rank-preferences over the last rank with rank-loss from rank reversal (Xie et al., 2017). Such distinction is consequential. Interventions on the income distribution to the point of *inverting* societal ranks is hardly, if ever, the explicit purpose or outcome of public policy. Rejection of interventions *closing* income gaps (without rank losses) or rejection of rank reversals (where rank-loss occurs) bear thus drastically different consequences: warranting potentially nontrivial adjustment of the intervention in the first case, information dissemination on the policy's purpose and distributional outcomes in the latter. Moreover, while rank-preferences assigning larger disutilities to the last rank are idiosyincratic to the last rank, rank reversal

[1] Even should one's relative position not directly enter the utility function, outcomes that people care about, such as job or marriage quality or access to food, depend on their rank in the distribution (e.g. of income, education, attractiveness). It hence makes evolutionary sense that people would care about rank.

[2] Support for such claim can be found in evolutionary arguments: The weakest and slowest animal in a herd is usually the last one to eat and the first one to perish.

aversion might bite across the distribution.

We therefore re-investigate the modified dictator game adopted by KBRN and extend it to provide evidence for and to distinguish between pure preferences over the last rank and rank loss. In doing so, we account for a potential reason behind previous failure to replicate the original design (Camerer et al., 2016), and contribute methodological insights to the literature replicating experimental results.

The modified dictator game in KBRN captures the distributional and behavioural consequences of rank-preferences on individuals' support for redistributive actions.[3] In their design, KBRN rank six subjects according to the size of their monetary endowment (from 1 to 6 Dollars) in unit increments. They were moreover asked to allocate, either to the person immediately above or to that immediately below them in the distribution, an additional and fixed amount of 2 Dollars.[4] Their finding is that the probability with which subjects allocate the money to the person immediately below them in the distribution decreases the lower their own rank is, with a significant and sharp drop for the fifth (second-to-last) ranked subject.[5] KBRN interpret such result as evidence for subjects' aversion to occupying the last place in the income distribution (termed "last place aversion"). As the additional amount subjects could allocate was twice as large as the monetary distance between two consecutive ranks, subjects would *de facto* lose their rank when allocating the money to the person occupying the rank immediately below theirs, as that person would "leapfrog" them in the distribution. Subjects ranked fifth-of-six transferring money to the sixth (last) would hence end up in the last place.

In a recent paper, Xie et al. (2017) uncover that external dictators avoid disrupting a given income distribution with monetary allocations (*rank reversal aversion*). They argue that - similar to what is observed in the animal world - such regularity might reflect an evolutionary strategy aimed at reducing disruptive and costly in-group conflict (Smith, 1982). It stands to reason that if third-party dictators are averse to changing the ranking among a set of individuals they have no relation with, such aversion will be even more pronounced when individuals can, by virtue of their own actions, disadvantageously change their *own* rank. Dislike of disadvantageous rank reversals might in fact be function of the rank an individual is bound to lose (equivalently, acquire), the stronger the lower the new rank is. *Rank-dependent* rank reversal aversion would hence be fully consistent with the evidence presented by KBRN. In other words, KBRN's finding that the propensity to allocate money to the person ranked immediately below oneself is lowest in the second-to-last place compared to elsewhere in the distribution might originate from a stronger aversion

[3] The authors also run an experiment linking individuals' rank to their propensity to purchasing risky lotteries. While the lottery games offer important insights into rank-preferences, the scope of this paper is limited to the modified dictator game described in what follows.

[4] The additional amount originated from a separate account, not from the allocators' endowment.

[5] We will often use the shorthand "to allocate downwards" in referring to the choice of allocating to the lower ranked person in one's choice set. As illustrated in Section 2, for ranks two to five this choice translates into allocating to the subject ranked immediately below oneself.

to having one's rank inverted with the last than with higher ranks, *ceteris paribus*.

The distinction between last place aversion and rank dependent rank reversal aversion is important: Most redistributive policies (are designed with the intention to) preserve societal rankings. Thus, if people would only exhibit an aversion to being overtaken by people at the bottom, but not to those at the bottom catching up with them, support for redistributive policies should not be affected. If this argument holds empirically, the reason behind low support for redistribution among the poor should hence be searched for elsewhere. If on the other hand last place aversion *per se* is confirmed, i.e. if the mere fact of the last ranked catching up is enough to cause disutility in the second-to-last rank, it could explain lower than predicted demand for redistribution often observed at the bottom of the income distribution. Understanding which of the two matters most is thus vital for understanding political opposition and welfare consequences of redistributive policies.

We modify KBRN's design to disentangle the effect of last place aversion and that of aversion to (disadvantageous) rank reversal. To do so, we replicate KBRN's design but ask subjects to allocate an amount of money exactly equal to the monetary distance between two consecutive ranks, instead of a sum twice as large. This way, allocations in favour of the subject ranked immediately below oneself do *not* cause one's rank to be inverted with that of the beneficiary. Notice that last place aversion as conceptualised by KBRN (which we here refer to as *pure* last place aversion) would still predict that indviduals shy away from allocations causing them to end up in the last place, even though such last place were to be shared with another subject.[6] On the contrary, aversion to rank reversals would have no bite in our design. To allow for comparability of our results with those in KBRN, we include a replication their original design to serve as a benchmark. As ranks cannot be inverted, we term our main condition the *No Rank Reversal condition* (*NoRR*, henceforth). On the other hand, as ranks can be inverted in the original design, we term our replication of KBRN the *Rank Reversal condition* (*RR*, henceforth).

In further investigating the mechanisms and conditions conducive to last place and/or rank-dependent rank reversal aversion, and to shed light on the causes of previous failed replications of the original design, we propose two further extensions to the baseline design (Camerer et al., 2016). Replicability of experimental research stands at the core of a sound scientific method. While successful replication offers evidence of the robustness of previous findings, failure to replicate might either reveal a previous false positive, or offer precious indication that some aspect of the experimental environment is reducing the likelihood of successful measurement of the phenomenon of interest. The intuitive, anecdotal, and

[6]KBRN do not take a stance on whether last place aversion affects subjects differently if the last rank is shared between two or more individuals (they formally define last place aversion only for the case where individuals have distinct incomes). Whether shared or not, ending up in the last place will qualitatively yield the same result of being "last", and will still be (discontinously) worse than occupying any other (higher) rank. From an evolutionary perspective, for instance, the likelihood of being hunted down by a pride of predators is 100% for the weakest and slowest animal. If two animals are equally weak, it depends on how large the pride is, but each of the weak animals is still caught with a probability of at least 50% (still discontinuously higher than the chance of any of the other members of the herd being caught).

scientific appeal (Fong, 2001; Gilens, 2009; Gill et al., 2018; Alesina et al., 2018) of the mechanisms here discussed warrant a critical reappraisal of the conditions under which their measurement was previously attempted, in search for the causes of their unsuccessful observation. In addition to providing further evidence and insights into the nature of the mechanisms at play, such exercise might offer tools facilitating future research.

Specifically, in our conditions *NoRR* and *RR*, which follow the design of KBRN, subjects randomly rotate across ranks at every repetition of the stage game. This feature of the design has two disadvantages. First, when individuals are allowed to rotate across ranks, they will (potentially early on in the session) experience being assigned low ranks, and as a result will suffer from monetary and psychological disutilities. More importantly, they will anticipate, in early periods, the positive probability with which they will be (re)assigned a low rank in the future. They might hence feel compelled to allocate money to the next-in-rank out of compassion after having experienced or anticipated the disutility associated with lower ranks. A second argument relies instead on subjects' *ex-ante* evaluation of the repeated game as a whole. Subjects can anticipate the positive probability with which they will be assigned any of the ranks. In expectation, each individual will thus *ex-post* be assigned the average rank throughout the session, such that the monetary and psychological disutility of being assigned (or losing) a specific rank in any given period will be reduced.[7]

Our third and fourth conditions, *fixed No Rank Reversal* and *fixed Rank Reversal* (*NoRRfixed* and *RRfixed*, henceforth), address these concerns by keeping ranks strictly fixed across all repetitions of the game. As subjects in these conditions know that the rank assigned will be fixed throughout the session, the material and psychological disutility of being assigned a given rank (or of losing it) are expected to be stronger. We expect a generally stronger aversion to allocating resources to the next-in-rank, particularly when this implies ranks will be reversed, when subjects know that the rank to them assigned will *for sure* be the rank based upon which their final payoff will be computed. We implement such sessions by using the monetary allocations originally adopted by KBRN, and the allocations we adopted in our first extension, hence both allowing and not allowing for rank reversals to take place. Our design can hence be summarised as a 2×2 factorial design (Table 1), one cell of which is the original KBRN design.

[7] In addition, Konrad and Morath (2010) show that "perceived social mobility" (i.e. mobility in the experimental income distribution from one round to the next, without any implications for current round incomes) has an effect on people's redistributive choices, even if these choices only concern a given round and have no implications for the rest of the session.

	Rank (re)assignment	
	NoRR No rank reversal, ranks reassigned	*NoRRfixed* No rank reversal, ranks fixed
(No) rank reversal		
	RR (repl. KBRN) Rank reversal, ranks reassigned	*RRfixed* Rank reversal, ranks fixed

Table 1: 2x2 design: on one dimension we allow ranks to be reversed or not when subjects make allocations to the subject immediately below them in the distribution; on the other dimension, we reassign ranks or keep them fixed at each repetition of the games. n denotes the number of subjects participating in each condition.

When ranks are randomly reassigned, we do not support neither last place nor rank reversal aversion, as in Camerer et al. (2016). However, when instead ranks are fixed, we support both mechanisms and distinguish between them. When ranks can be inverted, our results replicate the finding in KBRN. Subjects in all ranks exhibit a stark tendency to avoid allocating resources to the next in rank, save for the second ranked subject. Last place and rank reversal aversion are however still confounded. By *preventing rank reversals* we identify the effect of *pure last place aversion* as of KBRN. In this case, subjects ranked second-to-last avoid allocating resources to the last, even though such action *cannot* cause rank reversals. Intermediate ranks instead do not exhibit this behaviour and allocate downwards significantly more frequently. These results allow us to conclude that both pure last place aversion and rank reversal aversion impact subjects' behaviour.

Section 2 describes the experimental design and procedures, Section 3 lays out the hypotheses, Section 4 presents the results, Section 5 discusses and concludes.

2 Experimental procedures

All subjects are assigned to groups of six and monetary endowments ranging from 2 to 12 Euros in steps of 2 Euros.[8] This income distribution and the resulting rank ordering are illustrated in Table 2.[9]

[8] We adjusted the original distribution from KBRN to match our subject payment requirements.

[9] Confusion could here arise according to how one numbers and evaluates ranks. The perspective adopted here decouples rank numbering from rank prestige, adhering to the dominant representation of rankings in our culture. Rank 1 is therefore the highest and rank six the lowest. Within this perspective, a positive relationship between rank and propensity to allocate downwards would have high prestige, low-numbered ranks display the highest propensity while low prestige, high-numbered ranks display the lowest. An alternative perspective would assign high numbers to high prestige ranks and lower numbers to low prestige ranks. We however feel such approach would be less intuitive and less immediately applicable to our everyday experience.

Endowments €	2	4	6	8	10	12
Rank	6	5	4	3	2	1
	(last)					(first)

Table 2: Subjects' endowments and rankings in a representative group

At the beginning of each period, subjects could see the whole ranking of endowments and their position in the ranking, marked by the word "You". The other ranks were labelled with letters ranging from A for the first rank, endowed with 12 Euros and displayed on top, to F for the last, endowed with 2 Euros and displayed on the bottom. In *NoRR*, subjects were told they could allocate 2 additional Euros either to the person immediately above or to the person immediately below them in the ranking. It was made clear in the instructions that the 2 Euros subjects could allocate would come from a separate account and not from their own endowment. The option to not allocate the money was not allowed. As in KBRN, the first and last ranked subjects could allocate to either the second or the third ranked subject, or to the fourth or the fifth ranked, respectively. After all subjects made their choice, a new repetition started: groups were broken up, endowments randomly reassigned, new groups were formed, after which the subjects repeated their choice in the new group and new rank assigned. The conditions consisted of 20 repetitions of the game. At the end of the session, one repetition was selected to be valid for payment. Within this repetition, one person in each group was selected as the dictator, and his/her allocation was implemented. Subjects were paid the amount in their endowment in the selected period, plus eventual allocations to them directed by the dictator. Crucially, no feedback on the chosen allocations was provided during the session. Notice that in this condition ranks cannot be reversed by assigning the additional money to the subject ranked immediately below oneself. Notice moreover that we closely follow the design adopted by KBRN save for the departures necessary to introduce our modifications.

In the three remaining conditions, we maintain the experimental design identical except for the following modifications. First, in condition *Rank Reversals*, *RR* condition henceforth, the amount subjects can allocate is increased from 2 to 4 Euros. This is the exact replication of the design in KBRN, where people switch ranks with the person below themselves if they allocate the money "downwards".[10] A subject allocating 4 Euros to the person immediately below them would hence be leapfrogged by that person. Second, in conditions *No Rank Reversals Fixed* and *Rank Reversals Fixed*, respectively *NoRRfixed* and *RRfixed* henceforth, the experimental design is identical to that in *NoRR* and *RR*, except that subjects' ranks are *not reassigned* at the beginning of each period, such that a given subject will maintain the same rank throughout the session.

We collected post-experimental data to obtain a richer picture of subjects' behaviour. Subjects were told (at the beginning of the sessions) that the session consisted of three

[10] As the distribution here adopted proceeds in increments of 2 Euros between contiguous subjects, we accordingly adjusted the amount subjects could allocate.

sections, and that instructions for the second and third sections would be handed out after the first section was concluded. They were hence unaware of what the additional sections would consist of while participating in the first one. The second section consisted of an additional set of 15 repetitions of the same conditions played in the first section, but allowing subjects to make both an unconditional allocation (identical to the one made in the first section) and a conditional one. The conditional choice consisted of one allocation for each of the following three cases: when the endowment of the next-in-rank is unchanged, when it is *increased* by one unit, and when it is *decreased* by one unit, determined randomly. In such scenario, last place aversion should play no role in conditions *NoRR* and *NoRRfixed* when the next-in-rank's endowment is *decreased* by one unit. Downwards allocations would in fact leave ranks unchanged. On the contrary, last place aversion should bite when the next-in-rank's endowment is unchanged, even more so when it is increased.[11] Different is instead the case for conditions *RR* and *RRfixed*. In these conditions, any positive or negative unit random change in the endowment of the next lower ranked individual is inconsequential, as ranks would in any case be reversed by downwards allocations.[12] We incentivised behaviour in this second section in a similar way as we incentivised the first (main) section of the experiment, only that either the unconditional or the "conditional" allocation would be randomly selected for payment, and only one, randomly selected, conditional choice in the latter case.

Finally, we elicited subjects' basic measures of Social Value Orientation (Murphy et al., 2011) in the third section. The data collected in the second and third sections does not constitute the basis for our analysis.

Following practice in the replication literature we chose to gather a large amount of observations from the conditions replicating previous studies. A total of $n = 402$ subjects participated in our experiment: $n_{NoRR} = 90$ participated in the *NoRR* condition, $n_{RR} = n_{RRfixed} = 120$ in each of the *RR* and *RRfixed* conditions replicating KBRN, and $n_{NoRRfixed} = 72$ in the *NoRRfixed* condition.[13]

The sessions were conducted using the software z-Tree (Fischbacher, 2007) at the Econlab of the Max Planck Institute for Tax Law and Public Finance in Munich (Germany). The sessions lasted approximately one hour and approximate average payout was 20 Euros

[11] In fact, ranks would be reversed in the latter case.

[12] A larger random change in the next-in-rank's endowment, say by two or more units, would already cause rank reversals with the neighbouring subjects. Because we feared such design feature would introduce noise and mechanisms we could not account for, we decided to fix the size of the random changes to unity.

[13] In computing the power of our study, we use the target effect size observed in KBRN, i.e. a proportion below 0.6 (which we conservatively round up to 0.6) of subjects ranked fifth and a proportion above 0.8 (which we conservatively round down to 0.8) of subjects ranked second allocating money downwards. In each condition, we have a number of independent observations equal to the number of subjects participating in that condition. As the subjects participate in a series of independent repetitions of the game (no feedback is provided across repetitions with stranger matching) the number of observations in each rank is given by the number of subjects choosing in each rank multiplied by the number of repetitions. Our power in a two-sample proportions test exceeds $power = 0.9$ at $\alpha = 0.05$ in all conditions.

including a 6 Euros show-up fee.

Worth mentioning is an advantage offered by running our experimental sessions in Germany. German society is very positional, where social ranks, status and titles matter and are held in great consideration by most. This is true in academia as well: the German student population is used to rigid and formal hierarchies. Germany seems hence a socio-cultural environment particularly apt to making the impact of positional concerns to emerge. The language selection (the experiment was run in German) helped minimise the risk that foreign students used to less rigid social organisations might obscure the effect of the social ranks on average choices.

3 Hypotheses

Our hypotheses nest and extend the hypotheses underlying the experimental investigation of KBRN. We expect their results to emerge in our *RR* condition, replicating their design. We however do not write down such expectation in a formal hypothesis as we could not test it within our study in an internally valid framework.

We instead formulate hypotheses concerning the mechanisms we aim to directly test with comparisons of conditions *NoRR* and *RR*. In *NoRR*, ranks cannot be inverted. Allocating the extra money to the person ranked immediately below oneself would hence not cause one's rank that of the other subject to be inverted at one's expense. Instead, the smaller increase in the other subjects' income would cause them to join the allocator's rank. Noticeably, the allocator hence keeps his or her original rank. For this reason, *aversion to rank reversals cannot* be a reason for subjects to prefer to allocate the money to the person immediately *above* rather than *below* themselves in the ranking. However *last place averse* subjects would still avoid the last place, regardless of whether obtained via an inversion of their second-to-last rank with that of the last, or via an increase in the latter's income just large enough for them both to share the last place.

In *RR*, as in KBRN, we allow subjects to be leapfrogged in the distribution when allocating the extra money downwards. Any evidence of subjects refraining from such action in this condition *more* than in *NoRR* can hence only be due to an aversion to having one's rank and that of another subject disadvantageously inverted.

Consequently, should rank reversal aversion play no role at all in subjects' choices (i.e. should subjects *not* be rank reversal averse), with last place aversion being instead the only cause of the behaviours observed in KBRN and in our condition *RR*, we should observe no differences between behaviours in *RR* and *NoRR*. On the contrary, should rank reversal aversion affect subjects on top of last place aversion, we should observe different behavioural patterns in the two conditions. In particular, as subjects keep their rank in *NoRR*, we expect a greater proportion of downward allocations and a weaker relationship between rank and probability of allocating downwards compared to *RR* where subjects would lose their rank. These considerations constitute our first hypothesis:

Hypothesis 1.

a. if pure Last Place Aversion: same pattern in NoRR as in RR

b. if rank-dependent Rank Reversal Aversion also plays a role: greater proportion of downwards allocations and weaker relationship of rank and propensity to allocate downwards in NoRR than in RR

Further, as discussed above, we extend the design by fixing the rank assigned to each subject at the beginning of the session instead of reassigning ranks at the beginning of each period of play. A first implication of this new design feature is that, as it will be fixed throughout the session, subjects will be less keen on losing their rank to, or sharing it with, another subjects' advantage. With fixed ranks, in fact, subjects will feel a stronger "ownership" of their rank than if ranks are continuously reassigned. Moreover, the lack of a positive probability with which a current rank loss will be compensated in the future by being assigned a higher rank, will make subjects even less keen on allocating downwards. It hence stands to reason that last place and/or rank reversal aversion will have a stronger bite and will more strongly influence subjects' behaviours when ranks are fixed compared to when they are continuously reassigned. On the grounds of these considerations we formulate our second hypothesis. In particular, we hypothesise that fixing ranks will negatively affect subjects' propensity to allocating the extra money downwards. Moreover, we hypothesise that last place and/or rank reversal aversion will exert a stronger influence. We distinguish between the two with the very same empirical strategy forming the basis for Hypothesis 1.

Hypothesis 2.

1. *Lower proportion of allocations to the subject ranked immediately below oneself with fixed ranks*

2. *a. if pure Last Place Aversion: same pattern in NoRRfixed as in RRfixed*

   b. if rank-dependent Rank Reversal Aversion: greater proportion of downwards allocations and weaker relationship of rank and propensity to allocate downwards in NoRRfixed than in RRfixed

4 Results

Table 3 reports the share of subjects in each rank allocating money to the person occupying the lowest rank *among those in their choice set* in each condition. Because their choice set differs from that of the other ranks, we follow KBRN and exclude subjects ranked first and last from *all* our analyses and focus on ranks two to five. When reporting the proportion of subjects allocating downwards in each rank we will also report the proportion observed in ranks one and six for the sake of completeness.

	% subjects allocating to the lowest rank in their choice set *Ranks 1 and 6 reported for completeness though not comparable.*						
	All ranks pooled	By rank					
Condition	(Ranks 2 to 5)	6	5	4	3	2	1
NoRR	82.2%	77.3%	82.3%	80.7%	81.3%	84.7%	87.0%
RR (KBRN)	82.9%	80.8%	81.8%	85.7%	83.0%	81.0%	82.0%
NoRRfixed	72.3%	68.0%	63.7%	84.6%	77.1%	63.7%	68.3%
RRfixed	69.9%	69.2%	64.0%	65.7%	69.0%	81.0%	70.7%

Table 3: Proportion of subjects allocating money downwards in each condition. The first column reports proportions pooling over ranks 2 through 5, while columns 3 to 8 disaggregate by rank. *Ranks 1 and 6 reported for completeness though not comparable.*

Table 3 reveals that, in all conditions, a vast majority of the subjects, ranging from a highest of 82.9% in condition *RR* to a lowest of 69.9% in condition *RRfixed*, allocates the additional money to the person occupying the lower rank within their choice set, consistent with what observed in KBRN and with predictions of inquity aversion (Fehr and Schmidt, 1999; Kuziemko et al., 2014).[14]

We examine the data from each condition separately with the aim of disentangling and identifying the relative merit of last place and rank reversal aversion. To ease the presentation of our results, we will build the discussion up starting from our *NoRR* condition. We will first plot the share of subjects allocating downwards in *NoRR*.As we will move on to another condition, we will superimpose the corresponding graph and dim the previously discussed ones to ease comparability.

We will primarily rely on conservative Probit regressions in testing for the statistical significance of behavioural differences. The binary outcome variable indicates whether subjects allocated to the lowest ranked person in their choice set. Standard errors are always clustered at individual level. In analyses of the fixed effects of being in a specific rank of the distribution we add no further covariates, and relegate regressions including more controls and further robustness checks to Appendix B.

[14]As illustrated in Appendix C.1 inequity aversion predicts that in both conditions *NoRR* and *RR* subjects would rather allocate money to the person below them than to the person above them.

4.1 *NoRR* and *RR* condition

We begin by examining data from the *NoRR* condition, which is intended to investigate last place aversion by removing the eventual effects of disadvantageous rank reversals. Contrary to KBRN, allocations to the person immediately below oneself in the ranking do not here cause the subjects to be leapfrogged in the distribution. However, second to last subjects in the original distribution still would find themselves occupying the last place should they choose to do so. Therefore, last place aversion as conceived by KBRN would still predict subjects in the second to last place to shy away from allocating the additional money to the subject immediately below them, as it would cause them to end up in the last place.

Figure 1 displays the proportion of subjects in each of the ranks allocating money to the lower ranked subject within their choice set in condition *NoRR* (the highest rank is numbered 1 and the lowest rank is numbered 6). Overall, excluding the first and sixth ranks, 82.2% (see Table 3) of the subjects allocate money downwards. Consistent with inequity aversion, we therefore find that a vast majority of the subjects do allocate the money downwards (Kuziemko et al., 2014).

From Figure 1, the probability of allocating to the lower rank is constant over rank, contrary to what observed in KBRN. We find that 84.7% of the second ranked subjects give to the third rather than to the first, and 81.3% of the ranked third give to the fourth rather than to the second. The fourth ranked subjects allocate money downwards 80.7% and the fifth 82.3% of times. None of the proportions is significantly different from the fifth ranked in a Probit regression[15] of a binary variable indicating whether the subject allocated downwards (p-values reported in Figure 1). In addition, two-sided proportions tests (PR) return no significant differences between rank five and any other rank (in comparisons of rank 5 with ranks 4, 3, and 2: p-value=599, p-value=0.751 and p-value=0.441 respectively). These findings are summarised in Finding 1.

Finding 1. *The proportion of subjects in NoRR allocating money to the subject immediately below themselves in the ranking does not increase with subjects' rank. In particular, the fifth ranked subject does not allocate money to the subject immediately below less often than subjects in other ranks.*

From Finding 1, our data does not so far replicate the findings in KBRN. We thus turn to investigating and discussing the results from our exact replication of the design adopted by KBRN: condition *RR*. From Table 3, an overall 82.9% of the subjects (first and sixth ranks excluded) allocate money to the person ranked immediately below them. The difference with the proportion observed in *NoRR* is not statistically significant (PR p-value=0.665). Figure 2 displays the proportion of subjects making the same choice, by rank.[16] No relationship between rank and propensity to allocate the money downwards can be recognised. We observe 81.0% of the second, 83.0% of the third ranked subjects

[15]The output of the probit regressions are reported in Appendix A.

[16]Figure 2 can be compared with Figure IV in KBRN (Kuziemko et al., 2014, p. 127).

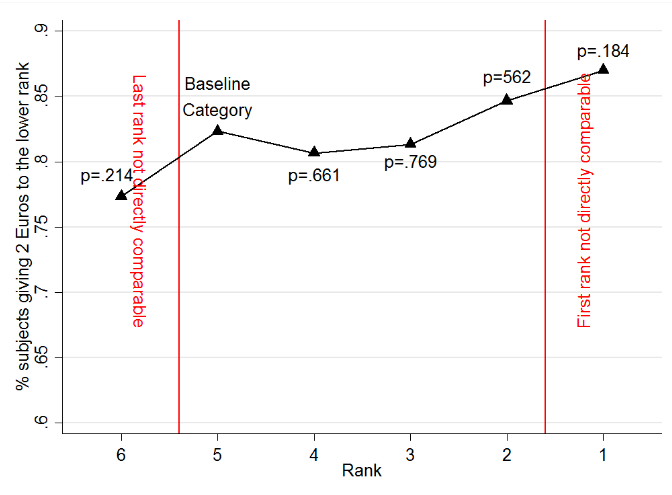

Figure 1: Condition *NoRR*
Share of subjects allocating 2 Euros to the lower ranked subject in their choice set.
Players in groups of six could choose to give 2 Euros either to the person immediately above or immediately below them in the ranking. The first and last players could choose between the second and third, and between the fourth and fifth ranked, respectively. All details in Section 2. As in KBRN, the p-values refer to comparisons of the estimated effect of being ranked k^{th} relative to being ranked second-to-last (excluded) in the following probit regression: $gave\ downwards_i = \sum_{k\neq 5}^{6} \beta^k rank_i^k + \varepsilon_i$. No further covariates were included in the regression and standard errors were clustered at the subject level (clustering at session level yields the same qualitative result). The y-axis reports the proportion of allocations to the next-in-rank (or lowest rank in the choice set) observed in each rank.
The previously discussed graphs are dimmed in grey.

allocate to the lower ranked subject in their choice set. Moreover, 85.7% of fourth ranked subjects allocate to the lower ranked subject making them the ones who are most likely to do so. Continuing, 81.7% of fifth ranked subjects allocate to the lower ranked subject. The fixed effects associated to each rank turn out not to be significant in a Probit regression of an binary variable indicating whether the subject allocated downards, using the fifth rank as the baseline (p-values reported in Figure 2): subjects ranked fifth do not allocate downwards with different probability than subjects occupying other ranks. Two-sided proportions tests confirm that the proportion of fifth ranks allocating downwards is *not* significantly different from that of subjects in any other rank (PR p-value=0.125 for the fourth, p-value=0.643 for the third, and p-value=0.785 for second ranked subjects).[17]

[17] Here, and throughout the rest of the paper, analogous Fisher's Exact tests lead to the same conclusions as the reported PR tests.

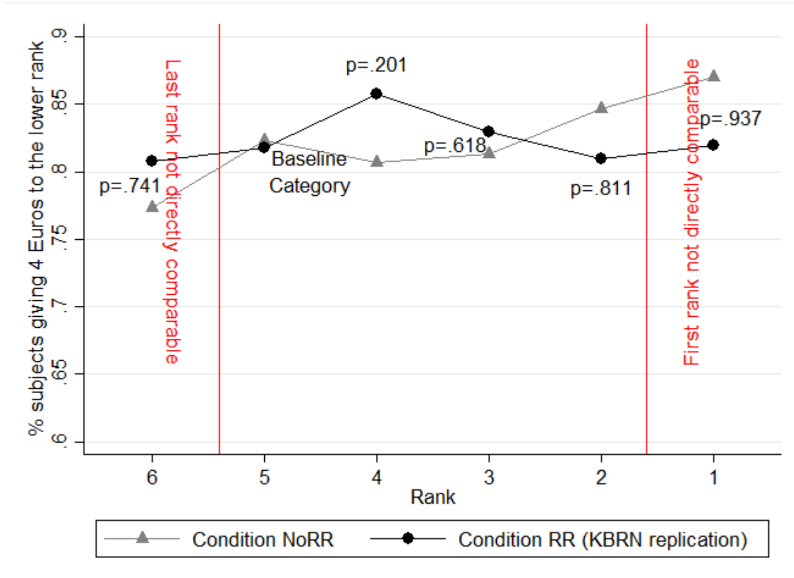

Figure 2: Condition *RR* (KBRN)
Share of subjects allocating 4 Euros to the lower ranked subject in their choice set.
Players in groups of six could choose to give 4 Euros either to the person immediately above or immediately below them in the ranking. The first and last players could choose between the second and third, and between the fourth and fifth ranked, respectively. All details in Section 2. As in KBRN, the p-values refer to comparisons of the estimated effect of being ranked k^{th} relative to being ranked second-to-last (excluded) in the following probit regression: $gave\ downwards_i = \sum_{k\neq5}^{6} \beta^k rank_i^k + \varepsilon_i$. No further covariates were included in the regression and standard errors were clustered at the subject level (clustering at session level yields the same qualitative result). The y-axis reports the proportion of allocations to the next-in-rank (or lowest rank in the choice set) observed in each rank.
The previously discussed graphs are dimmed in grey.

Finding 2. *The proportion of subjects in RR allocating money to the subject immediately below themselves in the ranking is not significantly different from that observed in NoRR, and does not increase with subjects' rank. In particular, the fifth ranked subject does not allocate money to the subject immediately below less often than subjects in other ranks.*

Results 1 and 2 do not support aversion to the last place as conceptualised in KBRN, nor aversion to to rank reversals, as drivers of subjects' behaviours. This conclusion emerges from the lack of a significant difference between the proportion of subjects allocating downwards in the two *NoRR* and *RR* conditions, and especially from the lack of significant variation in behaviour across the different ranks, the fifth in particular. These results are in line with the previous failed replication of KBRN's study in Camerer et al. (2016). The intuitive, anecdotal, and scientific appeal of both last place and rank reversal aversion warrant however a careful and critical reappraisal of the conditions within which the evidence was so far collected. As discussed above there are reasons to believe that the impacts of both last place aversion and rank reversal aversion might be obfuscated by the specific design choice of reassigning ranks at the beginning of each period.[18] We provide evidence in what follows.

4.2 Fixed ranks

We now turn to investigating conditions *NoRRfixed* and *RRfixed*, where we keep subjects' ranks fixed throughout the session. In our first two conditions *NoRR* and *RR* (as well as in the original design by KBRN), ranks were reassigned at the beginning of each repetition of the game. This feature of the design might be responsible for the lack of support for last place or rank reversal aversion in the data presented above. First, when ranks are reassigned, subjects will early on experience or anticipate being (re)assignment to lower ranks, and hence allocate the money downwards after having experienced or anticipated the disutility associated with lower ranks. Second, anticipating the positive probability with which they will be assigned any of the ranks, subjects will be less affected by the disutility stemming from a specific rank in a given period. For these reasons, in the following two extensions we reinvestigate the *NoRR* and *RR* conditions, this time keeping fixed throughout the session the ranks randomly assigned to each subject at the very beginning.

As can be observed in Table 3, the proportion of downward allocations drops from 82.6% when ranks are reassigned (conditions *RR* and *NoRR*, pooled) to 70.8% when ranks are held fixed throughout the session, (conditions *RRfixed* and *NoRRfixed*, pooled). A Probit regression on pooled reassigned and fixed rank conditions returns a significant difference (p-value< 0.001; ranks 1 and 6 excluded). A two-sided test of proportions confirm such finding (p-value< 0.001). This result holds if we disaggregate the data and compare the impact of fixing ranks in the *NoRR* and *RR* conditions. The proportion of downwards allocations drops from 82.2% in *NoRR* to 72.3% in *NoRRfixed* (Probit p-value=0.047; PR p-value< 0.001). The proportion of downward allocations drops from 82.9% in condition *RR* to 69.9% in *RRfixed* (Probit p-value< 0.001; PR p-value< 0.001). We summarise these findings in the following result.

Finding 3. *The proportion of subjects in ranks 2 through 5 allocating money to the person ranked immediately below them drops significantly when individuals' ranks are held fixed throughout the session.*

Finding 3 confirms Hypothesis 2.1, and constitutes a first indication that indeed any impact of aversion to the last place and/or of aversion to rank reversals might have been hampered by the fact of reassigning ranks at every repetition of the game. We next explore these findings more in detail with more detailed analyses of behaviours within these two

[18]See the discussion in Sections 1 and 2.

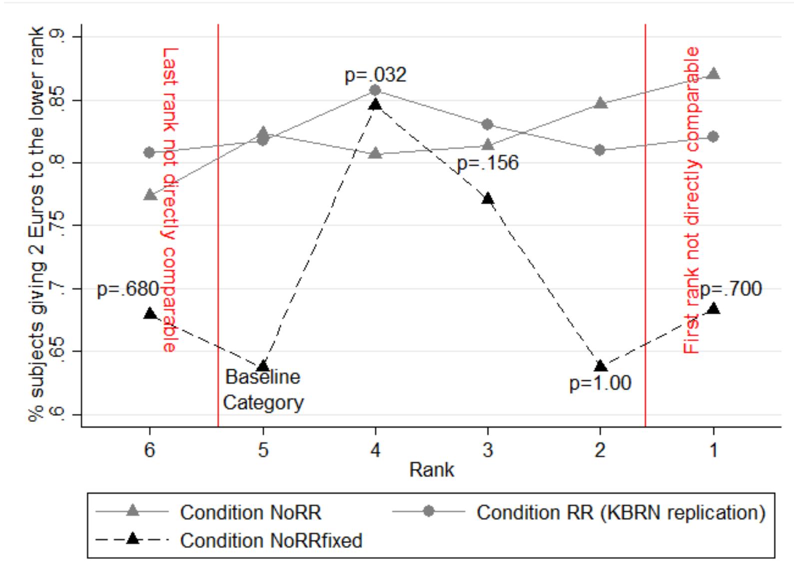

Figure 3: Condition *NoRRfixed*
Share of subjects allocating 2 Euros to the lower ranked subject in their choice set.
Players in groups of six could choose to give 2 Euros either to the person immediately above or immediately below them in the ranking. The first and last players could choose between the second and third, and between the fourth and fifth ranked, respectively. All details in Section 2. As in KBRN, the p-values refer to comparisons of the estimated effect of being ranked k^{th} relative to being ranked second-to-last (excluded) in the following probit regression: $gave\ downwards_i = \sum_{k \neq 5}^{6} \beta^k rank_i^k + \varepsilon_i$. No further covariates were included in the regression and standard errors were clustered at the subject level (clustering at session level yields the same qualitative result). The y-axis reports the proportion of allocations to the next-in-rank (or lowest rank in the choice set) observed in each rank.
The previously discussed graphs are dimmed in grey.

conditions.

First we focus on condition *NoRRfixed*. Figure 3 plots the proportion of subjects in each rank allocating money downwards in this condition.

From Table 3, 63.7% of the second ranked, 77.1% of the third ranked, 84.6% of the fourth ranked, 63.7% of the fifth ranked choose to allocate money to the person ranked immediately below them, outlining an inverted U-shaped pattern. A Probit regression of choosing to allocate downward on the ranks reveals significant differences between rank 4 and ranks 2 (T-test p-value=0.056) and 5 (p-value=0.032).[19] The same comparisons return significant differences in nonparametric tests of proportions (PR p-values<0.001 for comparisons of the second and fifth ranks with the fourth rank). Moreover, the same test return significant pairwise differences between the second and fifth ranks with the third

[19]P-values in Figure 3 and regression output in Appendix A.

rank (PR p-value=0.001 in both cases), though such difference is not picked up in a Probit regression.

We hence detect an inverted U-shaped relationship between subjects' rank and their propensity to allocate downwards. Choosing to allocate to the subject ranked immediately below oneself (first and last ranks excluded) is less common in extreme rather than in intermediate ranks.

Finding 4. *The proportion of subjects in NoRRfixed allocating money to the subject immediately below themselves in the ranking drops significantly in extreme ranks.*

The behaviours described in Finding 4 are consistent with an explanation based on last place aversion as conceptualised in KBRN. By allocating the money to the last-in-rank, the subject ranked second-to-last would effectively end up sharing the last place with the former. Striking is the fact that the same behavioural pattern observed in rank 5 is also observed in rank 2. As our theory and hypotheses do not explicitly address behaviours in rank 2, we relegate further discussions on this to the conclusions.

Finally, we analyze condition *RRfixed*, analogous to the KBRN design but with fixed ranks. The proportion of subjects in each rank allocating downwards is plotted in Figure 4. From Table 3, 81% of the second ranked, 69% of the third ranked, 65.7% of the fourth and 64% of the fifth ranked subjects choose to allocate money downwards. A Probit regression rejects the null hypothesis of no differences in downwards allocations across ranks 2 and 5 at 5% significance level (p-values reported in Figure 4). A test of equality of the coefficients associated with the second and fourth ranks reject that the difference is zero at 10% significance lelve (T-test p-value=0.076). Equality of coefficients for any other pairwise coefficient comparison cannot be rejected. Nonparametric proportions tests confirm these results (PR p-value< 0.001 on comparisons of rank2 with each of ranks 5 and 4).

A Probit regression on *condition* $\times$ *rank* indicators in *NoRRfixed* and *RRfixed* return significant differences between the fourth ranks (t-test p-value=0.042) in the two conditions.[20] Noticeably, differences between each of ranks 5, 4 and 3 in *RRfixed* and rank 5 in *NoRRfixed* cannot be rejected at conventional levels (T-test p-value=0.980, p-value=0.851, p-value=0.624, respectively).

Finding 5. *The proportion of subjects in RRfixed allocating money to the subject immediately below themselves in the ranking signifcantly drops throughout the whole distribution to levels comparable to those of rank 5 in NoRRfixed, except for rank 2.*

Finding 5 supports the hypothesis that rank reversal aversion exerts a deterrence effect on subjects' propensity to allocate to the person ranked immediately below them. In condition *RRfixed*, Rank Reversal Aversion has a bite: subjects allocate 4 Euros, thus allowing the subject immediately below them to leapfrog them in the distribution should they choose to

[20]Regression coefficients reported in Appendix B.2.

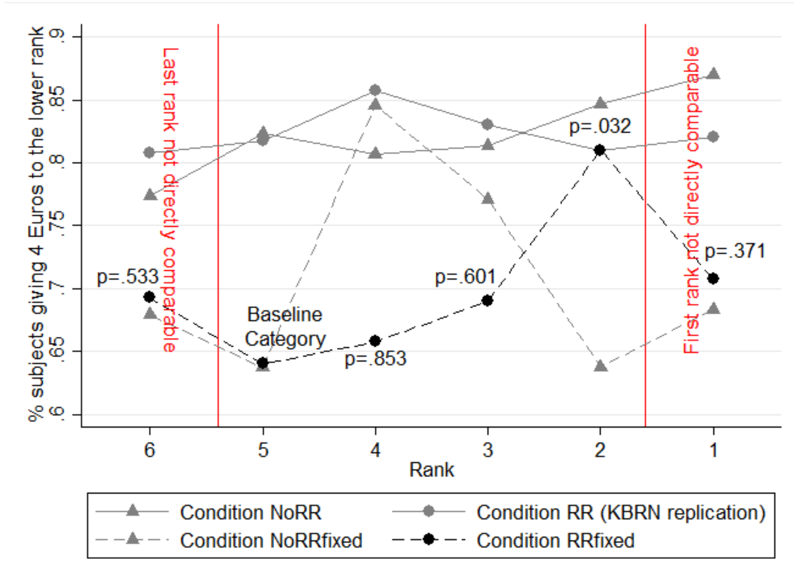

Figure 4: Condition *RRfixed*
Share of subjects allocating 4 Euros to the lower ranked subject in their choice set.
Players in groups of six could choose to give 4 Euros either to the person immediately above or immediately below them in the ranking. The first and last players could choose between the second and third, and between the fourth and fifth ranked, respectively. All details in Section 2. As in KBRN, the p-values refer to comparisons of the estimated effect of being ranked k^{th} relative to being ranked second-to-last (excluded) in the following probit regression: $gave\ downwards_i = \sum_{k\neq 5}^{6} \beta^k rank_i^k + \varepsilon_i$. No further covariates were included in the regression and standard errors were clustered at the subject level (clustering at session level yields the same qualitative result). The y-axis reports the proportion of allocations to the next-in-rank (or lowest rank in the choice set) observed in each rank.
The previously discussed graphs are dimmed in grey.

allocate the money to that person. In condition *NoRRfixed*, described above, rank reversals were not made possible. These results suggest that the absence of an inverted U-shaped relationship in the *RRfixed* condition is due to the frequency of downward allocations being significantly "compressed" in the intermediate ranks: People are generally, and irrespective of their own rank, less likely to allocate downwards if this causes them to lose their rank in someone else's favour, than if they would get to keep their rank. Once rank reversals are made possible, in fact, intermediate ranks do not behave differently from the extreme rank 5.

Summing up, we take these considerations as evidence that rank reversal aversion indeed influences individuals' allocation behaviours, and that the strength of such influence is not a function of subjects' rank. Rather, all subjects, regardless of rank, prefer not to disadvantageously switch their rank with that of another subject. As a consequence, rank reversals cause the relationship between rank and downwards allocations, hump shaped in their absence, to flatten out.

5 Discussion and conclusions

Support for redistributive policies is often found to be lower than expected precisely at the bottom of the income distribution, where the greatest benefits of redistributive policies would be reaped. Kuziemko et al. (2014) present experimental evidence supportive of an explanation based on individuals' dislike for occupying the lowest ranks of a distribution, which they refer to as "last place aversion". In their framework, however, last place aversion is confounded with a dislike of disadvantageous rank reversals (Xie et al., 2017). As most redistribution schemes are not, at least not purposefully, designed with the intention of inverting societal rankings, clarifying whether either or both these mechanisms impact individuals' distributional preferences and with relationship with their own rank is a crucial step towards understanding rank-preferences, their interaction with policy preferences, and hence towards a more purposeful and careful design of redistribution policies.

Our first result consists in the identification of a design feature potentially preventing the replication of the results of KBRN (Camerer et al., 2016): noticeably, the reassignment of ranks at each repetition of the stage game. We hence contribute to the recently developing literature on the replicability of experimental results. Failure to replicate previously observed results is a precious component of the scientific method. In addition to revealing potential false positive results, it should spur a critical reconsideration of the conditions under which the original evidence was collected.

The intuitive appeal and anecdotal and scientific evidence for rank-preferences (Card et al., 2012; Xie et al., 2017; Gill et al., 2018), as well as their implications, warrant a careful reappraisal of the scientific evidence gathered so far and a careful examination of the conditions potentially hiding important behavioural regularities from view (Kuziemko et al., 2014; Camerer et al., 2016). We have shown that reassignment of ranks at each repetition of the sage game might have in fact voided ranks of their meaning, nullifying the associated (dis)utilities, thus preventing the observation of the impact of rank-preferences on allocation behaviours. In joining the recent literature in advocating an expansion of the replication practice, we also stress the importance of considering both the positive and negative outcomes of replication studies as important scientific findings offering insights and to spur further research on the topics covered.

Our second main result stems from our systematic investigation of the impact on subjects allocation choices of the prospect of occupying the last place and, by disentangling the two, that of the prospect of losing one's rank in favour of others. Observing behavioural regularities consistent with both last place *and* rank reversal aversion constitutes evidence that indeed individuals do exhibit preferences over ranks. Our results offer support for both mechanisms. We provide a discussion and implications in what follows.

First, our findings in *NoRRfixed* support KBRN's hypothesis that the last rank might discontinuously generate greater disutilities than other ranks, as revealed by the lower proportion of downwards allocations among fifth ranks. We observe an inverted U-shaped relationship between allocations made to the person immediately below oneself and one's rank. Crucially, the second-to-last rank is associeated with a sharp drop in the probability of allocating downwards compared to intermediate ranks. Notice that despite ranks not being inverted, subjects in the fifth rank allocating to the sixth would nevertheless find themselves occupying the *last* rank in the resulting distribution.[21] Such finding is hence supportive of *pure last place aversion* as conceptualised by KBRN: The last rank generates discontinuously greater disutility.

Our findings in *NoRRfixed* are also reminiscent of those in Gill et al. (2018). They observe highest and lowest ranked subjects exerting greater effort compared to subjects in intermediate ranks, plausibly in their strife to respectively retain and escape their ranks. Our findings can be interpreted in a similar fashion. Subjects in intermediate ranks tolerate *sharing* their rank by allocating downwards significantly more than subjects in extreme ranks.[22] While sharing one's rank with a lower ranked other might not be as costly for intermediate ranks, such cost might increase the closer the rank is to the lowest place, possibly with a sharp increase at the second to last. Analogously, higher ranks are salient and (almost) as contested as the first place: In sports competitions, for instance, medals are awarded the first three ranked contestants, all of which have their place on the podium and enjoy of media attention.[23,24] Examples from the sports world also illustrate subjects' aversion to sharing lower ranks. While most of the focus is usually on the upper end of the classification, it seems plausible for competitiveness to pick up towards the end of the ranking, with athletes competing among each other to avoid ending up in the last position, possibly out of intrinsic motivation.[25]

Our results in *RRfixed* offer instead support for a general dislike of rank reversals (Xie et al., 2017), observed throughout most of the distribution. Downward allocations cause subjects to lose their rank in favour of the beneficiary. Intermediate ranks no longer choose

[21] Notice that the same is *not* true for higher ranks.

[22] Recall that in *NoRR* and *NoRRfixed* downwards allocations do not cause the subjects to lose their rank, but allow the subject ranked immediately below to "catch up".

[23] One may argue that only the first place is associated with the greatest utility. We do not dispute that. However, we point out that despite the fact that utility may decrease sharply with the second and even further with the third rank, any sports passionate would agree that neither the second nor the third placed athlete would be glad to share their place with the next classified contestant (if not symbolically by allowing them to step on their podium stall, or for other types of prestige or notoriety gains).

[24] While no competition takes place in our framework, it is reasonable to believe that our results would be amplified by the presence of active competition for the ranks among the subjects.

[25] A curious counterexample was pointed out to us. The rather unflattering title of "lanterne rouge" ("tail lamp", in English) is assigned to the last classified competitor in the cycling competition "Tour de France". The "lanterne rouge" is devoted a substantial amount of media and sponsor attention, causing in at least one known case competition to classify last in the race. While countering our reasoning, the peculiar circumstances surrounding and the media attention devoted to the "lanterne rouge" make it a case hardly generalisable to other contexts.

such action significantly more often than the second-to-last-rank, and significantly less often than their counterparts who cannot switch ranks. We interpret this finding as evidence that rank reversals cause strong disutility to the decision makers, irrespective of the rank occupied, pushing intermediately ranked subjects to refrain from actions they would have taken had they been able to retain their rank. It should be noted that fifth ranked subjects make virtually identical choices across conditions *NoRRfixed* and *RRfixed*. This should be unsurprising. Whether ranks are inverted or not, downward allocations cause fifth ranked subjects to occupy the last place; pointing towards a dominance of last place over rank reversal avoidance in the choice of allocation. Notice finally that the findings in *RRfixed*, replicating KBRN with fixed ranks, are now much closer to their results.[26]

These results join those in Kuziemko et al. (2014) and Gill et al. (2018) in highlighting the importance of taking individuals' rank-preferences into consideration in the design of redistribution schemes. We add to this discussion by showing that rank reversals (relevant in many competitive settings in sports as well as in business and management science) are strictly speaking *not needed* to induce behavioural regularities consistent with an opposition among the poor to policies increasing the income of individuals ranked even lower. The prospect of ending up in the last rank is enough for near-last individuals to voice their discontent. On the other hand, strict rank reversals are a motive of concern for individuals in the intermediate ranks of the distribution.

From our results, the mechanisms generating opposition to redistributive schemes in the lowest and highest as opposed to intermediate brackets of the income distribution might originate from two related though different mechanisms. In the first case, the mechanism induces an avoidance of sliding into the last place (irrespective of whether due to rank reversal or rank sharing), and of having to share a prestigious rank, respectively. In the second case, opposition to redistribution schemes might originate from fear of losing one's rank and status in favour of a previously lower ranked individual. Consequences range from loss of self-esteem, loss of positive and gain of negative utility in positional comparisons, fear of loss in esteem from esteemed others to the advantage of previously un-esteemed rivals. Such outcome is arguably hardly the explicit aim of redistributive policies, let alone their outcome. However, individuals' *belief* that redistributive policies would cause them to lose their rank might be enough to erode support among the intermediate ranks i.e. the middle class, arguably a non-negligible portion of the electorate in most economies.

Future empirical research should hence pay attention not only to the impact of redistributive policies on the gap between incomes at the lower end of the distribution, but to

[26]Behaviours observed among the second ranked subjects in *RRfixed* is more difficult to interpret. We speculate that for the second ranked the disutility from "upward" allocations of a large amount, originating from the resulting extremely unfavourable relative comparison, might outweigh that of losing their rank. Upward allocations for second ranks mean the first rank would have a much larger income, with no other subject available in between. For lower ranks, increasing the next higher rank's income means the latter will join the rank of another even higher ranked subject, a comparison the subject already faces to begin with. We leave further investigations into this regularity to future research.

individuals' *perception* of the resulting gap and their belief that it might be turned from a positive one (from a second-to-last ranked's perspective) into a negative one by switching ranks to their disadvantage. This consideration broadens up to the whole income distribution. A redistribution scheme might fail to gain support should individuals in the intermediate portion of the distribution perceive that they are or would be losing out to the advantage of their lower ranked neighbours.

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Appendix

A Probit regressions for the p-values in Figures 2, 1, 4 and 3

	Pr(Allocating to the lower rank in choice set)			
	Full sample			
Condition	*RR*	*NoRR*	*NoRRfixed*	*RRfixed*
1.Rank	0.00949	0.198	0.125	0.188
	(0.120)	(0.149)	(0.325)	(0.210)
	[0.937]	[0.184]	[0.700]	[0.371]
2.Rank	-0.0280	0.0941	0.000	0.519**
	(0.117)	(0.162)	(0.335)	(0.242)
	[0.811]	[0.562]	[1.00]	[0.032]
3.Rank	0.0483	-0.0379	0.390	0.137
	(0.0967)	(0.129)	(0.275)	(0.263)
	[0.618]	[0.769]	[0.156]	[0.601]
4.Rank	0.163	-0.0625	0.667**	0.0472
	(0.128)	(0.142)	(0.312)	(0.254)
	[0.201]	[0.661]	[0.032]	[0.853]
5.Rank				
6.Rank	-0.0372	-0.178	0.114	0.144
	(0.113)	(0.143)	(0.275)	(0.232)
	[0.741]	[0.214]	[0.680]	[0.533]
Constant	0.906***	0.928***	0.352*	0.358**
	(0.0997)	(0.150)	(0.209)	(0.162)
Observations	2,400	1,800	1,440	2,400

Robust standard errors in parentheses
P-values in square brackets
*** p<0.01, ** p<0.05, * p<0.1

Table A1: Probit regression of subjects' choice to allocate money to the lower rank in their choice set on the subjects' rank in the income distribution. Standard errors are clustered at subject level. No further covariates are included.

B Additional regressions

B.1 Probit regressions, sample restricted to the first ten periods

	Pr(Allocating to the lower rank in choice set)			
	Periods 1 to 10			
Condition	*RR*	*NoRR*	*NoRRfixed*	*RRfixed*
1.Rank	0.168	0.110	0.301	0.184
	(0.165)	(0.202)	(0.340)	(0.208)
2.Rank	-0.0567	0.234	0.252	0.728***
	(0.175)	(0.173)	(0.345)	(0.246)
3.Rank	0.0196	-0.0754	0.352	0.140
	(0.147)	(0.176)	(0.273)	(0.259)
4.Rank	0.168	0.0812	0.776**	0.0273
	(0.190)	(0.192)	(0.332)	(0.251)
5.Rank				
6.Rank	-0.162	-0.0508	0.204	0.214
	(0.152)	(0.188)	(0.293)	(0.246)
Constant	0.935***	0.941***	0.297	0.399**
	(0.133)	(0.163)	(0.210)	(0.163)
Observations	1,200	900	720	720

Robust standard errors, clustered at subject level, in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table B1: Restricted sample Probit regression (first 10 Periods) of subjects' choice to allocate money to the lower rank in their choice set on the subjects' rank in the income distribution. Standard errors are clustered at subject level. No further covariates are included.

B.2 Comparison of ranks across conditions ***RRfixed*** and ***NoRRfixed***

VARIABLES	Pr(Allocating to the lower rank in choice set)
NoRRfixed×1.Rank	0.125
	(0.324)
NoRRfixed×2.Rank	0.00
	(0.334)
NoRRfixed×3.Rank	0.390
	(0.274)
NoRRfixed×4.Rank	0.667**
	(0.311)
NoRRfixed×5b.Rank	
NoRRfixed×6.Rank	0.114
	(0.274)
RRfixed×1.Rank	0.194
	(0.247)
RRfixed×2.Rank	0.526*
	(0.275)
RRfixed×3.Rank	0.144
	(0.293)
RRfixed×4.Rank	0.054
	(0.286)
RRfixed×b.Rank	0.007
	(0.264)
RRfixed×6.Rank	0.151
	(0.266)
Constant	0.352*
	(0.208)
Observations	3,840

Coefficient comparisons

H_0 : $NoRRfixed \times 4.Rank = RRfixed \times 4.Rank$, p-value=0.042 (**)

H_0 : $NoRRfixed \times 3.Rank = RRfixed \times 3.Rank$, p-value=0.366

H_0 : $NoRRfixed \times 2.Rank = RRfixed \times 2.Rank$, p-value=0.096 (*)

Robust standard errors, clustered at subject level, in parentheses

*** p<0.01, ** p<0.05, * p<0.1

No further covariates are included

Table B2: Probit regression on condition × rank indicators.

B.3 Probits with additional covariates

	Condition *NoRR*			
VARIABLES	Pr(Allocating to the lower rank in choice set)			
1.Rank	0.198	0.197	0.198	0.219
	(0.149)	(0.150)	(0.146)	(0.145)
2.Rank	0.0941	0.0943	0.0940	0.113
	(0.162)	(0.162)	(0.162)	(0.162)
3.Rank	-0.0379	-0.0383	-0.0387	-0.0302
	(0.129)	(0.129)	(0.129)	(0.132)
4.Rank	-0.0625	-0.0618	-0.0615	-0.0347
	(0.142)	(0.143)	(0.142)	(0.135)
6.Rank	-0.178	-0.178	-0.177	-0.161
	(0.143)	(0.144)	(0.143)	(0.145)
Period		-0.00694	-0.00693	-0.00712
		(0.00595)	(0.00595)	(0.00596)
Female			0.0166	-0.0140
			(0.234)	(0.235)
Age				-0.0174
				(0.0132)
Constant	0.928***	1.002***	0.994***	1.469***
	(0.150)	(0.151)	(0.167)	(0.406)
Observations	1,800	1,800	1,800	1,800

Robust standard errors, clustered at subject level, in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table B3: Probit regression with added covariates: Period, subjects' gender and subjects' age.

	Condition *RR*			
VARIABLES	Pr(Allocating to the lower rank in choice set)			
1.Rank	0.00949	0.0106	0.0164	0.00246
	(0.120)	(0.120)	(0.121)	(0.124)
2.Rank	-0.0280	-0.0276	-0.0150	-0.00326
	(0.117)	(0.117)	(0.116)	(0.122)
3.Rank	0.0483	0.0480	0.0589	0.0643
	(0.0967)	(0.0970)	(0.0954)	(0.0976)
4.Rank	0.163	0.164	0.177	0.190
	(0.128)	(0.128)	(0.126)	(0.127)
6.Rank	-0.0372	-0.0378	-0.0210	0.0106
	(0.113)	(0.112)	(0.109)	(0.107)
Period		-0.00568	-0.00582	-0.00607
		(0.00664)	(0.00659)	(0.00684)
Female			0.212	0.0873
			(0.167)	(0.169)
Age				-0.0250***
				(0.00770)
Constant	0.906***	0.966***	0.835***	1.585***
	(0.0997)	(0.116)	(0.149)	(0.296)
Observations	2,400	2,400	2,400	2,400

Robust standard errors, clustered at subject level, in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table B4: Probit regression with added covariates: Period, subjects' gender and subjects' age.

	Condition *NoRRfixed*			
VARIABLES	Pr(Allocating to the lower rank in choice set)			
1.Rank	0.125	0.126	0.142	0.127
	(0.325)	(0.326)	(0.318)	(0.307)
2.Rank	-0	0.00162	-0.00319	-0.00517
	(0.335)	(0.336)	(0.336)	(0.336)
3.Rank	0.390	0.390	0.435	0.414
	(0.275)	(0.275)	(0.273)	(0.282)
4.Rank	0.667**	0.669**	0.687**	0.673**
	(0.312)	(0.312)	(0.308)	(0.311)
6.Rank	0.114	0.114	0.0632	0.0602
	(0.275)	(0.276)	(0.262)	(0.261)
Period		-0.0112	-0.0111	-0.0111
		(0.00697)	(0.00698)	(0.00698)
Female			-0.198	-0.211
			(0.188)	(0.188)
Age				0.00471
				(0.0146)
Constant	0.352*	0.469**	0.588**	0.483
	(0.209)	(0.221)	(0.240)	(0.405)
Observations	1,440	1,440	1,440	1,440

Robust standard errors, clustered at subject level, in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table B5: Probit regression with added covariates: Period, subjects' gender and subjects' age.

	Condition *RRfixed*			
VARIABLES	Pr(Allocating to the lower rank in choice set)			
1.Rank	0.188	0.188	0.195	0.197
	(0.210)	(0.210)	(0.212)	(0.213)
2.Rank	0.519**	0.523**	0.509**	0.498**
	(0.242)	(0.242)	(0.244)	(0.249)
3.Rank	0.137	0.138	0.177	0.177
	(0.263)	(0.263)	(0.268)	(0.269)
4.Rank	0.0472	0.0471	0.0415	0.0406
	(0.254)	(0.255)	(0.254)	(0.254)
6.Rank	0.144	0.146	0.162	0.162
	(0.232)	(0.233)	(0.232)	(0.231)
Period		-0.0132***	-0.0133***	-0.0133***
		(0.00508)	(0.00509)	(0.00508)
Female			0.147	0.140
			(0.147)	(0.145)
Age				0.00326
				(0.0114)
Constant	0.358**	0.498***	0.419**	0.346
	(0.162)	(0.170)	(0.196)	(0.338)
Observations	2,400	2,400	2,400	2,400

Robust standard errors, clustered at subject level, in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table B6: Probit regression with added covariates: Period, subjects' gender and subjects' age.

C Theoretical predictions

C.1 Inequity aversion in *NoRR* and *RR*

We here illustrate the predictions of inequity aversion for the *NoRR* and *RR* frameworks. Assume six players are ranked in terms of their monetary endowments π_i in the same way as they are in our experimental implementation of the games. Assume agents are inequity averse as in Fehr and Schmidt (1999), with a utility function represented by:

$$U_i(\pi) = \pi_i - \frac{\alpha_i}{n-1}\left(\sum_{j\neq i} \max\{\pi_j - \pi_i; 0\}\right) - \frac{\beta_i}{n-1}\left(\sum_{j\neq i} \max\{\pi_i - \pi_j; 0\}\right), \quad (1)$$

where α_i and β_i are preference parameters describing player i's sensitivity to disadvantageous and advantageous inequality respectively, satisfying $0 \leq \beta_i \leq \alpha_i$. Plugging the numbers from Table 2 into equation (1) yields a greater utility from allocations to the person below both for allocations of 4 (*RR*) and of 2 Euros (*NoRR*) for any i occupying any rank excluding the first and last.[27] Hence, according to inequity aversion, in both *RR* and *NoRR* sessions we should observe a greater proportion of subjects allocating the extra money to the person ranked immediately below them.

C.2 Reciprocity and fairness in *NoRR* and *RR*

Reciprocal preferences do not yield a unique behavioural prediction in our settings. According to the theory of reciprocity developed by Falk and Fischbacher (2006), reciprocity is "*a behavioral response to perceived kindness and unkindness, where kindness comprises both distributional fairness as well as fairness intentions*". The theory is formulated for two-player games but can be extended to multi-player games, where the degree of desired reciprocity towards different players (the *reciprocity parameter*) can vary.
In our setting, people are asked to decide who between two other players gets a fixed amount of money (2 or 4 Euros). The decision maker herself does not gain or lose anything from this decision, because the money she allocates is given to her in addition and is not part of her own endowment. People do not get any feedback about how other players in their group decided in previous rounds, and more importantly groups are randomly rematched every period. Each round should hence be treated by the subjects as an independent one-shot game. It is thus not at all clear whether people should be "kind" towards the person above or below themselves when deciding on the allocation of money, as there is no "act of kindness" (whether intentional or unintentional) of other players towards them that they could consider in their decision making process.
One possibility is that people *believe* that others will give *them* the extra money in their own decision and want to reciprocate accordingly. For instance, a person in 4th rank might believe that the person above her will always decide to give the money to her. Consequently, the person in rank 4 will want to reciprocate and in turn decide to give the money to the person ranked higher than her (which would then make that person's decision to pass the money down a best reply, and both persons' beliefs consistent). Clearly, such beliefs about other people's actions could be used to rationalize all kinds of observed behaviour as being best replies to (potentially wrong) beliefs about what other people will do in their decisions. However, note that since subjects do not get feedback about other people's actions until the very end of the experiment, we do not provide any anchors for such beliefs. We therefore have no indication of the direction in which such beliefs will emerge, unless they are consistent with equilibrium behaviour.

[27] The utility consequences of adding weight to the income distribution as with the choices i faces in the *NoRR* and *RR* conditions are independent of i's position in the income distribution, except for the person ranked first and last. The person ranked last is indifferent in both cases and the person in first rank is indifferent in the *NoRR* case and strictly prefers giving to the person in third rank in the *RR* case.

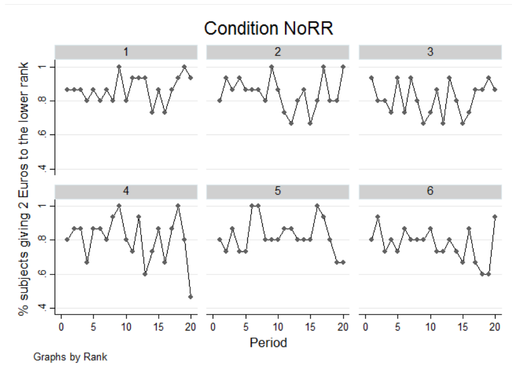
In our setup (given the limited action set of every player, namely to give money to either the person above or the person below oneself in the ranking), the only equilibrium with reciprocal preferences would be a situation where people with even ranks always give money to the person ranked lower than themselves (and expect those people to allocate the money to them) and people with odd ranks always allocate money to the person above themselves (and expect those people to give the money to the lower-ranked person). Then everybody's action would be a best reply to the beliefs about what the others will do, and all beliefs would be consistent. This would imply that the resulting probabilities of allocating money to the lower ranked person would follow a zig-zag path, with very high probabilities for ranks 2, 4 and 6, and very low probabilities for ranks 1, 3 and 5. We don't observe such a pattern in any of the conditions (see Figure 4). A similar argument applies to other theories about reciprocity, such as Bolton and Ockenfels (2000) and Rabin (1993)'s fairness equilibrium.

C.3 Social norms in ***NoRR*** and ***RR***

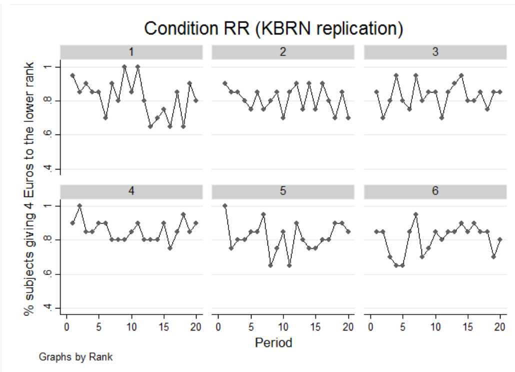
In our setup, most commonly cited social norms (helping the poor, giving to people who need it most, etc.) would predict that people, irrespective of their rank, give to the lower ranked person in all our conditions. Note that we do observe that a majority of people follow this behaviour, however, the probabilities of doing so vary across ranks and conditions. Social norms are not useful for explaining these variations.

D Figures

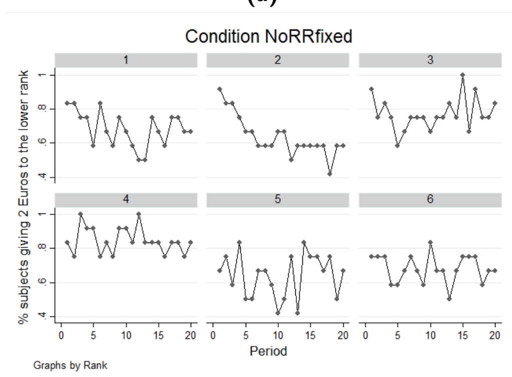
D.1 Downwards allocations by rank over the 20 Periods



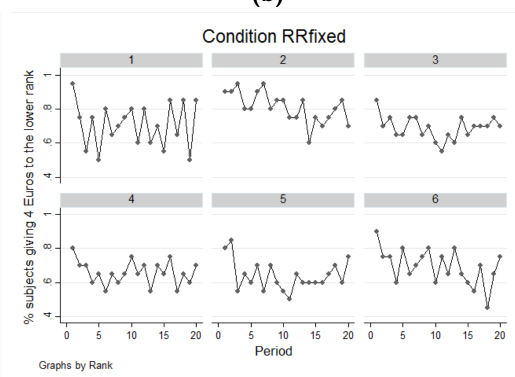
(a)



(b)



(c)



(d)

Figure D1: Average proportion of subjects choosing to allocate to the subject ranked lowest in their choice set in each period, by condition. Ranks 1 and 6 not directly comparable with other ranks.

D.2 Behaviours in Part 2

We here analyse behaviours in the conditional choices in Part 2. We cannot exclude demand effects arising from the subjects being asked to condition on the size of the next in rank's endowment, nor can we exclude spillovers from the first Part. Nonetheless, while refraining from drawing inference based on them, we felt the conditional choices would provide additional evidence for the investigated mechanisms and chose to implement them as incentivised post-experimental data.

Figure D2 displays the proportion of subjects allocating to the lowest ranked person in their choice set for each of her possible endowment sizes: increased or decreased by one unit, or unchanged. Based on the above discussion, we expect subjects in *NoRR* and in *NoRRfixed* to allocate downwards less frequently when the endowment size of the next in rank is increased. In this case, allocating 2 Euros to the next in rank would make this person leapfrog the allocator in the distribution (when the endowment of the next in rank is increased by 1 unit the distance between the two ranks shrinks to 1 Euro). Behaviours in Part 2 are consistent with this hypothesis. Proportions tests reject the null of equality at least at the 5% significance level for ranks two to four in *NoRR* and in *NoRRfixed* when the endowment of the next in rank is increased compared to when it is not. Moreover, we observe the same inverted U-shaped pattern discussed earlier in *NoRRfixed*. In conditions *RR* and *RRfixed* the random change in the next in rank's endowment is inconsequential. The amount subjects allocate is large enough to always cause the subjects to be leapfrogged should they decide to allocate downwards. The picture from the *RR* and *RRfixed* conditions in D2 is in fact much less clear cut. We did not want to increase the size of the variation in the next in rank's endowment as it would have induced rank reversals with consequent effects we could not control for, thus limiting in any case the informativeness of the data.

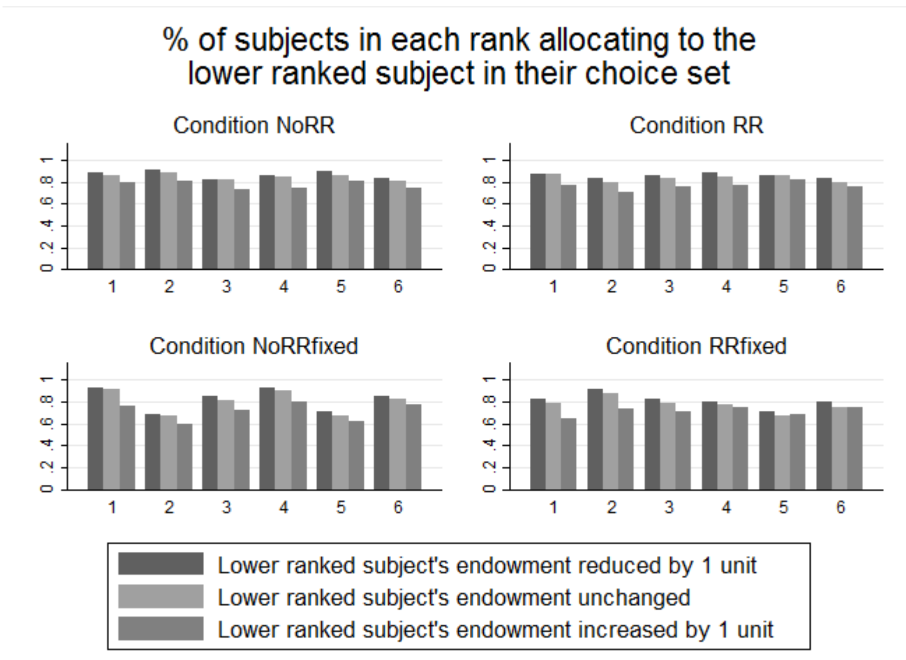


Figure D2: Proportion of subjects allocating to the lowest ranked person in their choice set for each of her possible endowment size.

E Experimental instructions

Instructions

We sincerely welcome you to this experiment. Please read the instructions carefully. They are the same for all participants. Each one of you is asked to make decisions on the computer.

At the end of the study, you will be paid in cash according to your decisions and the decisions of the other participants. In addition, you will receive 6 euros for arriving on time.

Throughout the study, you are prohibited to communicate with other participants. You are prohibited to use a mobile phone or start other programs on the computer. Unfortunately, if you violate these rules, we have to exclude you from the study. You will only receive the show-up fee.

If you have a question before the start of the experiment, please raise your hand. If the study is already in progress, please press the help key. A lab employee will come to your booth and answer your question quietly.

This study has three parts.

This instruction covers the first part. The instructions for the second part will be distributed after the first part has been completed. Those for the third part will be handed out after the second part has been completed.

Your choices in each part of the study do not affect your decisions and payout in the other parts.

All of your choices will be stored with an anonymous identification number. Your choices therefore cannot be traced back to you by anyone under any circumstance.

First Part

In this study you are in a group with 5 other participants. In each Part of this study you will participate in several rounds.

---Reassigned ranks conditions--

At the beginning of each round, the computer will randomly hold a lottery and give you and the other players in your group different amounts of money.

--Fixed ranks conditions--

At the beginning of the first round, the computer will randomly hold a lottery and give you and the other participants one of six different amounts of money. This will be your amount for the rest of the study. Group are formed with participants with different amounts.

During each round, you will be presented with a choice about who in your group should get more money. This additional money is drawn from a separate pool and does not take away from the amount of money you have. The choices you make are private, and will not be shown to anyone playing the game at any time.

Once everyone in your group has made a choice, the computer will randomly select one the choice of one participant in your group and award the additional money as that player decided. At that point, everyone's moneybag will be updated, but you will not be shown the final moneybags from the round.

---Reassigned ranks conditions--

Then, at the end of each round the groups are broken up, new ones for the next round will be randomly formed, a new lottery will be held and the next round will automatically begin.

--Fixed ranks conditions--

Then, at the end of each round the groups are broken up, new ones for the next round will be randomly formed and the next round will automatically begin.

At the end of the session, the computer will automatically select one round from either the First or the Second Part of the Study. Every player will receive their final score from that round. With that in mind, you should play the whole game as if each of your choices is the one determining final payments.

Please raise your hand if you have any questions.

Second Part

In the Second Part the exact amount of money in a certain player's moneybag, replaced by an "X", is unknown. All that is known is that it can be any of the amounts that will be displayed in the box next to it, with equal chance.
In each round, you will be asked to make two choices.

Choice A: is identical to the choices you've made in each round in the First Part.

Choice B: you make the same choice you've made so far but once for every possible amount that the person with the unknown amount might have.

As said before, one round either from the First or the Second Part will be randomly selected to be valid for final payments, and one person in every group in that round. That person's choice, either Choice A or B, will be randomly selected to determine the final scores from the round for everyone in the group. As soon as this player is determined, the person with the unknown amount will also be determined and that person's actual amount will be randomly determined. If Choice B is then selected to be valid, the valid choice is the one corresponding to the actual amount in the unknown moneybag in that period. With that in mind, you should play the whole game as if each of your choices is the one determining final payments.

Notice that you could be the person whose money bag is unknown for someone else. So if the amount in your moneybag differs from the original amount, it is because you were the person with an unknown amount for the person selected.

Please raise your hand if you have any questions.

Third Part

In the Third Part you will make a series of choices among several alternative allocations of Points.
The Points will be converted into Euros at a rate of **1 Point=0.08 Euros**.

You will be randomly paired with another person, whom we will refer to as the **other**. You will not know who the other person is, nor will the other person be informed about your identity.
You will be making a series of decisions about allocating resources between you and this other person. For each of the questions, please indicate the distribution you prefer most by selecting the corresponding button in the middle row. You can only make one choice for each question.
Your decisions will yield money for both yourself and the other person.

Diagram 1: Example of an allocation choice

In the example below, a person chose to the allocation giving 50 Points to herself, and 40 points to the unknown other person.

You receive	30	35	40	45	50	55	60	65	70
	○	○	○	○	●	○	○	○	○
Other receives	80	70	60	50	40	30	20	10	0

In terms of Euros, this yields an allocation of 50+0.08=4 Euros for the person making the choice, and of 40*0.08=3.2 Euros for the unknown other.

There are no right or wrong answers, this is all about personal preferences.
As you can see, your choices influence both the number of Points you receive, as well as the number of Points the other person receives.
After you have made all your choices, the software will randomly assign one person from your group (you or the other) the role of “Receiver” and the other the role of the “Sender”. One of the allocation choices made by the Sender will be **randomly selected by the software**. This allocation will be paid in cash to both the Sender and the Receiver.

If you have any questions, please raise your hand

NB: Please return all materials at the end of the experiment!