NBER WORKING PAPER SERIES

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Working Paper 17234
http://www.nber.org/papers/w17234

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
July 2011

The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research. Ryan Buell acknowledges a doctoral student stipend from Harvard Business School. Taly Reich acknowledges a doctoral student stipend from Stanford Business School.

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NBER Working Paper No. 17234
July 2011
JEL No. C91,D31,D72,H23,I3,J38

ABSTRACT

Why do low-income individuals often oppose redistribution? We hypothesize that an aversion to being in "last place" undercuts support for redistribution, with low-income individuals punishing those slightly below themselves to keep someone "beneath" them. In laboratory experiments, we find support for "last-place aversion" in the contexts of risk aversion and redistributive preferences. Participants choose gambles with the potential to move them out of last place that they reject when randomly placed in other parts of the distribution. Similarly, in money- transfer games, those randomly placed in second-to-last place are the least likely to costlessly give money to the player one rank below. Last-place aversion predicts that those earning just above the minimum wage will be most likely to oppose minimum-wage increases as they would no longer have a lower-wage group beneath them, a prediction we confirm using survey data.

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1 Introduction

Individuals in low-income groups often seem to vote against their economic interests, even as their shared circumstances would suggest that they would unite to demand greater redistribution. Americans have expressed widespread support for repealing the estate tax and for tax reforms that largely benefit those in the highest brackets (Bartels, 2008). Whereas the median-voter theorem (Meltzer and Richard, 1981) predicts that the demand for redistribution grows with income inequality, the large increases in inequality over the past thirty years have not led to greater support for redistribution in the US (Kelly and Enns, 2010), the UK (Georgiadis and Manning, 2011), or other OECD countries that have experienced rising inequality (Kenworthy and McCall, 2008).[1]

Scholars have offered many explanations for the seeming inability of lower-income groups to unite in support of redistributive policies.[2] The Marxist notion of "false consciousness" holds that the capitalist class promotes ideological concepts that blind the proletariat to their common interests (Engels, 1893). Similarly, Therston Veblen argued that members of the working class tend to admire the "leisure class" and even mimic its habits—such as conspicuous consumption—instead of identifying with members of their own class (Veblen, 1899). Especially in the American context, scholars often argue that racial, ethnic or cultural divisions (Woodward 1955; Alesina *et al.* 2001; Frank 2004) as well as a belief in income mobility (Bénabou and Ok, 2001) limit support for redistribution.

This paper offers another explanation, which to our knowledge has not been formally explored in past research. We hypothesize that there is a basic aversion to feeling that one is in "last place," which increases competition and inhibits political unity among members of lower-income groups. Instead of uniting in pursuit of general redistribution, working-class groups may wish to punish those who are slightly below or above themselves, with the hope of having at least one group to "look down on." As the probability of falling to the bottom of the income distribution decreases with income, anxiety about relative position would be less of a concern for middle- and upper-class individuals.

Our work relates to the large literature, pioneered by Duesenberry (1949), suggesting that utility

[1] See Picketty and Saez (2003) on the increase in income inequality in the US over the past several decades.

[2] When we refer to "redistributive policies" we mean policies explicitly designed to address economic inequality. Of course, many policies redistribute resources from one group to another, and the recipients are often not the least well off.

is related not only to absolute consumption or wealth but also to an individual's relative position in a given set of peers. Last-place aversion predicts that concerns about rank are most acute at the bottom of the distribution, and thus that utility may be convex with respect to *relative position*.[3] While we focus on the implications of last-place aversion and not its potential origins, it is consistent with the large social psychology literature on the power of shame and embarrassment as social emotions: there is likely little shame in finishing near the middle, so the effect of rank on shame should quickly diminish once someone moves from the bottom of the distribution.[4]

We explore whether an aversion to being in last place can help predict economic phenomena such as individuals' preferences over risky versus risk-free payoffs and their preferences regarding tax and transfer policies. We begin by defining a simple utility function that incorporates last-place aversion (LPA) and then develop laboratory experiments to test its predictions for both risk aversion and redistributive preferences. In the first experiment, subjects are randomly given distinct dollar amounts and then shown the resulting "income" distribution. Each player is then given the choice between receiving a payment with probability one and playing a two-outcome lottery of equivalent expected value, where the "winning" outcome of the lottery will typically offer the player the possibility of moving up in rank. We find that the probability of choosing the lottery is uniform across the distribution except for the two lowest-placed players, who choose the lottery more often. These results match the Nash equilbrium of the game when players are last-place averse: the last-place player is willing to bear the risk of the lottery for the possibility of moving up in rank, and the second-to-last-player is willing to do the same in order to defend his position.

In the second set of experiments, players play two money-transfer games. In both games, individuals are randomly assigned a unique dollar amount, with each player separated by a single dollar, and then shown the resulting distribution. The first game mimics a typical redistributive

[3]To the extent non-linearities in the effect of relative position on utility have been explored in existing research, they have generally been modeled as allowing the effect of the *absolute* index to vary with relative position, as in (Clark and Oswald, 1998). For example, Card *et al.* (2010) find that the difference between own pay and median pay in a sample of University of California employees has a larger effect for those below the median than those above. In contrast, Luttmer (2005) finds that the effect of neighbors' income is the same for individuals who are above and below the median income in their MSA. Our model of utility in Section 2 focuses directly on rank and not deviations in the absolute index from a given reference point. Zhou and Soman (2003) offer evidence consistent with concave effects of relative position in a setting where rank is salient, demonstrating the the probability of an individual leaving a queue depends more on the number of people behind than the number of people ahead of him, potentially suggesting that individuals are more sensitive to being close to last place than close to first, though other interpretations are possible.

[4]See Goffman (1967) for an early treatment on the function of shame, who writes that "the emotion of embarrassment or anticipation of embarrassment plays a prominent role in every social encounter."

scheme where individuals are asked to contribute income to those at the bottom of the distribution. Specifically, we give players the choice between receiving an additional dollar themselves, or having an additional two dollars added to the last-place player's balance. As LPA predicts, the second-to-last place person is the least likely to forgo the dollar.

Players in the second game are again randomly assigned a place in an income distribution where ranks are separated by a dollar. They are then given an additional \$2, which they must give to either the person directly above or below them. Giving to the person below means that the individual herself will fall in rank. We find that the second-to-last-place person is the most likely to give the extra two dollars to the person above her instead of the person below her, consistent with LPA's prediction that concern about relative status will be greatest for individuals who are at risk of falling into last place. In both games, we can show that merely being in the bottom half of the distribution does not explain the results—players must actually be close to last place—and can generally reject inequality aversion as an alternative hypothesis.

While the experiments allow us to test for LPA in a controlled setting, they cannot directly speak to how individuals' preferences over actual redistributive policies vary as a function of their place in the income distribution. We thus formulate tests of LPA using survey data on support for minimum wage increases. The minimum wage, by definition, defines the "last-place" wage that can be legally paid in most labor markets. As such, LPA would predict limited support for increasing the minimum wage among those with wages just above the current minimum—while their wage would likely increase to the new minimum, they might now have the "last-place" wage. We find exactly this pattern using data we collect from our own online survey and find similar results using surveys on the minimum wage published by the Pew Research Center.

The evidence from the money-transfer games as well as the minimum wage surveys highlights why it might be surprisingly difficult to create a coalition in support of redistribution. Groups close to the bottom of the distribution may only support policies that are rank-preserving, but such policies may generate little enthusiasm among the lowest group. The minimum-wage results suggest that even in cases where ranks are not reversed but merely condensed, redistribution may find little support among those who could previously think of themselves as distinctly above last place.

Our results may also shed light on why certain risk-taking behaviors seem concentrated among lower socio-economic groups. Consistent with LPA, recent work has found that low-income individuals are more likely to play lotteries in laboratory settings when they are primed to think about their poverty (Haisley *et al.*, 2008). Alternatively, poverty could lead to risk-taking behaviors such as crime or early initiation of sexual activity because those who would be in "last place" by conventional standards such as income begin to seek status based on alternative norms, as in the model of Oxoby (2004).

The remainder of the paper is organized as follows. Section 2 presents a simple utility function that allows for last-place aversion. Sections 3 and 4 describe, respectively, the lottery experiment and the money-transfer experiments, and derive and test predictions from the model in Section 2. Section 5 presents the results from survey data on minimum wage increases. Section 6 discusses the potential implications of last-place aversion for behaviors beyond those we study in this paper and offers concluding thoughts.

2 A simple model of last-place aversion

In this section, we define a utility function that incorporates last-place aversion. The purpose of this section is merely to describe the properties of this function, and not to explain *why* individuals might be last-place averse. It might be an innate human trait, or it might be a conditioned response to seeing that individuals in last place are treated poorly, or it might have an alternative origin. We take LPA as given and incorporate it into a simple utility function, which we will later use to generate predictions regarding how individuals will behave in different settings.

2.1 Individual utility under last-place aversion

Consider a finite number of individuals with income levels $y_1, y_2, ..., y_N$, and let y_L be the income of the lowest-income person. Let the utility of person i be defined by:

$$u(y_i) = (1-\alpha)f(y_i) + \alpha\mathbb{1}(y_i > y_L), \tag{1}$$

where $f' > 0$, $f'' < 0$, $\alpha \in [0,1]$ and $\mathbb{1}(y_i > y_L)$ is an indicator function that takes the value of one if an individual is not in last place and zero if she is in last place. Essentially, utility is a weighted average of a typical concave utility function and a bonus payment to all but the last-place individual. As $\alpha \to 0$, the function approaches a standard, non-reference-dependent utility function, and as $\alpha \to 1$, the only factor that determines utility is whether one is in or out of last place. For convenience, we will sometimes call the first term the "standard term" of the utility function and the second term the "LPA term" of the utility function.

Now, consider a small δ-perturbation in income for individuals i. If $y_i >> y_L$ or $y_i = y_L << y_{L+1}$, where y_{L+1} is the income of the second-to-last person, then the change in utility is merely $(1-\alpha)f'(y_i)\delta$. As such, LPA will typically not affect the decisions of an individual with income far above that of the last-place person or a last-place person so far behind the next person that he can never catch up.

In contrast, if $y_i - y_L < \delta$, then a loss of δ income—which would put individual i in last place—yields a utility loss of $(1-\alpha)f'(y_i)\delta + \alpha$. Similarly, if $y_i = y_L > y_{L+1} - \delta$, then a gain of δ, which would move i from last place, yields a utility gain of $(1-\alpha)f'(y_i)\delta + \alpha$. Therefore, as an individual approaches the last-place person from above or as the last-place person approaches the second-to-last-place person from below the change in the LPA term of the utility expression grows relative to that of the standard term.

The analysis above suggests that for individuals in or close to last place, standard results may no longer hold. For example, the last-place person should have a heightened tendency to accept gambles that provide a possibility of rank improvement, whereas absolute risk-aversion is generally believed to decrease with wealth (Arrow, 1971). Similarly, warm-glow models (Andreoni, 1990, Andreoni, 1989) predict that most people would choose to costlessly give money to a poorer individual, but LPA would diminish this tendency for individuals who are themselves close to last place.

2.2 Discussion

In equation (1), there is an increase in utility associated with moving out of last place, and then no further effect of relative position. An alternative utility function that captures the spirit of last-place aversion could incorporate a more continuous function of relative position:

$$u(y_i, r_i) = f(y_i) + g(r_i), \tag{2}$$

where r_i is individual i's relative position. Preferences similar to last-place aversion would be reflected in the shape of g—past work suggests that utility is increasing in relative position ($g' > 0$) but last-place aversion would suggest that $g(\cdot)$ is also *concave* and that its gradient is very large for small values of r (i.e., for individuals close to the bottom of the distribution) but then quickly flattens out.

Such a $g(\cdot)$ function would be difficult to distinguish empirically from last-place aversion, especially in settings without a large number of distinct ranks. In general, our empirical work will not focus on distinguishing last-place aversion from more general "low-rank" aversion that could be generated by certain $g(\cdot)$ functions, but will seek to show that last-place or low-rank aversion can be separately identified from a range of alternative hypotheses such as reference-dependent models where the median acts as a reference point and inequality-aversion models.

3 Experimental evidence of last-place aversion: making risky choices

Although preferences over redistribution motivate the paper, the model in Section 2 also has direct implications for individuals' willingness to bear risk. These predictions provide a useful opportunity to test the model in a context outside of the one we originally sought to explain while offering support for the impact of last-place aversion on a wider set of behaviors. In this section, we conduct an experiment that tests whether individuals choose to bear risk in return for the possibility of moving out of last place that they choose to forgo when placed in other parts of the distribution.

Our guiding principle in this and the later experiments is to create an environment that biases us against finding LPA, so that any evidence we find in support of the model would not be an artifact of a particular aspect of our experimental design. First, as shame or embarrassment may motivate individuals' desire to avoid last place, we take several steps to promote players' privacy during the game. Players never interact face-to-face, but instead through computers, and they generate their own screen names and are thus free to protect their identity. Each individual sits in a separate carrel, with large blinders placed around each carrel, which should further enhance privacy and anonymity. Players are not publicly paid at the end of the game and instead money is given to them while they are still sitting in their carrels.

Second, all of the experiments involve an initial assignment to a rank, and we make clear to participants that this assignment is done randomly by a computer. We believe the emphasis on random assignment should diminish LPA by discouraging players from associating rank and merit.

3.1 Data and experimental design

Participants ($N = 72$) sign up by registering online at the Harvard Business School Computer Lab for Experimental Research (CLER). See Appendix Table 1 for demographic summary statistics as well as more detailed information on eligibility requirements for registration and payment of participants.

We randomly divide participants into twelve groups of six in order to play a multi-round game. At the beginning of the game, the computer randomly assigns each player in the group a rank, and endows them with an amount of money that corresponds to that rank. The monetary endowment decreases by 25 cents for each lower rank, such that the player in first place receives \$3.00, the player in second place receives \$2.75 and the player in sixth place receives \$1.75. Ranks and actual dollar amounts of all players are common knowledge and clearly displayed throughout the game.

Next, participants play a series of rounds. At the start of each round, the computer presents an identical two-option choice set to all players in the game. The first option adds a stated amount of money to a player's balance with probability one. The second option offers participants the opportunity to play a two-outcome lottery, whereby they gain a stated amount with probability $3/4$ and lose a stated amount with probability $1/4$. After players have submitted their choices, the computer makes independent draws from the common $P(win) = 3/4$ probability distribution for each player who chose the lottery and adds the risk-free amount to the balance of each player who did not choose the lottery. The new balances and ranks are displayed and the game repeats. We include the instructions as well as a typical screen-shot of the game in Appendix A.

Each round, the payoffs associated with the two options are calculated in a particular manner. The payment players can receive with probability one is always equal to half the difference between the current balance of the last-place player and the second-to-last-place player. The "winning" payment of the lottery is always equal to the difference between the current balances of the last-place and the fourth-place player. The "losing" outcome of the lottery is set so that the lottery and the certain payment offered in the first option are equal in expected value.[5]

[5] Let $\delta_6, \delta_5, \delta_4$ be the current balances of the sixth- (last-) place player, the fifth-place player, and the fourth-place

The payoffs are designed so that last-place players always have the opportunity to accept a gamble that offers the possibility of moving out of last place, holding all other players' balances constant, and, usually, even if the second-to-last-place player took the certain amount.[6] In contrast, taking the certain amount never allows the last-place player to improve his rank, holding other player balances constant, and in fact only allows a rank improvement if the second-to-last player chooses the lottery and loses.

As an example, consider a round in which players begin with the following balances: \$6, \$6.50, \$7, \$7.50, \$8, \$8.50. They would then all receive the following instructions:

In this round, which would you prefer?

(i) *Win \$.25 with 100 percent probability.*

(ii) *Win \$1.00 with 75 percent probability and lose \$2.00 with 25 percent probability.*

As described above, the two options have identical expected values ($0.75 * 1 - 0.25 * 2 = 0.25$). Similarly, the certain payment is half the difference between the two lowest-ranked players' balances ($0.5 * (6.50 - 6) = 0.25$) and the winning amount of the lottery is the difference between the fourth-ranked and last-place player ($7 - 6 = 1$).

Each game consists of nine rounds, but participants are not told how many rounds the game entails to avoid end effects.[7] Participants are told that one randomly selected player will be paid his balance from one randomly selected round. Note that while every game begins with the initial winning prize of the gamble set at \$.50, in all subsequent rounds the prize depends on the outcomes of past rounds and tends to grow over time as the differences between ranks grow in terms of absolute dollars. The average winning prize in the final (ninth) round is \$6.00.[8]

player, respectively. We define the payment individuals can receive with probability one as $\theta_{certain} = \frac{\delta_5 - \delta_6}{2}$ and the payment individuals receive if they win the lottery as $\theta_{win} = \delta_4 - \delta_6$. Thus θ_{lose} is determined by setting the expected value of the lottery equal to the certain payment: $\frac{3}{4}\theta_{win} - \frac{1}{4}\theta_{lose} = \theta_{certain}$. Note that $\theta_{certain}$ need not be a whole number and in such cases we round up to the nearest penny.

[6] If x equals the balance the sixth-place player will have in the next round conditional on winning the gamble, and y the balance of the fifth-place player if he takes the certain amount, then $x > y \Leftrightarrow \delta_4 > \delta_5 + \frac{\delta_5 - \delta_6}{2} \Leftrightarrow 2\delta_4 > 3\delta_5 - \delta_6 \Leftrightarrow 2(\delta_4 - \delta_5) > \delta_5 - \delta_6$. This condition holds in over 58 percent of the rounds.

[7] In many experimental settings, subjects play differently when they know they are playing the final round of the game. See Rapoport and Dale (1966) for an early treatment of so-called "end effects."

[8] The fact that the average prize in the final round rounds to a a whole dollar is merely a coincidence: after the first or second round, the algorithm for determining the θs based on the balances of the sixth-, fifth- and fourth-place players rarely produces round dollar amounts or even amounts that are multiples of five or ten cents. As a consequence, the math involved in any optimization becomes more difficult as the game progresses.

The game generates considerable shuffling between ranks. For example, the median player experiences four distinct ranks throughout a game and the average round results in 57 percent of players having a different rank than they did the previous round.

3.2 Predictions

Below, we discuss how the model in Section 2 predicts players of different ranks will decide whether to choose the lottery over the certain payment. To demonstrate the basic intuition, we will assume in this section that players make their decision either holding other players' balances constant or believing that other players are playing a fixed strategy. In Appendix B, we generate the same predictions by solving for the Nash equilibrium of the game.

3.2.1 Last-place player

Consider the decision of the last-place player with balance $y = y_L$ and utility function as described in Section 2. Holding other players' balances constant, he chooses to gamble whenever:

$$(1-\alpha)(\tfrac{1}{4}f(y-\theta_{lose}) + \tfrac{3}{4}f(y+\theta_{win})) + \tfrac{3}{4}\alpha > (1-\alpha)f(y+\theta_{certain}),$$

or

$$\frac{3\alpha}{4(1-\alpha)} > f(y+\theta_{certain}) - (\tfrac{1}{4}f(y-\theta_{lose}) + \tfrac{3}{4}f(y+\theta_{win})). \tag{3}$$

As $\alpha \to 1$, and thus LPA increases, his propensity to gamble grows. As the θs are set such that two decisions have equal expected value, the right-hand side of equation (3) is merely the utility of a certain quantity minus the expected utility of a lottery with equal expected value and is thus always positive so long as individuals are risk averse. Therefore, as risk-aversion falls the right-hand-side goes to zero and the propensity to gamble also increases.

3.2.2 Second-to-last-place player

The second-to-last-place player should never gamble if he assumes that the last-place player never gambles—he gains nothing from the LPA term of the utility expression and any amount of risk-aversion should lead him to reject the gamble based on the standard term of the utility expression.

Now, suppose the second-to-last-place player assumes the last-place player always gambles. Then, he will choose to gamble whenever:

$$\tfrac{3}{4}((1-\alpha)f(y+\theta_{win})+\alpha)+\tfrac{1}{4}(\tfrac{3}{4}(1-\alpha)f(y-\theta_{lose})+\tfrac{3}{4}((1-\alpha)(f(y-\theta_{lose})+\alpha) > (1-\alpha)f(y+\theta_{certain})+\tfrac{1}{4}\alpha$$

or, after some algebra,

$$\frac{9\alpha}{16(1-\alpha)} > f(y+\theta_{certain}) - (\tfrac{3}{4}f(y-\theta_{lose}) + \tfrac{1}{4}f(y+\theta_{win})). \quad (4)$$

Therefore, again, for α sufficiently close to one, the second-to-last player will always take the gamble under the specified assumptions. Whether, for the same α, he will more often gamble than the last-place player depends on how quickly absolute risk aversion diminishes—while the left-hand side of equation (3) is always greater than that of equation (4), the right-hand side of equation (4) is smaller than that of equation (3) so long as absolute risk aversion diminishes with income.

3.2.3 Other players

By construction θ_{win} allows the last-place player to attain the current earnings of the fourth-place player, so choosing the certain option of $\theta_{certain}$ will always allow the fourth-place player to remain at least higher than the current last-place player. Thus, there is no reason for her to bear the risk of the gamble and she will take the certain option. By the same logic, so will everyone above her.

3.2.4 Summary of predictions

The last-place player will gamble given sufficiently high values of α, the weight on the last-place-aversion term of the utility expression. Similarly, for sufficiently large α as well as a belief that the last-place player will gamble, the second-to-last-place player will also gamble. In Appendix B, we show that these two players will each play a mixed strategy between choosing the lottery and the certain payment, whereas all other players will choose the certain payment.

Of course, participants may have considerations beyond their actual payoffs when deciding between the lottery and the certain payment. For example, they may choose the lottery merely because adding an element of chance makes the game less boring. Alternatively, players may care about rank beyond merely avoiding last place, and choose to gamble in the middle of higher parts of the distribution in order to catch the person above them. As such, some higher-ranked players will likely choose the lottery as well, but LPA predicts that the last- and second-to-last-place players should do so at measurably higher rates.

3.3 Results

3.3.1 Basic graphs

Figure 1 shows the share of individuals who choose to gamble, by their rank at the time they make the decision. The first series includes all rounds of play. The highest-ranked four players choose the lottery option at very similar rates—just over 40 percent of the time. The last two players, however, gamble at a higher rate—the fifth-place player chooses the lottery just over sixty percent of the time and the last-place player just under sixty percent.

The second series excludes observations from the first two rounds, as players may need time to understand how the game works even after hearing the instructions. Given past work showing preferences are more stable as subjects gain experience, we will often show results with the first two rounds excluded in addition to results with all rounds included.[9] The patterns are all very similar, though in general players seem to gamble at slightly higher rates in the first few rounds. The higher gambling rates may reflect the fact that the absolute value of the stakes tend to rise as the game unfolds, though they may also reflect players simply "trying out their luck" in the beginning of a game.

Figure 1 also plots p-values from comparing the decisions made at each rank to those made by the last- and second-to-last place player. These results are based on OLS regressions with standard errors clustered by player.[10] All but one are significant at the ten-percent level (the exception is $rank = 4$ when the first two rounds are excluded, with $p = 0.157$). Overall, these results are consistent with our predictions that the two lowest-ranked players will bear the cost of additional risk in an attempt to escape or avoid last place.

[9] See Carlsson (2010) for a discussion and review of literature on why preferences may be more stable as subjects gain experience, and Slonim and Roth (1998) for an example of learning throughout the rounds of the ultimatum game.

[10] Specifically, the regression equation is $chose\,lottery_i = \sum_{k=1}^{4} \beta^k rank_i^k + \epsilon_i$, where $rank_i^k$ is an indicator variable for player i having rank k. The omitted group is players in last or second-to-last place (ranks 5 and 6).

Regression results

Table 1 displays results from probit regression analysis. Col. (1) shows that the basic result from Figure 1 holds when round fixed effects are included. Players in fifth or last-place gamble at a significantly higher rate than more highly ranked players, and this effect remains after excluding the first two rounds (col. 2).

Col. (3) includes only the first round. While there may indeed be more noise in the first round, one reason to focus on it is that it is the only round where ranks are determined purely via random assignment and are not in part the consequence of past play. Including only the first round increases the coefficient on the variable of interest.

Col. (4) includes all rounds, but adds controls for players' current balance, as well as the "winning payment" of the lottery and the "certain payment" they can instead receive with probability one.[11] Including these controls increases the magnitude of the coefficient of interest slightly, relative to that in col. (1).

A potential confound in the game is that the winning amount of the lottery is equal to the difference between the fourth-place and last-place players' balances and thus is not set based on higher-ranked players' ability to move up in rank. We can test whether this confound is driving the heightened tendencies of the lowest-ranked players to gamble by focusing only on the first round, where the balance differences between players are all equal and thus the lottery provides all players outside of first place the same opportunity to move up in rank. As seen in col. (3), the coefficient of interest is actually larger in this sample.

We nonetheless further probe this potential confound in col. (5) by explicitly controlling for whether a player could "catch" the next player: that is, for whether the winning amount is greater than the gap between him and the player above him. As this variable is only defined for those with a player above them, we exclude the first-place player. Comparing cols. (4) and (5) shows that the coefficient of interest is unchanged—in fact, the slight decrease in col. (5) is entirely due to the different sample (running the col. 4 specification on the col. 5 sample yields a coefficient of 0.419). As this control does not affect the variable of interest and requires us to drop the first-place player,

[11] Note that current balances vary at the individual level, while the latter two variables vary at the round-game level. As such, all variables can be identified even though the regressions always include round fixed effects.

we exclude it from the rest of the regressions.[12]

In col. (6) we explore whether the effect on the last-place and fifth-place players predicted by the LPA model can be separated from a more general effect of being below the median. We will return to this question throughout the paper, as we seek to separate LPA from models where individuals merely want to be in the top half of the distribution. While adding an indicator variable for being below the median in the six-person distribution (i.e., in fourth, fifth or last place) reduces the coefficient of interest slightly from its level in col. (5), it remains positive and highly significant.

In col. (7) we test whether the effects that we interpret as LPA can instead be explained by inequality aversion. Following Fehr and Schmidt (1999), we assume that for player i "disadvantageous" inequality is proportional to $\sum_{j \neq i} \max\{x_j - x_i, 0\}$ and "advantageous" inequality is proportional to $\sum_{j \neq i} \max\{x_i - x_j, 0\}$, and that the two types of inequality can have different effects on individual utility. We then calculate the expected value of the two terms under two scenarios: (1) player i plays the lottery and all other players take the safe option; (2) player i takes the safe option, as do all other players. For each player, we calculate the difference in disadvantageous (advantageous) inequality under these two scenarios, and use this difference as a proxy for the net effect of his decision on disadvantageous (advantageous) inequality.

The results in col. (7) suggest that these controls have no effect on the propensity of the last two players to play the lottery. While neither of the coefficients is significant, we note that the estimated effect of disadvantageous inequality is not of the expected sign—when playing the lottery would seem to increase disadvantageous inequality, players are slightly more likely to choose the lottery regardless.[13]

In col. (8) we evaluate LPA versus a more general model where rank has a continuous effect on utility, as described in equation (2). While the two effects are jointly significant ($p = 0.002$), neither is individually significant at conventional levels, though the "last or fifth place" dummy is

[12] Readers may wonder why we designed the game in such a way that this confound would exist. The alternative would be setting the lottery payoffs differently for each rank. However, doing so then introduces its own confound, that any differences across rank in the probability of choosing the lottery could be driven by the fact that the lotteries themselves are in fact different across ranks.

[13] We experimented with many other specifications to explore the potential effects of inequality aversion, all of which are available upon request. We calculated the differences in the inequality-aversion terms assuming that: (1) player i plays the lottery while all $j \neq i$ have their balance held constant, which might be an approximation that players use; (2) that player i *wins* the lottery while all $j \neq i$ takes the certain payment; (3) that i wins while all j's are held constant. We also simply included the *level* of each player's advantageous and disadvantageous inequality at the start of each round. In none of these specifications does the coefficient on the effect of being in the lowest two ranks drop below 0.43.

far closer ($p = 0.193$ versus $p = 0.384$). With only six ranks, it is difficult to precisely estimate the effect of both a linear rank term and an indicator variable for being in the bottom two ranks. Moreover, as we show in Appendix Table 2, when only the first round—which is based on pure random assignment— is included, the effect of being in the bottom two ranks is highly significant even when linear rank is included.

Appendix Table 2 shows that the coefficients of interest in the key Table 1 specifications increase when demographic controls are added, relative to specifications estimated on the same sample but without demographic controls. The only demographic variable that is itself significant is political orientation, with more liberal participants less likely to choose the lottery. The table also shows that the results are robust to including individual fixed effects in a conditional logit estimation. We do not emphasize these results because the specification uses no between-participant variation, and it is the between-participant variation that is at least initially driven by pure random assignment. The final three columns show that when only the first round is included, LPA can be separately distinguished from not only a linear-rank effect, as noted in the previous paragraph, but also a below-the-median effect and inequality aversion.

We also investigated whether the coefficient of interest was larger among certain subgroups, though we do not report the results. We found no statistically significant patterns, though insufficient power is likely a hindrance. The interaction term that comes closest to statistical significance ($p = 0.117$) suggests that being religious may mitigate the tendency of low-ranked players to choose the lottery.

3.4 A note on the dynamic design of the game

We chose to design the experiment as a dynamic game, where the outcomes in all rounds except the first are determined in part by the decisions individuals made in the previous round, as opposed to re-randomizing balances each round. This design better mimics the dynamics of the income distribution, where individuals may be able to improve their position slightly from year to year on the basis of sound decisions or luck. Re-randomization, in contrast, would imply that a millionaire and a minimum-wage worker would have the same expected income the following year.

There are two drawbacks to this decision. First, variation in rank is in part endogenous. While not ideal, this endogeneity does not appear to matter greatly in practice. As shown in col. (3), the last-place effect is actually larger in the first round, when rank is purely a function of random assignment, suggesting our results are not being driven by this endogeneity. It likely has limited effect because half the players choose the lottery each round, creating a large random component to players' balances and ranks even after the first round.

The second drawback is that the dynamic setting makes it more difficult to draw sharp predictions from the model. Given that players are paid based on one randomly chosen round and that they do not know when the game will end, they should weigh both the immediate effect of their decision on the subsequent round as well as the effect on later rounds. They likely weigh the immediate effects more heavily as they know the current distribution with certainty and can only guess at the distribution in later rounds. Moreover, past work has shown that players tend to maximize current payoffs even in multi-round games where the payoff is explicitly based on the final balance.[14] We thus, as readers may have noted, derive our predictions in Section 3.2 and Appendix B assuming that players play each round as if it is the one that "counts," though obviously that is a simplifying approximation.

3.5 Discussion

The evidence from this experiment provides support for the predictions of the last-place-aversion model. The last-place player chooses to bear additional risk for the opportunity to move up in rank, and the second-to-last-place player chooses to bear risk in order to defend his current position. We also find no evidence that the results can better be explained by players' desire to be in the top half of the distribution. Players in first through fourth place exhibit almost identical tendencies to choose the lottery over the risk-free payment. As such, a prospect-theory model where the reference point is the middle of the distribution—so that individuals below the reference are risk-loving and those above risk-averse—would not appear to explain the results.

The results in this section contrast with the standard result that absolute risk-aversion diminishes with wealth, and with experimental findings that individuals exhibit diminishing absolute risk

[14]Benartzi and Thaler (1995) argue that due to myopia and mental accounting, individuals maximize current payoffs even in settings where the salient outcome is the final future payoff. Gneezy and Potters (1997) show that individuals tend to maximize over an "evaluation period." Since we inform all players of the new balances each round, each round is an evaluation period in our experiment and thus players would play each game as if it is one-shot. Camerer *et al.* (1993) use software that allows them to record the information players are viewing as they play a game. They conclude that even in a sequential game that is relatively simple to solve via backward induction, "subjects concentrated on the current round when making decisions."

aversion with respect to laboratory earnings.[15] In our experiment, the two players with the lowest earnings play the lottery most often. Our results thus suggest that the relationship between wealth and risk-aversion may depend on whether individuals view wealth in an absolute or relative sense.

4 Experimental evidence of last-place aversion: preferences over redistribution

In this section, we return to our original motivation, determining how relative position affects individuals' preference for redistributive policies. We present two experiments that explore how support for redistribution toward either the last-place player, or toward lower-placed players more generally, vary by rank. The first experiment better mimics common redistributive policies—where general revenue is raised from the entire population and then directed to the least well-off—but is a less demanding test of the last-place aversion model. The second experiment provides a more demanding test of last-place aversion but does not have an obvious policy parallel.

4.1 First money-transfer game: redistribution toward the last-place player

4.1.1 Experimental design

As in the lottery game, the game begins with players ($N = 24$, divided into four six-player games) being randomly assigned dollar amounts, in this case \$1, \$2,...,\$6. As before, the ranks and current balances of all players are common knowledge throughout the game.

Each player is then given a choice between receiving an extra dollar for herself, or having the last-place player receive an extra two dollars. In both cases, the money comes from a separate account and not from the player or any other player. Given that this choice is not well-defined for the last-place player himself, we give him the choice between keeping the dollar and giving money to the second-to-last-place player. As only his choice does not involve giving to a less-well-off player, we generally do not focus on his decision. The instructions and a typical screen-shot from the game appear in Appendix C.

After players make their decisions, one player is randomly chosen and his choice determines the final payoffs of that round. As such, players should make their decisions as if they alone will determine the final distribution of the round. Players do not know which player is chosen each

[15] See, for example, Levy (1994) for evidence of diminishing absolute risk aversion in laboratory settings.

round or the outcome of the round. After the end of each round, players are re-randomized across the same \$1, \$2,...,\$6 distribution and the game repeats. Players are not told how many rounds there will be, but in practice each game consisted of nine rounds, where the first is a practice round. They are paid their final balances for one randomly chosen round.

4.1.2 Changes from the lottery experiment

We decided to make several changes based on experience from the lottery experiment. First, in this and the later redistribution experiments, we re-randomize balances after each round, making the experiment a series of one-shot games as opposed to the dynamic design of the lottery experiment. While, as noted earlier, re-randomization poorly captures the dynamics of the income distribution, it allows us to draw predictions without having to make assumptions regarding players' time horizons.

Second, instead of implementing all players' decisions simultaneously, after each round one player is randomly chosen to have his decision implemented, so a player need not take into account other players' decisions when making his own decision. We made this design choice largely to follow existing literature, where risk-taking in group settings is often investigated using game shows and other competitions, where strategic concerns are salient, but preferences over redistribution are often elicited using Dictator games, where players need not consider the actions of others.[16]

4.1.3 Predictions

Standard utility maximization would predict that all players keep the additional dollar themselves. Models in which players try to maximize total surplus would predict all players forgo the \$1 in order to create two dollars for the last-place player. Reference-dependent models might predict that players' behavior changes once they have reached a certain reference point, such as the median of the distribution. Inequality aversion as parameterized in the Fehr-Schmidt model predicts that the probability of keeping the additional dollar is decreasing in rank.[17]

[16] See Gertner (1993) and Metrick (1995) for two early papers using game shows to investigate risk-aversion. See Camerer (2003) for a review of past work using the Dictator game to elicit redistributive preferences. Of course, we cannot know for sure whether players still think about what other players are likely to do when they make their own decisions, even though we emphasize in the instructions that if they are chosen only their decision is implemented.

[17] Recall that the Fehr-Schmidt model assumes that individuals are especially sensitive to "disadvantageous inequality," which is proportional to $\sum_{j \neq i} \max\{x_j - x_i, 0\}$. For the first-place player, keeping the dollar has no effect on this sum; for the second place player, keeping it decreases the sum by one; for the third-place player, by two, and so on. Forgoing the additional dollar increases the sum by one for the second-to-last-place player (the last-place player now has \$1 than he does) and by two for the last-place player (the second-to-last-place player now has \$3 more than

Last-place aversion predicts that the second-to-last-place player will be the least likely to forgo the $1, as doing so would result in his moving to last place. The empirical work that follows attempts to separate LPA from the models described above.

4.1.4 Results

Figure 2 plots the probability a participant forgoes the extra $1, by the participant's rank. As before, we show results for all rounds as well as results when the first two rounds are removed, as players may need a few rounds to understand the game. The p-values—based on an OLS regression with the second-to-last player the omitted category—are also plotted. For completeness, we include the sixth-place player in this figure, even though her choice is not parallel to that of all other ranks.

The shape of Figure 2 is broadly consistent with the predictions of LPA. The top half of the distribution is most likely to sacrifice for the benefit of the last-place player—roughly forty percent of the time, players in these positions forgo the extra dollar for themselves so that the last-place player can receive an additional $2. This tendency falls slightly for the fourth-place player and is lowest for the second-to-last-place player, who forgoes the extra dollar only ten percent of the time. As documented by the p-values on the figure, the pairwise differences between the second-to-last-place player and more highly-ranked players are generally statistically significant.

Table 2 shows results from probit regression analysis. All regressions include round fixed effects and a dummy variable for the last-place player, since her choice is not parallel to other ranks. Col. (1) shows that, relative to all other higher ranks, the second-to-last-place player is significantly less likely to forgo the additional dollar. In col. (2), the effect increases after excluding the first two rounds.

Col. (3) shows that controlling for whether a player is currently below the median substantially reduces this effect, though col. (4) shows that after the first two rounds the effect of being in second-to-last place regains its significance.

Cols. (5) and (6) explore the effect of inequality aversion. As in the previous section, we calculate the change in advantageous and disadvantageous inequality when a person decides to forgo versus keep the additional dollar. Given the payoffs of the game, these two variables are a linear

he does), but has no effect for higher-ranked players. Therefore, the net effect of keeping the additional dollar is to decrease disadvantageous inequality by 0, 1, 2, 3, 5, and 7 for, respectively, players in ranks one through six.

transformation of each other, so we only include the change in disadvantageous inequality. The coefficient suggests that the greater the net increase in disadvantageous inequality associated with forgoing the additional dollar, the more likely players will keep the dollar. As noted earlier, the net effect on disadvantageous inequality from forgoing the dollar is decreasing in rank, so it is not surprising that including this measure in col. (5) reduces the effect of being in second-to-last place. In col. (6) the first two rounds are excluded and the coefficient of interest regains its significance.

In cols. (7) and (8) we see whether the effect of being in second-to-last place can be separated from a general linear trend in rank. Including this measure in col. (7) reduces the coefficient on the second-to-last-place indicator from its magnitude in col. (8), but it regains its statistical significant in col. (6) when the first two rounds are excluded.

In Appendix Table 3 we show that adding covariates to the main Table 2 specifications always increases the magnitude of the effect of being in second-to-last place. It also shows the main result holds when a player-fixed-effect model is estimated via conditional logit. We prefer the estimates in Table 2 because with only eight rounds, ranks are not balanced across players and thus between-player variation is still useful.

Allowing the second-to-last-place coefficient to vary for different subgroups of the data does not yield any evidence that certain groups are driving the effect. In regressions where we interact the second-to-last-place variable with, sequentially, gender, age, political views and religious views, the coefficients on the interaction terms are never close to conventional levels of signficance.

4.1.5 Discussion

The results from this first redistribution are generally consistent with last-place aversion. The second-to-last player is indeed the least generous to the last-place player. While we cannot always separate this effect from a below-the-median effect, inequality aversion, or a more general effect of rank, given the small sample size (this experiment was the least well attended of all four that we conducted) even a small amount of noise would make such a separation difficult. When early rounds—which we suspect are noisier as players are still learning the game—are removed, the effect of being in second-to-last place can be distinguished from these alternative stories.

Given that many redistributive or poverty-alleviation policies (e.g., food stamps, Medicaid, Temporary Assistance to Needy Families) raise revenue from the general population and then transfer it to the least well-off, studying individuals' tendency to transfer money to a last-place player may indeed help explain variation across the income distribution in support for redistributive policies. But while this game might approximate typical policies, it has at least one important limitation in testing last-place aversion as a more general theory of behavior. The game potentially confounds disutility regarding moving down in rank with any last-place-aversion effect since only the fifth-place player actually moves down in rank by giving the \$2 to the last-place person. This confounding effect might also impact the decision of the fourth-place person, since giving the last-place person \$2 means she would now be tied with the formerly last-place person for second-to-last place. Players in all other ranks never move down in the distribution by forgoing the \$1. We thus design a game that tests how sensitivity to moving down a rank varies by rank.

4.2 Second redistribution game

The objective of this game is not to mimic any particular redistributive policy, but rather to test last-place aversion in a more demanding setting. This game focuses on how individuals treat the players directly above and below them, and how these decisions vary by rank.

4.2.1 Experimental design

The game is identical to the first money-transfer game (players are randomly assigned across dollar amounts \$1, \$2,...,\$6; there is re-randomization after each round; decisions are completely confidential; players do not learn the outcome of the round) except we change the two redistributive outcomes between which players must choose. Each player ranked two through five must choose between giving the player directly above or directly below them an additional \$2. The first-place player decides between the second- and third-place player, and the last-place player decides between the fourth- and fifth-place player. These choice sets are summarized in Table 3. As before, the additional \$2 comes from a separate account and not from the player herself. In the interest of space, we do not show a screen-shot of this game but, aside from the different choice sets, it is identical to that of the first money-transfer game.

4.2.2 Predictions

Unlike the previous money-transfer game, this game does not allow players to keep extra money themselves. Their choice set is limited to giving an extra $2 to one of two other players. As such, pure self-interest does not obviously push them toward one choice or the other, as their balance remains at its initial level regardless of their decision. Furthermore, because total surplus is held constant, players do not face an equity-efficiency trade-off, as in Engelmann and Strobel (2004).

Inequality aversion would predict that all players in ranks one through five give to the lower-ranked player. In fact, the game is constructed so that the net effect of giving to the lower-ranked person on the standard Fehr-Schmidt inequality terms is constant for ranks one through five.[18] As such, any variation among these five ranks in the probability of giving to the lower-ranked player cannot be explained by standard inequality aversion.

By construction, giving to the lower-ranked player in their choice set causes all players except the first and last to drop one rank in the distribution. LPA predicts that dropping in rank would have the largest psychic cost for the second-to-last-place player, and thus we predict that individuals will be the least likely to give to the lower-ranked player when they themselves are in second-to-last place.

4.2.3 Initial results

Figure 3 shows how the probability a player gives the additional $2 to the lower-ranked player in his choice set varies by rank. Overall, players choose to give to the lower-ranked player in their choice set 75 percent of the time. This probability varies from over eighty percent in the top half of the distribution, to less than sixty percent for the second-to-last place player. Players are the least likely

[18] To see this, note that for ranks two through five, giving to the lower-ranked player increases disadvantageous inequality by one, whereas giving to the higher-ranked player increases it by two, so the net effect of giving to the lower- versus higher-ranked player is a decrease in disadvantageous inequality of one. For rank one, giving to the higher-ranked player in the choice set (rank two) increases disadvantageous inequality by one, whereas giving to the lower-ranked player (rank three) does not change it, so for the first-place player the net effect of giving to the lower-ranked player is to decrease disadvantageous inequality by one. For advantageous inequality, ranks two through five decrease this term by one if they give to the lower-ranked player and have no effect on it if they give to the higher-ranked player, so the net effect of giving to the lower-ranked player is a decrease of one. The first-place player decreases advantageous inequality by two if he gives to the lower-ranked player and by one if he gives to the higher-ranked player, so the net effect of giving to the lower-ranked player is a decrease of one. To summarize, for ranks one through five, the net effect of giving to the lower-ranked player is to decrease disadvantageous and advantageous inequality by one. As players are assumed to dislike both types of inequality, inequality-aversion would suggest that all these players always give to the lower-ranked player in their choice set.

to give to the last-place player when they are in second-to-last place and this difference is pairwise significant for the first-, third- and last-place players, and marginally significant ($p = 0.120$) for the second-place player. Those ranked fourth are nearly equally likely to deny the $2 to the lower-ranked player, though the difference grows somewhat when the first two rounds are eliminated.

The first- and last-place players are the most likely to give to the lower-ranked player in their choice set, consistent with their not facing an equality-rank trade-off. The first-place player is the most likely to give to the lower-ranked player—concerns over rank and inequality both push him toward giving money to the third- instead of the second-place player. The player in the bottom half of the distribution most likely to give to the lower-ranked player in his choice set is the last-place player, consistent with his being able to give money to the lower-ranked player without changing his rank, as he remains in last place regardless of his decision.

Table 4 presents probit regression results. In all cases, round fixed effects and separate dummy variables for the first- and last-place players are included, since these two players do not have parallel choice sets to those of other ranks. Col. (1) shows that adding round fixed-effects does not change the general patterns in Figure 3. The fifth-place player is less generous than the other ranks. However, col. (2) shows that, as in the figure, this effect is largely driven by players in the bottom half of the distribution (again, excluding the last-place player) being less likely to give to the lower-ranked player.

A key challenge in separating any last-place-aversion effect from competing hypotheses is that with only six ranks we have limited degrees of freedom. This problem is aggravated in the current game relative to the the earlier ones because only ranks two through five have comparable choice sets, whereas in the first redistribution game we could compare ranks one through five and in the lottery game ranks one through six. Being able to compare only four ranks makes it nearly impossible to separate, say, a story in which individuals dislike being near last place versus one in which they want to be above the median. For this reason, we decided to re-run the experiment with eight players.

4.2.4 Results from the eight-player game

The game is exactly parallel to the six-player game described in Section 4.2.1. Players in ranks two through seven must decide between giving $2 to the person directly above them or below them, and the first-place player decides between the second- and third-place players while the last-place player decides between the sixth- and seventh-place players. As before, we also control separately for players in first or last place as their choice set is not parallel to that of other players.

Figure 4 is the analogue of Figure 3 and presents the basic results from the eight-player game. As before, the second-to-last-place player is the least likely to give to the player below him, and this difference is often pair-wise significant from other ranks. Also as before, the third-to-last-place player is relatively unlikely to give to the player below him. Importantly, however, the player just below the median ($rank = 5$) shows no such tendency, and the pairwise difference with the second-to-last-place player is statistically significant. Put differently, comparing the six- and eight-player games suggests that there is nothing particularly salient about being, say, in fourth or fifth place, but instead behavior appears to depend on how close one is to last place: the fourth- and fifth-place players in the six-player game show strong evidence of LPA, while the fourth- and fifth-place players in the eight-player game do not.[19]

Cols. (3) through (11) of Table 4 present probit regression results from the eight-player game. Consistent with the figure, in col. (3) the second-to-last-place player is significantly less likely to give to the lower-ranked player than all other players (though, again, the first- and last-place players always have their own fixed effect, so their generally higher tendency to give to the lower-ranked player is not contributing to the coefficient). In col. (4) we gain precision by including those in third-to-last place as being affected by last-place aversion: if they give $2 to the lower-ranked player, they would fall into second-to-last place. This effect increases when the first two rounds are discarded. For the remainder of the table, we will focus on distinguishing this effect—the aversion to falling to the bottom two ranks of the distribution—from alternative hypotheses.

The next two columns explore the hypothesis that players are simply less likely to give to a lower-ranked player when they themselves are below the median, which we could not distinguish from last-place aversion in the six-player game. In contrast, the below-the-median indicator in col. (6) is small in magnitude and statistically insignificant and the estimated effect of being in the bottom of the distribution increases relative to the estimate in col. (4). Removing the early rounds (col. 7) only increases the magnitude of the coefficient of interest.

[19] Interestingly, in both the six- and eight-players games, the second-place player is one of the least likely ranks to give to the player below him. We speculate that there may be some utility gained from remaining close to first place in rank, even though he would be further away in terms of absolute dollars.

Cols. (8) and (9) test whether inequality aversion can explain the reluctance of those close to last place from giving the \$2 to the lower-ranked player. As noted earlier, inequality aversion in the standard two-term Fehr-Shmidt parameterization cannot explain the results, as the decision of each player in ranks two through seven has the same effect on the two terms. As such, we test whether players respond to how the Gini coefficient of the overall distribution changes when they give to the higher- versus lower-ranked of the two people in their choice set. The positive coefficient on this variable indicates that the greater this difference, the more players give to the lower-ranked player, suggesting that, all else equal, players wish to make the distribution more equal. However, this effect is not statistically significant, and including it only increases the estimated effect of being second or third from last.[20]

Cols. (10) and (11) test whether including a linear rank term diminishes the estimated effect of avoiding the bottom of the distribution. Again, the coefficient on the indicator for being second or third from last increases. Although the p-value in col. (11) grows slightly, to 0.102, having only eight ranks from which to identify a linear effect of rank and three indicator variables (for being in last, for being in first, and for being in sixth- or seventh-place) likely limits the precision with which any single effect can be measured. When the first two rounds are excluded, the coefficient on the variable of interest regains its significance. Finally, cols. (12) and (13) presents the baseline result when both the six- and eight-player games are included.

Appendix Table 4 shows that the main results are robust to adding demographic controls and including player fixed effects. Those who report being liberal are significantly more likely to give to the lower-ranked player, as are those who report being religious, though that effect is only marginally significant. Unlike the previous experiments, a few interaction terms are significant. While on average those who are religious are more likely to give to the lower-ranked player, religiosity is associated with greater last-place-aversion effects—that is, religious individuals' relative tendency to give to the lower-placed player is substantially reduced when they themselves are close to last place. Younger players also appear to be more last-place averse.

[20] Readers may wonder why we control for this $\Delta\, Gini$ variable in this table but not in Table 2. The reason is that for players of ranks one through five in the first redistribution experiment, the difference in the Gini coefficient from keeping the \$1 versus transferring \$2 to the last-place player is itself a linear function of rank. In particular, $\Delta Gini = 0.318 - 0.0152 * rank$. As such, for the five ranks with comparable choice sets in the first redistribution experiment, we cannot separately identify the effect of rank and changes in the Gini coefficient, so we only consider rank.

4.3 Discussion

The results using the eight-player design offer broad support for the hypothesis that players experience disutility from being in the bottom of the distribution. This effect can be separated from players' merely wanting to be above the median as well as from inequality aversion. Both the six- and eight-player games suggest that players take steps to avoid falling not just to the very bottom rank, but to the second-lowest rank as well.

It is worth emphasizing that in the second redistribution game those close to last place are willing to take measures that typically have high psychological cost in order to avoid falling closer to last place. As Tricomi *et al.* (2010) show, in both subjective ratings and fMRI data, the poorer member in a two-player game evaluates transfers to the richer member more negatively than the richer person evaluates transfers to the poorer person. Indeed, in the middle of the distribution the participants in our experiments generally make decisions consistent with this finding. However, between a quarter and a half of those in second-to-last place prefer to give the $2 to a person who already has more money than they do, suggesting that last-place aversion can outweigh the general aversion to giving money to a richer person found in other games and in other parts of the distribution in our experiment.

The evidence supporting last-place aversion is especially striking given that our experiments offer players confidentiality and anonymity, as well as emphasize that rank is based on random assignment and not merit. While we believe that these conditions allow us to test for last-place aversion in a more rigorous manner, they may limit the experiments' connection to how individuals' support for redistributive public policies depends on their actual economic position, as economic position is typically not randomly assigned nor completely confidential. The remainder of the paper explores last-place aversion outside the laboratory, using survey data on minimum wage policy.

5 Last-place aversion and support for minimum wage increases

In choosing a "real-world" policy to test the predictions of last-place aversion, we select the minimum wage over other redistributive policies for several reasons. First, the minimum wage defines the "last-place" wage that can legally be paid in most labor markets, so it allows us to define "last place" more easily than in the context of other policies. Second, while the worst-off workers are not always those being paid the minimum wage (e.g., middle-class teenagers might take minimum-wage jobs during the summer), past work has found that policies that more explicitly target the poor such as Temporary Assistance for Needy Families could have potentially confounding racial associations.[21] Third, through spillover effects to other low-wage workers, the minimum wage plays an important role in the compensation of low-income workers and thus analyzing its political support has potentially important policy consequences.[22]

5.1 Predicting who would support a minimum wage increase

A minimum wage increase is a transfer to some low-wage workers from—depending on market characteristics—other low-wage workers who now face greater job rationing, employers with monopsony power in the labor market, or consumers who now pay higher prices.[23]

Assuming low-wage workers are not concerned with adverse employment effects—a hypothesis we directly test in the empirical work—they should generally exhibit the greatest support for an increase relative to other workers. First, they themselves might see a raise, depending on the difference between their current wage and the proposed new minimum and the strength of spillover effects to workers just above the proposed new minimum. Second, even for those who would not be directly affected, the policy could act as wage insurance and should increase their reservation wage. Finally, if low-wage workers are relatively substitutable, then those making just above the current minimum should welcome an increase as employers would then have less opportunity to replace them with lower-wage workers.

Last-place aversion, in contrast, predicts that individuals making just above the current minimum would have limited enthusiasm for seeing it increased. The minimum wage essentially defines the "last-place" wage a worker in most labor markets can legally be paid. A worker making just above the current minimum might see a wage increase from the policy, but could now herself be "tied" with many other workers for last place.

[21] See Gilens (1996) on the association white survey respondents make between welfare and African-Americans.

[22] In fact, Lee (1999) estimates that the majority of the growth in the wage gap between the tenth and fiftieth percentiles during the 1980s was due to the erosion of the federal minimum wage during the decade.

[23] There is a large literature on the effect of the minimum wage on employment levels, which we do not review here. The monopsony argument was first made by Stigler (1946), and Aaronson (2001) provides evidence of price pass-through in the restaurant industry.

5.2 Evidence from online survey data

5.2.1 Data collection and summary statistics

Questions regarding the minimum wage have often appeared in opinion surveys, but to the best of our knowledge none have also asked respondents to report their own wages (as opposed to income). We thus designed our own survey, which was administered in the fall of 2010.[24] Subjects were randomly selected from a nationwide pool and invited to complete the online survey in exchange for five dollars. Enrollment in the study was limited to employed individuals between the ages of 23 and 64, so as to target prime-age workers. We also over-sampled low-wage and hourly workers.

The survey stated the current federal minimum wage ($7.25) and then asked respondents whether it should be increased, decreased or left unchanged. The survey asked those who identified themselves as hourly-wage workers: "What is your current hourly wage? If you have more than one job, please enter the wage for your main job." For those who did not specifically identify themselves as hourly workers, the survey asked: "If you are currently paid by the hour for the main job you hold, what is your hourly wage? (Even if you are not actually paid by the hour, please calculate your estimated hourly wage. You can do this by dividing your paycheck by how many hours you typically work in a pay period.)"

We make the following sampling restrictions in generating our regression sample. First, we drop the 74 people who completed the survey in less than two minutes (even though we wrote the survey, it took us an average of three minutes to complete). We also drop from this sample twelve individuals who report being unemployed but somehow slipped through the survey's filter. We also drop 63 observations with missing or unusable wage data (e.g., "I work on commission," "Depends"). These exclusions leave a regression sample of 489 observations.

The first column of Appendix Table 5 displays summary statistics from the online survey data. Given the explicit oversampling of certain groups and the fact that online surveys by their nature are not likely to appeal to the entire population equally, we do not expect the data to resemble a random sample of the U.S. population. Indeed, compared to the sample from the Pew Research Center that we use later in this section, there is over-representation of women and college graduates, and under-representation of minorities and married people. The median wage in our sample is $13.60

[24] The survey was administered by C&T Marketing Group, `http://www.ctmarketinggroup.com`.

and just over three-quarters of respondents support a minimum wage increase.

5.2.2 Graphical results

Figure 5 shows how support for increasing the minimum wage varies across wage groups in our survey. The first category includes those with wages at or below the current minimum, and this group tends to be highly favorable toward minimum-wage increases.[25] The most striking feature of Figure 5, however, is the relative lack of support for minimum wage increases among those making just above the current minimum. They are, in fact, the group least likely to support it, and the difference between them and other groups in the figure is often statistically significant.

5.2.3 Regression results

Table 5 subjects the results in Figure 5 to regression analysis. Without any controls, the effect of being "just above" the current minimum wage (i.e., making more than $7.25 but no more than $8.25 an hour) is negative but not significant. Note that this specification is somewhat demanding because we do not include any other controls for wage or limit the sample to those with relatively low wages. As such, those making just above the minimum wage are largely being compared to those making substantially more than they do. When we limit the sample to those in the bottom half of the wage distribution or control linearly for wage, the effect of being "just above" the current minimum is statistically significant.

For the sake of being conservative and parsimonious, we choose the more demanding specification in col. (1), and in col. (2) adding race, gender and age controls generates a negative coefficient on the "just above" indicator that is statistically significant at the ten-percent level. Adding controls for Census division and the state-level minimum wage in col. (3) has no effect on the coefficient of interest. Controlling in col. (4) for education, marital status and whether a participant is U.S.-born slightly increases the magnitude of the effect. Controlling for party affiliation, union status and approval rating of President Obama also increases the effect slightly. With a small sample like ours, the coefficient estimate might be attributable to randomly having sampled, say, a very conservative group who happen to make within a dollar of the current minimum. In fact, however, workers

[25] In one version of the survey, we asked questions specifically designed to illicit information regarding people who report making less than the minimum wage. About a third worked for tips. More than half reported that they thought their own wage would rise if the minimum wage increased.

making between \$7.25 and \$8.25 give Obama the highest approval rating of any of the wage groups depicted in Figure 5.

An important concern regarding the results reported so far is that they may be driven by worries regarding the effect of the minimum wage on the demand for low-wage labor and not last-place aversion. For this reason, we also asked participants the following question: "Do you worry that if the minimum wage is set too high, it might make employers reduce hiring and possibly cause you to lose your job?" In col. (5), we show that individuals making just above the current minimum are no more concerned than are other survey respondents. In fact, of the four lowest-wage groups in Figure 5, those making between \$7.25 and \$8.25 report the lowest concern about employment effects, and yet they exhibit the greatest opposition to a minimum wage increase.

5.3 Pew Research Center data

Workers in our survey making just above the minimum wage exhibit limited support relative to other workers for seeing it raised, a result that might be seen as surprising but is consistent with last-place aversion. We now seek confirming evidence in a more nationally representative sample. As noted earlier, results from existing national surveys are at best just suggestive, as only income and not wage data are available. Our approach in this section is to present the data with as little analysis as possible and merely try to gauge whether the income patterns appear roughly consistent with the wage patterns in our online survey.

5.3.1 The data

We selected every Pew Research Center survey over the past ten years that both asked respondents if they approved or disapproved of a minimum wage increase and asked for their income and employment status.[26] Three surveys (from June 2001, December 2004, and March 2006) met these criteria. During this period, the federal minimum wage was \$5.15 per hour, and respondents were asked about increasing it to \$6.45, except that the March 2006 survey randomly assigned half the sample to consider an increase to \$6.45 and the other half to \$7.15.

[26] We excluded other Pew surveys that instead asked whether increasing the minimum wage should be a "top priority, important but lower priority, not too important or should not be done," because the wording was not similar to our web survey. The other publicly-accessible national polls on the minimum wage are conducted by the *New York Times* and CBS. We chose Pew over *NYT*/CBS because Pew offers greater disaggregation of income and thus more detail on the income levels of poorer households.

To match the online survey, we sample employed individuals between the ages of 23 and 64. Summary statistics appear in the last two columns of Appendix Table 5.

5.3.2 Results

Figure 6 shows how support for increasing the minimum wage from \$5.15 to \$6.45 varies across the income groups in the Pew survey. The raw data show a small drop in support going from the lowest-income group to the second-lowest-income group, and a general downward trend in support as income increases. When we control for basic demographics and background characteristics such as education, marital status and political affiliation, the relative opposition among the second-lowest-income group increases. Conditional on these controls, individuals with family income between \$10,000 and \$20,000 are the *least* supportive among all groups with annual family income below \$100,000.

Figure 7 is analogous to Figure 6 but includes only the smaller sample of participants (half of the March 2006 survey) who were asked to consider a minimum wage increase from \$5.15 to \$7.15. Individuals with family income between \$20,000 and \$30,000 are, both in the raw data and after controlling for background characteristics, the least supportive of an increase among all respondents with family income below \$100,000. Interestingly, leaving aside the very highest income group, as the hypothetical new minimum wage increases, the income level of the group most opposed to it also increases, consistent with the last-place effect reaching further up in the income distribution.

How might the family income levels in the Pew survey relate to wages? On the one hand, someone working fifty weeks a year and forty hours a week would make \$14,300 at a wage of \$7.15 and \$12,900 at a wage of \$6.45. On the other hand, in the 2004 March Current Population Survey the median family income of a worker between the ages of 23 and 64 who makes between \$5.25 and \$7.15 an hour is between \$25,000 and \$30,000. As such, those who might be most affected by last-place aversion concerns arising from minimum-wage increases would likely have income between \$10,000 and \$30,000, consistent with Figures 6 and 7. However, it must be emphasized that the correspondence between family income and wage levels is very rough, and thus that these results, while generally consistent with the online data, are at most suggestive.

5.4 Discussion

In both our online survey and the Pew data, we find that low-wage and low-income workers are often the least likely to support increases in the minimum wage. The relatively tepid support among low-income workers for such a transfer is consistent with last-place aversion, as those who are marginally better off seek to retain their ability to distinguish themselves from those in "last place." One might have expected that in moving from the laboratory—where reference groups are fixed and highly salient—to the field—where individuals can be members of many peer groups—would have diminished the LPA effect. However, these minimum wage results suggest that the income or wage distribution is salient to individuals in the bottom of the distribution, resulting in behavior consistent with the behavior observed in the laboratory experiments.

A further prediction of LPA not directly tested here is that not only are those at the bottom of the distribution opposed to transfers to those just below them, but, relative to low-income individuals, middle- and upper-income individuals are less opposed to a transfer to a marginally worse-off group than themselves. A potential test of this prediction would be to ask individuals their income and then describe a tax credit that phased out just below their income level. LPA would predict that support for such a scheme would be weakest among low-income workers. In this paper we wished to focus on an actual policy that would be familiar to respondents, but examining how individuals respond to hypothetical transfer policies that benefit different parts of the income distribution is a potentially interesting question for future research.

As noted earlier, we chose to focus on the minimum wage in part to avoid the strong racial connotations of redistributive programs such as welfare. But future work might wish to explore implications of last-place aversion on racial attitudes. For example, African Americans have always occupied a lower position in the national income distribution than whites, and thus might well serve as the "last-place" reference group for whites. Of course, individual African Americans have higher incomes than individual whites, but even today median household income for non-Hispanic whites is over sixty percent higher than that of African Americans ($55,530 versus $34,218).[27] LPA predicts that this reference group should have little meaning to whites whose incomes place them a safe distance from the bottom of the income distribution. However, for, say, the thirty percent of whites

[27] See Income, Poverty and Health Insurance Coverage in the United States, which is based on the 2008 Current Population Survey, at `http://www.census.gov/prod/2009pubs/p60-236.pdf`.

with household income below that of the median African-American household, any improvement in the social or economic position of African Americans may cause significant disutility and thus lead them to oppose redistributive policies that might benefit African Americans.

6 Conclusion

We began by presenting a simple model in which individual utility depends on a standard concave function of income as well as an indicator variable for whether one is in last place among a finite reference group. We then set up an experiment in which the model predicts that the two lowest-placed members of a six-player game would have a higher propensity to choose a lottery over a risk-free payment of equivalent expected value. The data strongly support this prediction, and the elevated likelihood of gambling among the individuals with the lowest income is consistent with the last-place person bearing the risk of the lottery for a chance to improve his rank and the second-to-last-place person doing the same to defend against falling in rank.

In the money-transfer experiments we conducted, the tendency to give to the last-place player is lowest for the second-to-last place player, again consistent with last-place aversion. Perhaps most striking is that in order to maintain their rank, players close to last place will often give money to players ranked above them rather than players ranked below.

We then apply the insights from the redistribution experiments to predict respondents' preferences regarding a particular redistributive policy—the minimum wage. Last-place aversion would predict that those making just above the current minimum wage would face a trade-off: on the one hand, they may receive a raise if the new minimum wage is above their current wage; on the other hand, they would then join the "last-place" group. In data we collect ourselves, we find that support for a minimum wage increase is lowest among those making just above the current minimum. Using data from the Pew Research Center, we also find that support for a minimum wage increase is relatively low among groups whose income would suggest they themselves make close to the minimum wage.

Future research might explore the implications of LPA in a seemingly unrelated domain: consumer behavior. Past work has noted consumers' tendency to purchase the second cheapest wine on a menu (McFadden, 1999). While consumers might be making rational inferences about product attributes (see, e.g., Kamenica, 2008), they might also be exhibiting a standard response to price but simultaneously avoiding association with the "last-place" product. In a choice set of three or four, these tendencies would lead consumers to pick a "middle" option—the "compromise effect" in behavioral decision theory (Simonson, 1989).

LPA might also contribute to our understanding of the higher incidence of crime and delinquency exhibited by members of lower socio-economic groups. Violent crime, especially among males, is often related to status and "saving face," and LPA would indeed predict status anxiety to be most acute near the bottom of a given distribution.[28] For example, LPA might help explain why criminal activity increased among the boys who moved to better neighborhoods in the Moving-to-Opportunity study (Kling *et al.*, 2005), as they now attend better schools where they are more likely to be at the bottom of the classroom distribution.

Finally, modifying certain aspects of our experimental design would shed further light on last-place aversion. While we took steps to design the experiments in a manner that would not bias us toward finding evidence for last-place aversion, future research could relax some of these conditions in order to examine which factors intensify or diminish LPA. We suspect that making payoffs public or making rank a function of task performance would increase the magnitude of LPA. Outcomes besides risk aversion and redistribution could also be studied; for example, will those in last place work especially hard at a given task to try to move up in rank, or will they instead tend to give up?[29] In our experiments, the peer groups were randomly assigned and fixed throughout the game, but future work may focus on the role of LPA in endogenous group formation. For example, LPA would predict that those with the lowest rank in a current game would be the most likely to choose to join a different game with lower average payoffs but the promise of an improved rank.

References

Aaronson, D. (2001). Price pass-through and the minimum wage. *Review of Economics and Statistics*, **83** (1), 158–169.

[28]The classic study of Philadelphia homicides by Wolfgang (1958) found that nearly 40 percent began with an "[a]ltercation of relatively trivial origin: insult, curse, jostling."

[29]Genicot and Ray (2009) model the interaction of aspirations and investments, with poverty traps arising because the very poor will likely remain at least somewhat poor regardless of their investments, leading them to not invest at all. Empirically, Hoxby and Weingarth (2008) use random assignment to classrooms to estimate peer effects and find that low-achieving students perform better when they are not the only low-achieving student in the classroom.

Alesina, A., Glaeser, E. and Sacerdote, B. (2001). Why doesn't the United States have a European-style welfare state? *Brookings Papers on Economic Activity*, **32** (2001-2), 187–278.

Andreoni, J. (1989). Giving with impure altruism: Applications to charity and ricardian equivalence. *Journal of Political Economy*, **97** (6), 1447–58.

— (1990). Impure altruism and donations to public goods: A theory of warm-glow giving? *Economic Journal*, **100** (401), 464–77.

Arrow, K. (1971). *Essays in the Theory of Risk-Bearing*. North-Holland Pub. Co.

Bartels, L. M. (2008). *Unequal Democracy: The Political Economy of the New Gilded Age*. Princeton University Press.

Bénabou, R. and Ok, E. A. (2001). Social mobility and the demand for redistribution: The poum hypothesis*. *Quarterly Journal of Economics*, **116** (2), 447–487.

Benartzi, S. and Thaler, R. H. (1995). Myopic loss aversion and the equity premium puzzle. *The Quarterly Journal of Economics*, **110** (1), 73–92.

Camerer, C. (2003). *Behavioral game theory: Experiments in strategic interaction*. Princeton University Press.

Camerer, C. F., Johnson, E. J., Rymon, T. and Sen, S. (1993). Cognition and framing in sequential bargaining for gains and losses. In K. Binmore, A. Kirman and P. Tani (eds.), *Frontiers of game theory*, *1*, Cambridge, MA: MIT Press, pp. 27–47.

Card, D., Mas, A., Moretti, E. and Saez, E. (2010). *Inequality at Work: The Effect of Peer Salaries on Job Satisfaction*. National Bureau of Economic Research Working Paper No. 16396.

Carlsson, F. (2010). Design of stated preference surveys: Is there more to learn from behavioral economics? *Environmental Resource Economics*, **46**, 167–177.

Clark, A. E. and Oswald, A. J. (1998). Comparison-concave utility and following behaviour in social and economic settings. *Journal of Public Economics*, **70** (1), 133–155.

Duesenberry, J. (1949). *Income, Saving and the Theory of Consumer Behavior*. Harvard University Press.

Engelmann, D. and Strobel, M. (2004). Inequality aversion, efficiency, and maximin preferences in simple distribution experiments. *The American Economic Review*, **94**, 857–869(13).

Engels, F. (1893). Letter to franz mehring. In D. Torr (ed.), *Marx and Engels Correspondence*, International Publishers (1968).

Fehr, E. and Schmidt, K. M. (1999). A theory of fairness, competition, and cooperation. *The Quarterly Journal of Economics*, **114** (3), 817–868.

Frank, T. (2004). *What's the Matter with Kansas? How Conservatives Won the Heart of America*. Henry Hold and Company.

Genicot, G. and Ray, D. (2009). Aspirations, inequality, investment and mobility.

Georgiadis, A. and Manning, A. (2011). Spend it like beckham? inequality and redistribution in the uk, 19832004. *Public Choice*, pp. 1–27, 10.1007/s11127-010-9758-7.

Gertner, R. (1993). Game shows and economic behavior: Risk-taking on card sharks. *The Quarterly Journal of Economics*, **108** (2), 507–521.

Gilens, M. (1996). “race coding” and white opposition to welfare. *The American Political Science Review*, **90** (3), 593–604.

Gneezy, U. and Potters, J. (1997). An experiment on risk taking and evaluation periods. *The Quarterly Journal of Economics*, **112** (2), 631–645.

Goffman, E. (1967). *Interaction Ritual*. Anchor.

Haisley, E., Mostafa, R. and Loewenstein, G. (2008). Subjective relative income and lottery ticket purchases. *Journal of Behavioral Decision Making*, **21** (3), 283–295.

Hoxby, C. M. and Weingarth, G. (2008). Taking race out of the equation: School reassignment and the structure of peer effects.

Kamenica, E. (2008). Contextual inference in markets: On the informational content of product lines. *American Economic Review*, **98** (5), 2127–49.

Kelly, N. J. and Enns, P. K. (2010). Inequality and the dynamics of public opinion: The self-reinforcing link between economic inequality and mass preferences. *American Journal of Political Science*, **54** (4), 855–870.

Kenworthy, L. and McCall, L. (2008). Inequality, public opinion and redistribution. *Socio-Economic Review*, **6** (1), 35–68.

Kling, J. R., Ludwig, J. and Katz, L. F. (2005). Neighborhood effects on crime for female and male youth: Evidence from a randomized housing voucher experiment. *The Quarterly Journal of Economics*, **120** (1), 87–130.

Lee, D. S. (1999). Wage inequality in the United States during the 1980’s: Rising dispersion or falling minimum wage? *Quarterly Journal of Economics*, **114** (3), 977–1023.

Levy, H. (1994). Absolute and relative risk aversion: An experimental study. *Journal of Risk and Uncertainty*, **8** (3), 289–307.

Luttmer, E. F. P. (2005). Neighbors as negatives: Relative earnings and well-being. *The Quarterly Journal of Economics*, **120** (3), 963–1002.

McFadden, D. L. (1999). Rationality for economists? *Journal of Risk and Uncertainty*, **19** (1-3), 73–105.

Meltzer, A. H. and Richard, S. F. (1981). A rational theory of the size of government. *Journal of Political Economy*, **89** (5), 914–27.

Metrick, A. (1995). A natural experiment in "jeopardy!". *American Economic Review*, **85** (1), 240–53.

Oxoby, R. J. (2004). Cognitive dissonance, status and growth of the underclass*. *The Economic Journal*, **114** (498), 727–749.

Picketty, T. and Saez, E. (2003). Income inequality in the united states: 1913-1998. *QJE*, **118**, 1–39.

Rapoport, A. and Dale, P. S. (1966). The “end” and “start” effects in iterated prisoner's dilemma. *Journal of Conflict Resolution*, **10** (3), 363–366.

Simonson, I. (1989). Choice based on reasons: The case of attraction and compromise effects. *Journal of Consumer Research: An Interdisciplinary Quarterly*, **16** (2), 158–74.

Slonim, R. and Roth, A. (1998). Leaning in high stakes ultimatum games: An experiment in the slovak republic. *Econometrica*, **66** (3), 569 – 596.

Stigler, G. J. (1946). The economics of minimum wage legislation. *The American Economic Review*, **36** (3), 358–365.

Tricomi, E., Rangel, A., Camerer, C. F. and O'Doherty, J. P. (2010). Neural evidence for inequality-averse social preferences. *Nature*, **463** (7284), 1089–1091.

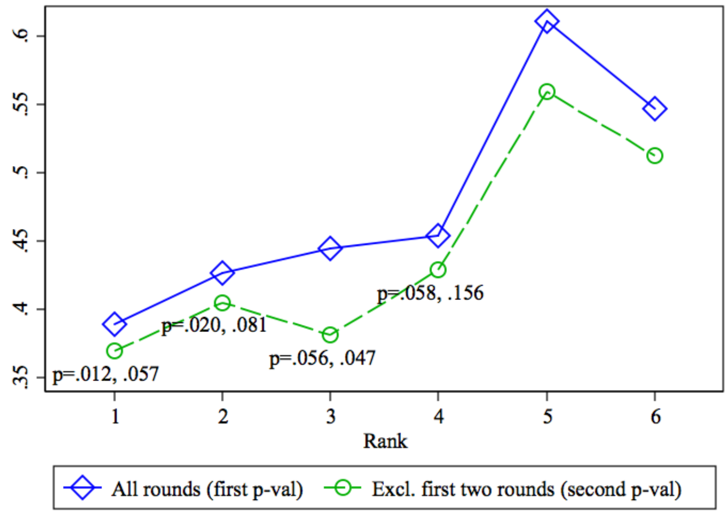
Veblen, T. (1899). *The Theory of the Leisure Class*. New York: The Macmillan Company.

Wolfgang, M. (1958). *Patterns in Criminal Homicide*. University of Pennsylvania Press.

Woodward, C. V. (1955). *The Strange Career of Jim Crow*. New York: Oxford University Press.

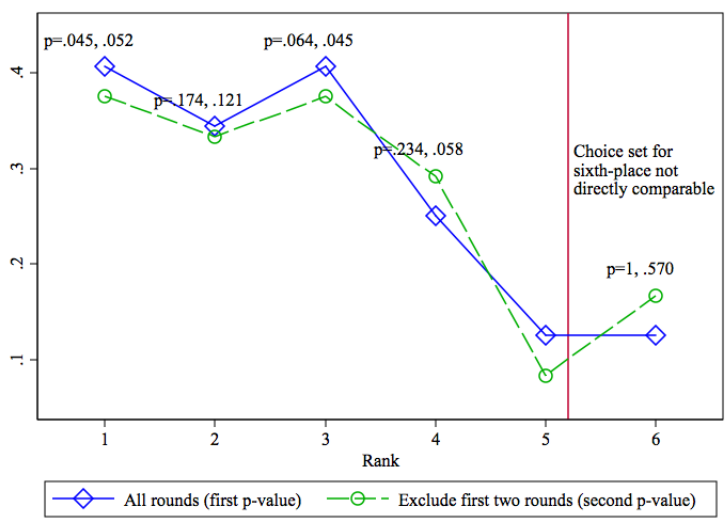
Zhou, R. and Soman, D. (2003). Looking back: Exploring the psychology of queuing and the effect of the number of people behind. *Journal of Consumer Research: An Interdisciplinary Quarterly*, **29** (4), 517–30.

Figure 1: Share choosing the lottery over the certain payment



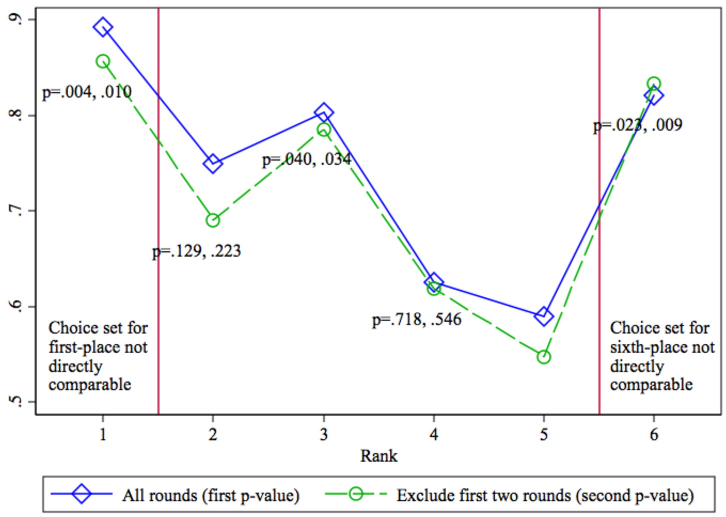
Notes: Based on twelve six-player games of nine rounds each, for a total of 648 observations. Each round every player was given the same choice between a two-outcome lottery and a risk-free payments of equivalent expected value. See Section 3 for details. All p-values are based on OLS regressions with rank fixed effects (omitted category $rank = 5$ or $rank = 6$) and no other controls, with standard errors adjusted for clustering by individual. The first p-value is from estimating this equation on all rounds of data, and the second p-value from all rounds of data except the first two.

Figure 2: Share choosing to forgo the additional $1



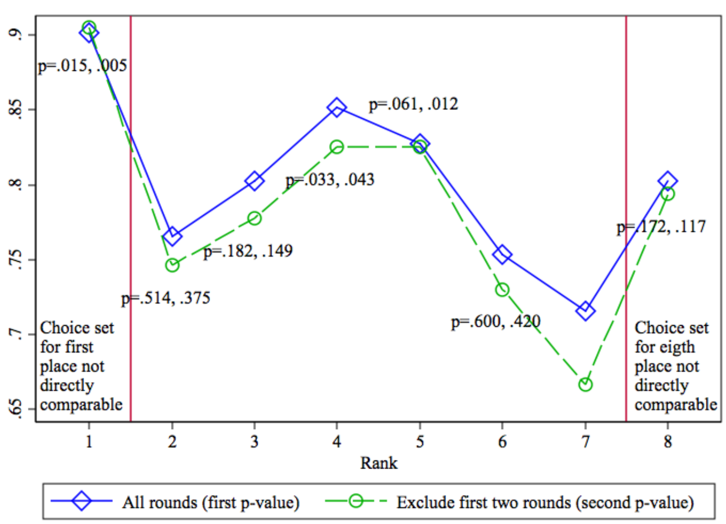
Notes: Based on four six-player games of eight rounds each, giving a total of 192 observations. Each player except the last-place player were given the choice between giving an extra $2 to the last-place player or keeping an extra $1 for themselves. The last-place player decided between keeping the additional $1 or giving $2 to the second-to-last place person. See Section 4.1 for details. All p-values are based on OLS regressions with rank fixed effects (omitted category $rank = 5$) and no other controls, with standard errors adjusted for clustering by individual. The first p-value is from estimating this equation on all rounds of data, and the second p-value from all rounds of data except the first two.

Figure 3: Share choosing to give $2 to the lower-ranked player in their choice set



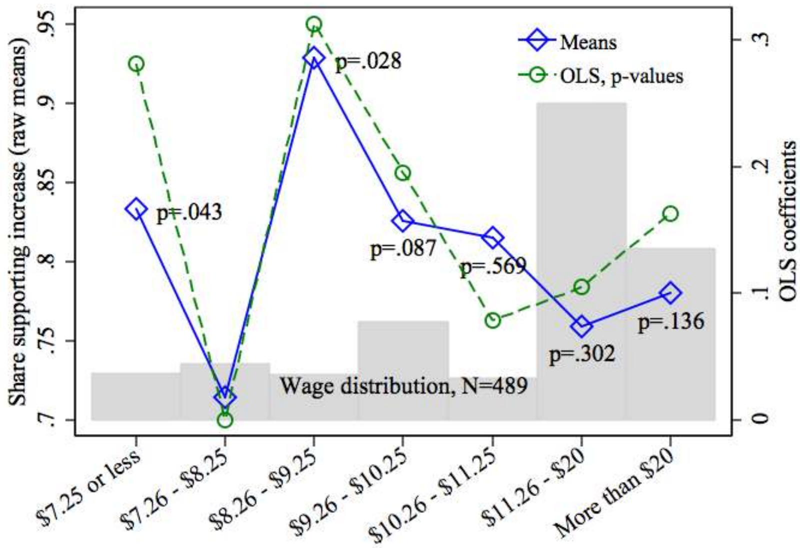
Notes: Based on seven six-player games of eight rounds each, giving a total of 336 observations. Each player except the first- and last-place player were given the choice between giving an extra $2 to the person directly above or below them in the distribution. The first-place player decided between the second- and third-place player, while the last-place player decided between the fourth- and fifth-place player. See Section 4.2 for details. All p-values are based on OLS regressions with rank fixed effects (omitted category $rank = 5$) and no other controls, with standard errors adjusted for clustering by individual. The first p-value is from estimating this equation on all rounds of data, and the second p-value from all rounds of data except the first two.

Figure 4: Share choosing to give $2 to the lower-ranked player in their choice set (eight-player game)



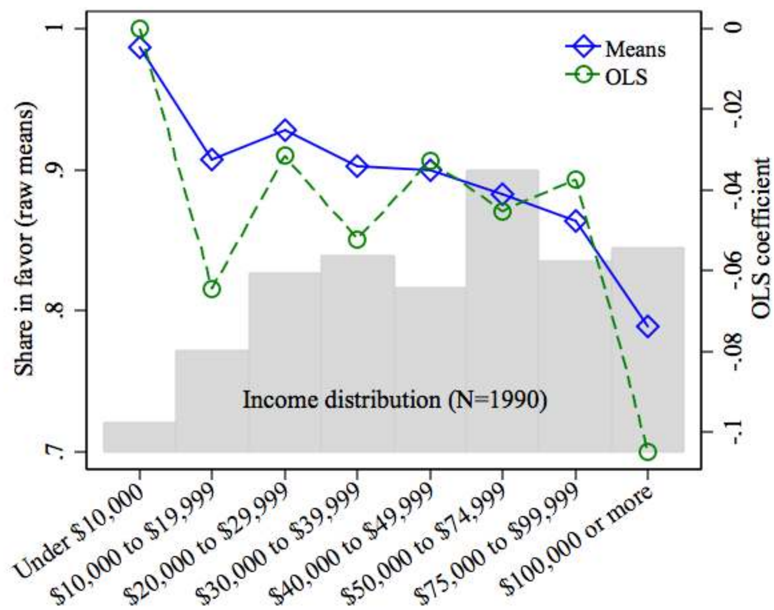
Notes: Based on nine eight-player games of nine rounds each, giving a total of 648 observations. Each player except the first- and last-place player were given the choice between giving an extra $2 to the person directly above or below them in the distribution. The first-place player decided between the second- and third-place player, while the last-place player decided between the sixth- and seventh-place player. See Section 4.2 for details. All p-values are based on OLS regressions with rank fixed effects (omitted category $rank = 7$) and no other controls, with standard errors adjusted for clustering by individual. The first p-value is from estimating this equation on all rounds of data, and the second p-value from all rounds of data except the first two.

Figure 5: Support for increasing the minimum wage from \$7.25, by wage rate



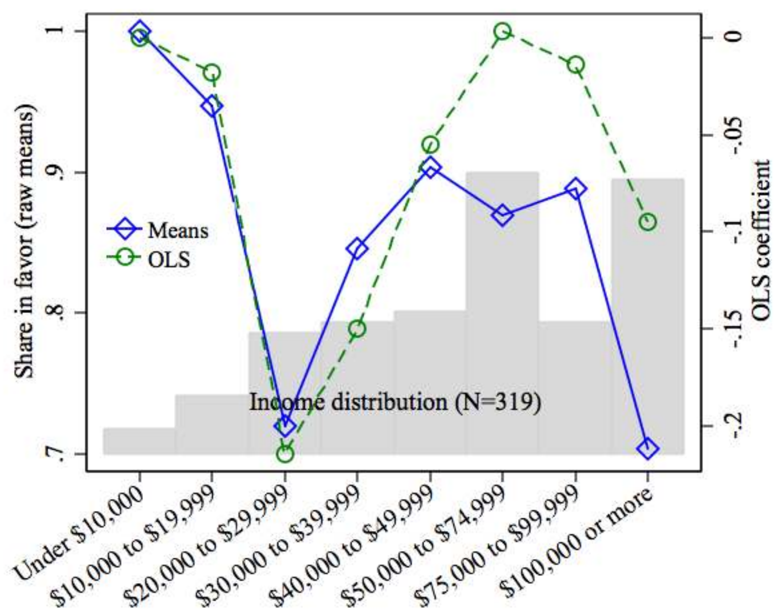
Notes: Based on authors' online survey of employed individuals ages 23 to 64. See Section 5.2 for details. The first series displays the share of each wage group that supports increasing the minimum wage. The second series plots the coefficients (with p-values labeled) on the wage-category fixed effects (omitted category $\$7.25 > wage \geq \$8.25$) from an OLS regression that also controls for gender, race, ethnicity, educational level, party affiliation, marital and parental status, approval rating of President Obama, and union status.

Figure 6: Support for increasing the minimum wage from \$5.15 to \$6.45, by family income



Notes: Based on employed individuals ages 23 to 64 in June 2001, December 2004 and March 2006 Pew surveys. See Section 5.3 for further detail. The first series displays the share of each income group that supports increasing the minimum wage. The second series plots the coefficients on the income-group fixed effects from an OLS regression that also controls for gender, race, ethnicity, educational level, party affiliation, marital and parental status, approval rating of President Bush, and union status.

Figure 7: Support for increasing the minimum wage from \$5.15 to \$7.15, by family income



Notes: Based on employed individuals ages 23 to 64 in the March 2006 Pew survey. Otherwise all analysis follows that in Figure 6.

Table 1: The effect of rank on propensity to choose the lottery over the certain payment

	Dependent variable: Chose the lottery over the certain payment							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Last or fifth place	0.390***	0.357**	1.046***	0.464***	0.450***	0.376**	0.441***	0.297
	[0.126]	[0.147]	[0.377]	[0.134]	[0.137]	[0.178]	[0.142]	[0.228]
Current balance				0.0258**	0.0266**	0.0276**	0.0359	0.0296**
				[0.0127]	[0.0126]	[0.0127]	[0.0219]	[0.0126]
Winning lottery payment				-0.0909	-0.0910	-0.0907	36.37	-0.0901
				[0.0635]	[0.0635]	[0.0630]	[31.44]	[0.0633]
Certain payment				0.133	0.131	0.129	-48.51	0.123
				[0.154]	[0.154]	[0.152]	[41.93]	[0.154]
Could catch next player					0.0512			
					[0.154]			
Below median						0.124		
						[0.167]		
Δ Disadv. inequality							4.044	
							[3.492]	
Δ Adv. inequality							-4.052	
							[3.492]	
Rank								0.0590
								[0.0678]
Rounds	All	Ex. early	First	All	All	All	All	All
Observations	648	504	72	648	648	648	648	648

Notes: Based on twelve six-player games of nine rounds each. All regressions are estimated via probit and include round fixed effects and cluster standard errors by individual player. The dependent variable for all regressions is an indicator variable coded as one if the subject chose the gamble over the risk-free payment. See Section 3 for further details on the experiment. In specifications that "exclude early" rounds, the first two rounds are not included. "Could catch next player" is an indicator variable for $x_i + winning\,payment > x_{i+1}$, where x_i is player i's current balance and x_{i+1} is that of the player directly above him. Following Fehr and Schmidt (1999), *Disadvantageous inequality* is defined as $\sum_{j \neq i} \max\{x_j - x_i, 0\}$ and *Advantageous inequality* as $\sum_{j \neq i} \max\{x_i - x_j, 0\}$. The Δ for each of these variables is defined as the expected value when player i plays the lottery minus the value when he takes the certain option. ${}^{*}p < 0.10, {}^{**}p < 0.05, {}^{***}p < 0.01$.

Table 2: The effect of rank on propensity to forgo the additional $1

	Dependent variable: Chose to forgo the additional dollar							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Second-to-last place	-0.786*	-1.006*	-0.482	-0.847*	-0.388	-0.794*	-0.501	-0.854*
	[0.463]	[0.515]	[0.422]	[0.457]	[0.518]	[0.482]	[0.472]	[0.456]
Below median			-0.396	-0.209				
			[0.293]	[0.306]				
Δ Disadv. inequality					-0.113	-0.0602		
					[0.109]	[0.116]		
Rank							-0.113	-0.0602
							[0.109]	[0.116]
Rounds	All	Ex. early	All	Ex. early	All	Ex. early	All	Ex. early
Observations	192	144	192	144	192	144	192	144

Notes: Based on four six-player games of eight rounds each. All regressions are estimated via probit, include round fixed effects and a separate control for being in last place (as this player's choice set is not directly parallel to the others), and cluster standard errors at the individual level. The dependent variable is an indicator variable for whether the individual chose to forgo the additional $1 so that another player (the last-place player, for ranks one through five; the second-to-last-place player, for the last-place player) could instead receive $2. See Section 4.1 for further details on the experiment. *Disadvantageous inequality* is defined as $\sum_{j \neq i} \max\{x_j - x_i, 0\}$, and $\Delta \textit{Disadvantageous inequality}_i$ is defined as this sum when the player i forgos the additional dollar minus this sum when he keeps it. This variable is collinear with $\Delta \textit{Advantageous inequality}$ and thus we cannot estimate both. $^{*}p < 0.10, ^{**}p < 0.05, ^{***}p < 0.01$.

Table 3: Summarizing choice sets for players in the second redistribution game

Rank	Initial balance	Choice set: Give $2 to...
First	$6	Second- or third-place player
Second	$5	First- or third-place player
Third	$4	Second- or fourth-place player
Fourth	$3	Third- or fifth-place player
Fifth	$2	Fourth- or sixth-place player
Sixth	$1	Fourth- or fifth-place player

Table 4: The effect of rank on propensity to give \$2 to the lower-ranked player in choice set

	Dependent variable: Gave money to the lower-ranked player												
	Six-player games		Eight-player games									Both	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Second from last	-0.395*	-0.0985	-0.268*										
	[0.231]	[0.259]	[0.160]										
Second or third from last				-0.259**	-0.302**	-0.315*	-0.420**	-0.320**	-0.359**	-0.464	-0.522*	-0.382**	-0.379**
				[0.116]	[0.130]	[0.186]	[0.188]	[0.133]	[0.145]	[0.283]	[0.287]	[0.112]	[0.112]
Below median		-0.465**				0.0733	0.155						
		[0.234]				[0.203]	[0.220]						
Δ Gini coefficient								34.08	32.93				
								[32.80]	[35.39]				
Rank										0.0672	0.0723		
										[0.0852]	[0.0889]		
Rounds	All	All	All	All	Ex. early	All	Ex. early	All	Ex. early	All	Ex. early	All	Ex. early
Observations	336	336	648	648	504	648	504	648	504	648	504	984	756

Notes: The first three columns are based on seven six-player games of eight rounds each, giving a total of 336 observations, and the next three columns are based on nine eight-player games of nine rounds each, giving a total of 648 observations. All regressions are estimated via probit, include round fixed effects, and cluster standard errors at the individual level. The dependent variable is an indicator variable for whether the individual chose to give \$2 to the lower ranked of the two players in his choice set. See Section 4.2 for further details on the experiment. $\Delta Gini$ is defined as the Gini coefficient if the player gives the additional \$2 to the higher-ranked player minus the Gini coefficient if he gives the \$2 to the lower-ranked player. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 5: Support for minimum wage increases by hourly wages

	Support min wage increase (Yes/No)					Job worries (1-7)
	(1)	(2)	(3)	(4)	(5)	(6)
Just above current min wage	-0.243	-0.437*	-0.436*	-0.473*	-0.499*	-0.0230
	[0.234]	[0.248]	[0.253]	[0.259]	[0.269]	[0.311]
Male		-0.260*	-0.258*	-0.278*	-0.218	-0.108
		[0.139]	[0.143]	[0.147]	[0.156]	[0.176]
Black		1.064**	1.170**	1.116**	0.588	-0.0309
		[0.450]	[0.475]	[0.494]	[0.527]	[0.362]
Hispanic		-0.437	-0.415	-0.399	-0.402	0.282
		[0.437]	[0.449]	[0.478]	[0.484]	[0.591]
Age		-0.00594	-0.00480	-0.000460	0.00556	-0.00351
		[0.00623]	[0.00642]	[0.00731]	[0.00791]	[0.00816]
Specification	Probit	Probit	Probit	Probit	Probit	OLS
Demographic controls	No	Yes	Yes	Yes	Yes	Yes
Geographic controls	No	No	Yes	Yes	Yes	Yes
Background controls	No	No	No	Yes	Yes	Yes
Political controls	No	No	No	No	Yes	Yes
Observations	489	488	483	481	481	486

Notes: All data are from the minimum wage Internet survey. The first five regressions have as the dependent variable an indicator variable coded as one if the respondent says he approves of a proposed minimum wage increase. The last takes as its dependent variable the answer to the question: "Do you worry that if the minimum wage is set too high, it might make employers reduce hiring and possibly cause you to lose your job?" where one indicates "not at all worried" and seven indicates "very worried." "Demographic controls" include age, race, and ethnicity. "Geographic controls" include fixed effects for the eight Census divisions and the level of the state minimum wage. "Background controls" include marital status; an indicator for being born in the US; and indicator variables for no high school, some high school, high school degree, some college, two-year college degree, four-year college degree, master's degree, doctoral degree, professional degrees. "Political controls" include: fixed effects for major party affilation; a one-to-seven approval rating of President Obama; and union status. See Section 5.2 for further detail. $^{*}p < 0.10,^{**} p < 0.05,^{***} p < 0.01$.

Appendix Table 1: Summary statistics, experimental data

	Section 3	Section 4.1	Section 4.2	
			Six-player games	Eight-player games
Answered demographic questions	0.639	1	0.690	0.972
	(0.484)	(0)	(0.468)	(0.165)
Male	0.391	0.417	0.552	0.557
	(0.493)	(0.504)	(0.506)	(0.500)
Age	25.74	23.50	24.83	24.61
	(2.955)	(3.833)	(4.184)	(4.154)
Black	0.0652	0.125	0.103	0.0571
	(0.250)	(0.338)	(0.310)	(0.234)
Hispanic	0.239	0.0833	0.0690	0.114
	(0.431)	(0.282)	(0.258)	(0.320)
Full-time student	0.761	0.958	0.690	0.800
	(0.431)	(0.204)	(0.471)	(0.403)
Very conserv. (1) to very liberal (7)	5.261	5.292	5.414	5.343
	(1.219)	(1.429)	(1.701)	(1.295)
Not at all (1) to very religious (5)	2.326	2.875	2.586	2.371
	(1.156)	(1.262)	(1.323)	(1.265)
Observations	72	24	42	72

Notes: All observations are drawn from the pool of individuals who registered with the Harvard Business School Computer Lab for Experimental Research (CLER). In order to be eligible, individuals must not be on the Harvard University payroll, must be 18 or older, fluent in English and comfortable using a computer. For tax purposes, they must have a valid Social Security number or letter of sponsorship and visa connected to their country of tax residency. All subjects were paid $15 per hour. Additionally, in the lottery experiment, they were told a randomly chosen player would receive a cash payment equal to $20 plus his current balance in the game at that point. The $20 was given so that no player would actually leave the experiment with less money than their hourly compensation.

Appendix Table 2: Additional specifications from the lottery experiment in Table 1

	Dependent variable: Chose the lottery over the certain payment									
	Table 1, col. (1)			Table 1, col. (4)		Table 1, col. (6)		Table 1, cols. (6), (7), (8)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Last or fifth place	0.448***	0.540***	0.666**	0.520***	0.612***	0.356	0.384	1.379**	2.545***	1.477**
	[0.142]	[0.151]	[0.261]	[0.153]	[0.161]	[0.232]	[0.241]	[0.601]	[0.966]	[0.603]
Male		-0.0291			-0.00745		0.0195			
		[0.142]			[0.139]		[0.136]			
Black		-0.472			-0.485		-0.598			
		[0.474]			[0.505]		[0.479]			
Hispanic		-0.0319			-0.0574		-0.0559			
		[0.161]			[0.159]		[0.156]			
Age		-0.0404			-0.0429		-0.0556			
		[0.0368]			[0.0341]		[0.0364]			
Very conserv. (1) to very liberal (7)		-0.124**			-0.114**		-0.103*			
		[0.0543]			[0.0555]		[0.0528]			
Not at all (1) to very religious (5)		-0.0205			-0.0202		-0.0117			
		[0.0592]			[0.0561]		[0.0554]			
Estim. method	Probit	Probit	C. logit	Probit	Probit	Probit	Probit	Probit	Probit	Probit
Player fixed effects	No	No	Yes	No	No	No	No	No	No	No
Payment controls	No	No	No	Yes	Yes	Yes	Yes	No	No	No
Below-median control	No	No	No	No	No	Yes	Yes	Yes	No	No
Ineq-aversion controls	No	No	No	No	No	No	No	No	Yes	No
Linear rank control	No	No	No	No	No	No	No	No	No	Yes
Round	All	All	All	All	All	All	All	First	First	First
Observations	414	414	594	414	414	414	414	72	72	72

Notes: The dependent variable for all regressions is an indicator variable coded as one if the subject chose the gamble over the risk-free payment (see Section 3 for further details on the experiment). Each specification tests the robustness of a key result from the main text, and the column headings refer to the specification being tested. Fixed effects for educational attainment are included in cols. (2), (5) and (7). "Payment controls" include the individual's current earnings, the winning amount of the lottery and amount of the certain payment. In cols. (1), (4) and (6), observations with any missing value for the variables included in, respectively, cols. (2), (5) and (7) are dropped so that the sample is constant for each pair of specifications. Cols. (8) through (10) use only observations from the first round to test whether the effect of being in fifth or sixth place can be separated from, respectively, the effect of being below the median, inequality-aversion controls, and a linear effect of rank. $^{*}p < 0.10,^{**} p < 0.05,^{***} p < 0.01$.

Appendix Table 3: Additional specifications from the first redistribution experiment in Table 2

	Dependent variable: Chose to forgo the additional dollar						
	Table 2, col. (1)			Table 2, col. (3)		Table 2, col. (5)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Second-to-last place	-0.786*	-0.843*	-2.932***	-0.482	-0.583	-0.388	-0.470
	[0.463]	[0.465]	[1.053]	[0.422]	[0.430]	[0.518]	[0.533]
Below median				-0.396	-0.334		
				[0.293]	[0.267]		
Δ Disadv. inequality						-0.113	-0.106
						[0.109]	[0.110]
Male		-0.368			-0.346		-0.347
		[0.511]			[0.521]		[0.518]
Black		-0.538			-0.500		-0.529
		[0.704]			[0.710]		[0.710]
Hispanic		-0.124			-0.127		-0.116
		[0.719]			[0.719]		[0.722]
Age		0.0376			0.0350		0.0336
		[0.0662]			[0.0656]		[0.0664]
Very conserv. (1) to very liberal (7)		-0.0350			-0.0358		-0.0397
		[0.120]			[0.122]		[0.122]
Not at all (1) to very religious (5)		0.00802			0.0101		0.00263
		[0.180]			[0.176]		[0.182]
Estim. method	Probit	Probit	C. logit	Probit	Probit	Probit	Probit
Player fixed effects	No	No	Yes	No	No	No	No
Observations	192	192	120	192	192	192	192

Notes: The dependent variable for all regressions is an indicator variable coded as one if the subject chose to forgo the additional dollar (see Section 4.1 for a description of the experiment). Each specification tests the robustness of a key result from the main text, and the column headings refer to the specification being tested. Fixed effects for educational attainment are included in cols. (2), (5) and (7). In cols. (1), (4) and (6), observations with any missing value for the variables listed in, respectively, cols. (2), (5) and (7) are dropped so that the sample is constant for each pair of specifications. $^{*}p < 0.10,^{**}p < 0.05,^{***}p < 0.01$.

Appendix Table 4: Additional specifications from the second redistribution experiment in Table 4

	Dependent variable: Gave money to the lower-ranked player in choice set								
	Table 4, col. (4)		Table 4, col. (6)		Table 4, col. (12)			Interactions	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Second or third from last	-0.246**	-0.253*	-0.373*	-0.385*	-0.290**	-0.300**	-0.463*	0.235	-1.714***
	[0.120]	[0.134]	[0.197]	[0.199]	[0.116]	[0.123]	[0.276]	[0.211]	[0.643]
Religious (1-5) x Second or third from last								-0.224***	
								[0.0859]	
Age x Second or third from last									0.0580**
									[0.0240]
Below median			0.166	0.172					
			[0.201]	[0.209]					
Male		-0.00566		-0.00243		-0.143			
		[0.247]		[0.247]		[0.202]			
Black		0.0124		0.0137		0.0693			
		[0.407]		[0.406]		[0.269]			
Hispanic		-0.0604		-0.0551		-0.254			
		[0.397]		[0.393]		[0.354]			
Age		-0.0348		-0.0346		-0.00373			-0.0208
		[0.0295]		[0.0294]		[0.0256]			[0.0270]
Very conserv. (1) to very liberal (7)		0.238**		0.238**		0.0906			
		[0.109]		[0.109]		[0.0755]			
Not at all (1) to very religious (5)		0.219*		0.219*		0.156*		0.198**	
		[0.129]		[0.129]		[0.0823]		[0.0816]	
Estim. method	Probit	Probit	Probit	Probit	Probit	Probit	C. logit	Probit	Probit
Player fixed effects	No	No	No	No	No	No	Yes	No	No
Observations	630	630	630	630	862	862	489	862	862

Notes: The dependent variable for all regressions is an indicator variable coded as one if the subject chose to give to the lower-ranked member in his choice set (see Section 4.2 for a description of the experiment). Each specification in cols. (1) though (7) tests the robustness of a key result from the main text, and the column headings refer to the specification being tested. Fixed effects for educational attainment are included in cols. (2), (4) and (6). In cols. (1), (3) and (5), observations with any missing value for the variables listed in, respectively, cols. (2), (4) and (6) are dropped so that the sample is constant for each pair of specifications. Cols. (8) and (9) add interaction terms to the Table 4 col. (12) specification. $^{*}p < 0.10,^{**} p < 0.05,^{***} p < 0.01$.

Appendix Table 5: Summary statistics, minimum wage surveys

	Online survey	Pew Research Center surveys	
	All	All	Fam. inc.< $50,000
Male	0.301	0.520	0.476
	(0.459)	(0.500)	(0.500)
Married	0.280	0.600	0.440
	(0.450)	(0.490)	(0.497)
Age	44.32	41.39	39.94
	(10.72)	(10.62)	(11.03)
Black	0.0593	0.111	0.157
	(0.236)	(0.315)	(0.364)
Hispanic	0.0184	0.112	0.134
	(0.135)	(0.316)	(0.341)
College graduate	0.382	0.337	0.195
	(0.486)	(0.473)	(0.396)
Family income last year	59458.1	69446.4	30090.4
	(43498.5)	(50935.8)	(11363.2)
Supports minimum wage	0.785	0.872	0.907
increase	(0.411)	(0.334)	(0.291)
Observations	489	2544	1136

Notes: All data taken from Pew surveys from June 2001, December 2004, and March 2006. Only individuals who report being employed are sampled.

Appendix A Instructions for the lottery game

Scrambled is a game of chance, where you play against other players in your row. In this version of the game, most of you are not playing for real money. However, at the end of the session, the computer will automatically select one round from one player in the session. That player will be given an extra $20.00 plus whatever they won or lost in the selected round. With that in mind, you should play the whole game as if you are playing for real money.

To get started, please type your name or nickname in the field provided and click the button to continue. Then, wait for further instructions.

[Wait 15 seconds People should be standing up.]

At this point, everyone should see a big red stop sign on their screen. Please raise your hand if you dont see a stop sign.

[Fix problems until everyone sees the stop sign.]

Before we continue, there are two things I need to mention:

(i) You will play a number of rounds in this game. In each round, before you can proceed to the next round, everyone in your row must first make a decision. If you feel you have been waiting too long, please raise your hand and I will come around and see whats going on.

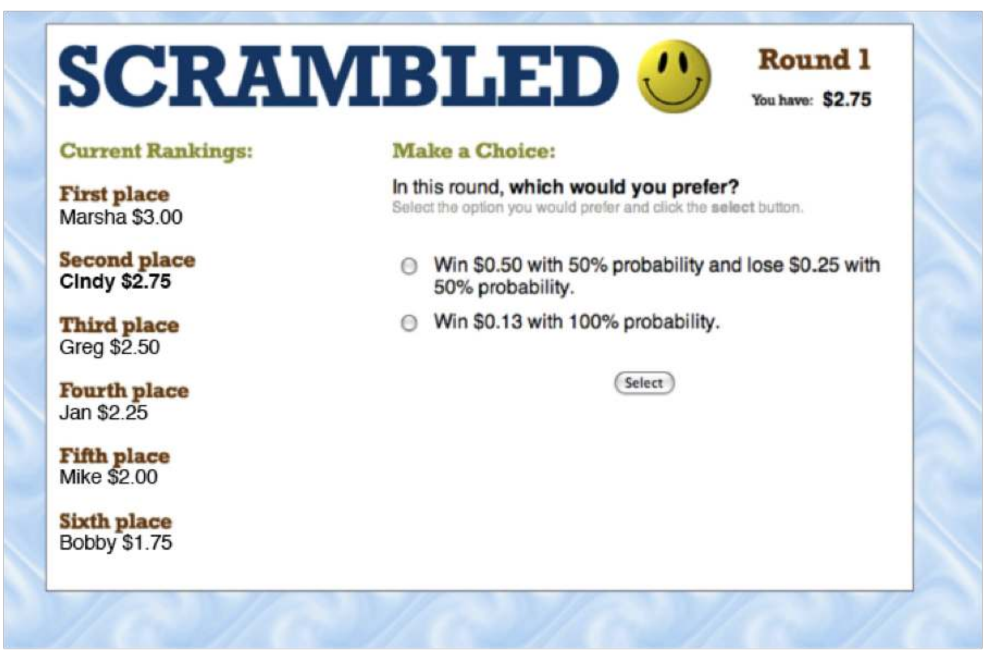
(ii) Please dont click the next, back or refresh buttons in your browser while playing this game. If you do, it will break the game for all of the players in your row.

Does anyone have any questions at this point?

Please sit down and click the button to continue. You will now see instructions about how to play the game. Once you have read the instructions, you will be able to click the button to get started.

Please read the instructions and click the button marked Continue to begin the game

Typical screenshot from the lottery game



Appendix B Solving for the Nash Equilbirum of the Lottery Experiment

Assumptions

As discussed in the text, we assume individuals play each round as a one-shot game. We also assume that when the fifth-place player takes the "certain" option, the last-place player can pass him if he wins the lottery (a condition that holds in the majority of rounds in the data).

Claim 1. *The dominent strategy of players in ranks one through four is to choose the "certain" option, whereas for sufficiently large α the players in ranks five and six will play a mixed strategy between the "certain" option and the lottery.*

Proof. The proof for ranks one through four is outlined in Section 3 and here we just focus on the last- and fifth-place players.

Since the game is finite by assumption and meets the other conditions of the Nash Existence Theorem, there must be an NE between these two players. Here, we show that there is no pure-strategy NE, so it must be the case that the two players play a mixed strategy between taking the lottery option and taking the certain option.

Below we show that for sufficiently large α none of the four potential pure strategies are NEs.

Both pick "certain"

If the fifth-place player picks the certain option, then the last-place player will play the lottery whenever

$$\frac{3\alpha}{4(1-\alpha)} > f(y+\theta_{certain}) - (\tfrac{1}{4}f(y-\theta_{lose}) + \tfrac{3}{4}f(y+\theta_{win})),$$

equation (3) from the text (y is his current balance). In other words, so long as α is sufficiently large, the last-place player is willing to take on additional risk for the possibility of escaping last place.

Last-place player picks "certain" and fifth-place player picks lottery

If the last-place player plays certain, then the fifth-place player can always maintain his rank by also playing certain. He will always prefer this option because he is risk-averse and prefers not to take a gamble of equal expected value to the certain option. Moreover, this option also brings a risk of losing the lottery and falling into last-place himself, which has additional, negative utility consequences for any positive value of α.

Fifth-place player picks "certain" and last-place player picks lottery

This case was already examined in Section 3. If the last-place player plays the lottery, then the fifth-place player would rather play the lottery whenever

$$\frac{9\alpha}{16(1-\alpha)} > f(y+\theta_{certain}) - (\tfrac{3}{4}f(y-\theta_{lose}) + \tfrac{1}{4}f(y+\theta_{win})),$$

equation (4) from the text.

Both pick lottery

The last-place player would rather pick the "certain" option, because if the fifth-place player picks the lottery, then playing the lottery never gives the last-place player any greater chance of moving up than does playing the certain option regardless of whether the fifth-place player wins or loses. Thus, he would rather avoid the risk and play the safe option.

Consider the two possibilities when the fifth-place player picks the lottery. If he wins, then even if the last-place player also wins the lottery he cannot move up, so playing the lottery offers him no greater chance of moving up than does the certain option (both offer a probability of zero).

If the fifth-place player loses the lottery, then, as we show below, he will fall into last place with probability one if the last-place player picks the "certain" option. Thus, playing the lottery gives the sixth-place player no greater chance of moving up under this scenario either.

Using the notation from Section 3, let the current balances of the last-place, fifth- and fourth-place place player be, respectively, $\delta_6 < \delta_5 < \delta_4$. Recall that $\theta_{certain} = \frac{\delta_5 - \delta_6}{2}$ and $\theta_{win} = \delta_4 - \delta_6$.

By construction, $\frac{3}{4}\theta_{win} - \frac{1}{4}\theta_{lose} = \theta_{certain}$, or, $\theta_{lose} = 3\theta_{win} - 4\theta_{certain}$.

Substituting the formulae for θ_{win} and $\theta_{certain}$ gives:

$$\theta_{lose} = 3(\delta_4 - \delta_6) - 4\left(\frac{\delta_5 - \delta_6}{2}\right),$$

or,

$$\theta_{lose} > 3(\delta_5 - \delta_6) - 4\left(\frac{\delta_5 - \delta_6}{2}\right) = \delta_5 - \delta_6.$$

So, if the fifth-place player loses the lottery, we have that

$$\delta_5 - \theta_{lose} < \delta_5 - (\delta_5 - \delta_6) = \delta_6.$$

Therefore, the last-place player will always move up by picking the certain option (or, in fact, by doing nothing, though that is not an option). ■

Appendix C Instructions for redistribution games

The Moneybags Game is a game where you play with X other players in the lab. During the game, you will play several rounds, and 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.

During each round, you will be presented with a choice about who 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 players choice, and award the additional money as that player decided. At that point, everyones score will be updated, but you will not be shown the final score from the round. Then, a new lottery will be held and the next round will automatically begin.

In this version of the game, most of you are not playing for real money. However, at the end of the session, the computer will automatically select one round from one group and every player in that group will receive their final score from that round. With that in mind, you should play the whole game as if you are playing for real money.

To get started, please type your name or nickname in the field provided and click the button to continue. Then, wait for further instructions.

[Wait 15 seconds People should be standing up.]

At this point, everyone should see a big red stop sign on their screen. Please raise your hand if you dont see a stop sign.

[Fix problems until everyone sees the stop sign.]

Before we continue, there are two things I need to mention:

(i) As I mentioned before, you will play a number of rounds in this game. In each round, before you can proceed to the next round, everyone in your group must first make a decision. If you feel you have been waiting too long, please raise your hand and I will come around and see whats going on.

(ii) Please dont click the next, back or refresh buttons in your browser while playing this game. If you do, it will break the game for all of the players in your group.

Does anyone have any questions at this point?

Please sit down and click the button to continue. Well now play a practice round together. This round is for practice only. If you have any questions during the practice round, please raise your hand. When the practice round ends, you will automatically begin with round 1. Click the continue button to start the practice round.

Typical screenshot from the first redistribution game