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Social Reference Points and Risk Taking

by

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Abstract

We test whether social reference points impact individual risk taking. In a laboratory experiment, decision makers observe the earnings of a peer subject before making a risky choice. We exogenously manipulate the peer earnings across two treatments. We find a significant treatment effect on risk taking: decision makers vary their risk taking in order to surpass or stay ahead of their peer. Our findings are consistent with a social-comparison-based, reference-dependent preference model that formalizes relative concerns via social loss aversion. Additionally, we relate our findings to the impact of private reference points on risk taking.

Keywords: Social Comparisons, Social Loss Aversion, Reference-Dependent Preferences, Lab Experiments, Relative Income Concerns.

JEL: C91, D03, D81.

Social reference points are embedded in many decision making contexts—and most of the time, they should be irrelevant to the decision at hand according to standard economic theory. Take, for example, a risky choice that only affects the outcome of the decision maker. Whether the context provides information on the earnings of another individual or not should be negligible to the decision maker. However, outcomes of others are often an important source of reference for individuals. Such cues for social comparisons affect important facets of the subjective well-being of individuals: their self-assessment, job satisfaction, fairness judgement, happiness, and reward-related brain activity (see, e.g., Festinger, 1954, Akerlof and Yellen, 1990, Clark and Oswald, 1996, Fehr and Gächter, 2000, Luttmer, 2005, Fliessbach, Weber, Trautner, Dohmen, Sunde, Elger and Falk, 2007 and Card, Mas, Moretti and Saez, 2012). In consequence, social reference points—by triggering relative concerns—may motivate individuals to modify their behavior: to accomplish favorable or avoid unfavorable social comparisons. In this study, we test these behavioral implications of social reference points.

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While the idea that relative concerns are an important motive for human behavior is not new (see, e.g., Veblen, 1899, Duesenberry, 1949 and Frank, 1985a,b), it is inherently difficult to test. First, the relevant social reference points of individuals are difficult to observe. Second, a convincing exogenous variation of social reference points is hard to obtain. Third, individuals usually observe outcomes and behavior of others simultaneously, and (expect that) others observe their own behavior and outcomes. This impedes the identification of relative concerns in isolation of additional peer effects—e.g., imitation, learning, and social pressure are important determinants for individual behavior (Sacerdote, 2001, Falk and Ichino, 2006, Mas and Moretti, 2009).

The primary contribution of our study is to offer a novel approach that allows to draw causal inference about the impact of social reference points on risk taking. In a laboratory experiment, decision makers observe the earnings of a peer subject before making a risky choice. We exogenously vary this social reference point across two treatments. By comparing the risky choices between the two treatments, we identify the impact of social reference points on risk taking. Other peer effects are ruled out: decision makers cannot imitate the behavior of other decision makers, as they never observe the behavior of others; decision makers are not driven by social pressure, as they know that their outcomes and behavior are not revealed to others.

In our experiment, two subjects participate per lab session. We assign them to one of two roles—a decision maker and a peer—by a coin toss in front of their eyes. The peer receives a fixed payment of s. The decision maker receives the outcome of his preferred binary lottery. Each lottery (x, q) in his choice set pays an upside of $x \in [\underline{x}, \overline{x}]$ with a likelihood of q and pays nothing with $1 - q$. His choice involves a tradeoff between choosing riskier lotteries—that combine larger upsides with lower likelihoods of receiving them—or less risky lotteries—that combine lower upsides with higher upside likelihoods.

We use a between-subject design to test the impact of social reference points on risk taking. The decision makers learn the fixed payment of the peer before they receive any information on their risky choice and before they choose their preferred lottery. One group of decision makers observes peer earnings of s_{HI} (HI treatment), and the other group observes s_{LO} (LO), with $\overline{x} > s_{\text{HI}} > \underline{x} > s_{\text{LO}}$.

To derive predictions for our experiment, we formalize the impact of relative concerns on individual behavior in a simple model of reference-dependent preferences. Starting with Kahneman and Tversky's (1979) prospect theory, models of reference-dependent preferences formalize behavioral consequences of loss aversion around reference points that are based on private outcomes: e.g., (lagged and/or current) status quo or expected outcomes (see, e.g., Bell, 1982, 1985, Loomes and Sugden, 1982, 1986, Tversky and Kahneman, 1991, Gul, 1991, Kőszegi and Rabin, 2006, 2007, 2009 and Baucells, Weber and Welfens, 2011). Our model assumes individuals to be loss averse around the earnings of their peer: while they like earning more and dislike earning less than their peer, they weight social losses more than equal-sized social gains.

In case relative concerns play no role, we should expect no difference in risk taking across treatments. However, the manipulation of the peer earnings changes the risk-taking incentives for subjects who are social loss averse: in the LO treatment, unfavorable relative outcomes are unlikely to follow from choosing a lottery with a low upside and, therefore, a high likelihood of receiving it; on the contrary, in the HI treatment, avoiding a "social loss" can only follow from choosing a lottery with a large upside, and, therefore, a lower upside likelihood. Thus, social loss averse decision makers should, on average, pick riskier lotteries in the HI compared to the LO treatment.

This is precisely what we observe. The average chosen upside likelihood of 34 subjects in the HI treatment is 63%, and of 33 subjects in the LO treatment is 73%: decision makers accept more risk in case their peer's earnings are greater. This treatment effect is statistically significant and robust to controlling for individual risk attitudes. Thus, our main result indicates that social reference points—by triggering relative concerns—impact individual behavior.

Our main finding complements previous research on relative concerns (Veblen, 1899, Frank, 1985a, 2005, Bowles and Park, 2005, Heffetz, 2011). For example, Neumark and Postlewaite (1998) study female labor supply and show that women are more likely to be employed if their husbands earn less than the husband of their (non-employed) sisters; Kuhn, Kooreman, Soetevent and Kapteyn (2011) study car purchase decisions and find that (non-winning) close neighbors of winners in the Dutch Postcode Lottery are more likely to buy a car 6 months after the lottery took place. Both studies yield interesting and useful results on how social comparisons affect behavior. However, only Kuhn et al. (2011) can be certain about the exogenous variation of their social reference points, and neither can be certain to rule out all other peer effects than relative concerns: their decision makers and peers interact in such ways that allow for, e.g., social pressure and conformism to be behaviorally relevant. In contrast, our study leaves no room for other peer effects and thus allows to draw causal inference of relative concerns on risk taking.

Our study is also related to experiments on status concerns (e.g., Ball, Eckel, Grossman and Zame, 2001 and Huberman, Loch and Onculer, 2004). In these experiments, status is induced by publicly—i.e., in front of peer subjects—announcing winners in "competitive" stages. Our experiment does not share this feature: the outcomes of decision makers are not announced to their peer. Status concerns are defined to constitute a preference for favorable relative outcomes that are socially recognized (see, e.g., Heffetz and Frank, 2011). Our main result indicates that relative concerns are behaviorally relevant, independent of social recognition.

By testing how social reference points impact behavior, our study contributes to the literatures on reference-dependent preferences and social preferences.

Models with private reference points—e.g., status quo or expectations—received empirical support in several economic applications: e.g., risk taking (see, e.g., Kahneman and Tversky, 1979 and Sprenger, 2011), the endowment effect (see, e.g., Kahneman, Knetsch and Thaler, 1990, Ericson and Fuster, 2011), the equity premium puzzle (see e.g., Benartzi and Thaler, 1995), labor supply (see, e.g., Camerer, Babcock, Loewenstein and Thaler, 1997, Crawford and Meng, 2011), the disposition effect (see, e.g., Odean, 1998), and effort provision (see, e.g., Abeler, Falk, Goette and Huffman, 2011, Gill and Prowse, 2012). However, recent evidence suggests that they are insufficient to cover all reference-dependent behavior (e.g., Engelmann and Hollard, 2010, Heffetz and List, 2013 and Gneezy, Goette, Sprenger and Zimmermann, 2013). Our contribution to the literature on reference-dependent preferences is threefold.

First, we test and provide support for a new source of reference: outcomes of others.[1]

Second, we study the relative importance between social and private, expectation-based reference points for individual behavior. We compare our main finding with the impact of private, expectation-based reference points on the same risky choice for the same sample of decision makers. We show that private, expectation-based reference points—induced like in Abeler et al. (2011)—impact risk taking in equal magnitude compared to social reference points. This indicates that social and private reference points are of similar relevance for individual behavior in our context.

Third, in an additional experiment with a new sample of decision makers, we investigate a potential connection between social and private, expectation-based reference points. It is conceivable that outcomes of others are an important ingredient for the formation of expectations. This notion implies that relative concerns simply capture private loss aversion relative to private, expectation-based reference points. In that case, the decision makers in our main experiment expect to earn as much as their peer after they learn their peer's earnings—an expectation that would differ between our two treatments. If decision makers do not revise their expectations after learnings that their peer's earnings are irrelevant to their risky choice, the difference in their risk taking may be caused by the difference in their "lagged" expectations.[2] In the lagged expectations (henceforth EX) experiment, we test whether lagged expectations explain our main result. The EX experiment is identical to our main experiment, but only one subject participates in each lab session. The experimenter randomly assigns the subject to be either active or passive. Passive subjects receive the same earnings as peers in the main experiment (s_{HI} in EX-HI and s_{LO} in EX-LO), and active subjects face the same risky choice as decision makers in the main experiment. Active subjects choose their preferred lottery after learning what they would have earned if they had been assigned to be passive. This information allows active subjects to form different expectations across treatments before they receive information on their risky choice. Since no peer is present, relative concerns are ruled out. The results of the EX experiment indicate that lagged expectations in isolation of a social

[1] Related to that is Linde and Sonnemans (2012). They test whether prospect theory's reflection effect extends to social settings, i.e., whether the curvature of the social gain (loss) function is concave (convex). While they do not find support for a social reflection effect, we provide evidence for social loss aversion.

[2] While models of reference-dependent preferences that assume individuals to form reference points based on rational expectations (e.g., Kőszegi and Rabin, 2007) do not necessarily predict an impact of these lagged expectations, recent evidence indicates that they may have an influence, see Song (2012).

context are not sufficient to explain our main result.

Our study also contributes to the literature on social preferences and models of inequity aversion (see e.g., Fehr and Schmidt, 1999, Bolton and Ockenfels, 2000, Charness and Rabin, 2002 and Falk and Fischbacher, 2006). These models also assume peer earnings to serve as reference points and are used to describe behavior when individuals interact with their peers, e.g., in allocation games, where an individual affects both her own and the outcomes of a peer.[3] In our main experiment, decision makers choose a lottery that only affects their own earnings. Thus, our findings indicate that inequity aversion models also apply to private decisions in which individuals do not affect outcomes of their peers. However, we present additional evidence that competitive variants of inequity aversion models—in which individuals like being ahead of their peer and dislike being behind (see e.g., Fershtman, Gneezy and List, 2012)—explain our data best.[4] In contrast, inequity aversion typically assumes that individuals dislike any difference in earnings.

In the following, we proceed with the main experimental design in Section 1. Section 2 derives predictions for the experiment. Section 3 presents the main result of the experiment. Section 4 discusses alternative mechanisms behind social reference points rather than relative concerns. Section 5 concludes.

1 Experimental Design

The main experiment is designed to allow for a precise measurement of risk taking while decision makers are aware of the earnings of a peer subject. Between two treatments, we exogenously manipulate the predetermined earnings of the peers. A between-subject comparison of the willingness to take risk across the treatments allows us to identify the impact of social reference points on risk taking.

Two subjects participate in each lab session. Upon their arrival, the experimenter tosses a coin in front of their eyes to assign them to one of two roles: a decision maker and a peer (called participant A and B). Thereafter, the subjects receive instructions in private, which reveal the following common knowledge: both subjects complete a survey and receive earnings consisting of two parts, a constant participation fee and an additional payment each. The instructions are also in part role-specific. The decision maker learns, first, that his peer receives s additionally. Second, he is told that his own payment is not predetermined, but the outcome of a risky choice he makes before completing the survey. Third, he gets to know that his peer receives no information on his additional payment. Forth, he learns about the risky choice. The peer receives non of the above information.

The risky choice (Andreoni and Harbaugh, 2010) is constant between the two treatments. Each decision maker chooses his preferred binary lottery from a set of lotteries

[3] E.g., Bolton, Brandts and Ockenfels (2005) and Bolton and Ockenfels (2010) study risk taking when decision makers affect both their own and the outcomes of a peer.

[4] This is inline with Cappelen, Konow, Sørensen and Tungodden (2013), who show that risk-taking subjects are less eager to equate earnings with non risk-taking subjects.

$\{(x_i, q_i)\}_{i=0}^{100}$. Each lottery pays an upside of $x_i = 16.5 - 13.5q_i$ with an upside likelihood of $q_i = i/100$ and nothing instead. The set of lotteries entails, for example, a certain payment of 3 euros, a payment of 8.75 euros with a likelihood of 50%, and a payment of 16.23 euros with a likelihood of 2%. Each decision maker faces a tradeoff between choosing a riskier lottery—that combines a larger upside with a lower upside likelihood—or a less risky lottery—that combines a lower upside with a higher upside likelihood. We use a visual elicitation method that allows to facilitates the understanding of the tradeoff decision makers face when choosing their preferred lottery, see Figures 2 and 3.

In the HI treatment, the decision maker chooses his preferred lottery after learning that his peer receives $s_{\mathrm{HI}} = 8$ euros additionally. If he has relative concerns, the risky choice allows him to choose a lottery that combines a relatively low upside likelihood with a large upside, in order to have a chance not to earn less than his peer. In the LO treatment, the decision maker's peer receives $s_{\mathrm{LO}} = 2$ euros. A decision maker with relative concerns increases his chance not to earn less than his peer by choosing a lottery that combines a higher upside likelihood with a lower upsides.

The only variation between the two treatments is the level of the peer earnings. Thus, any difference in the decision makers' risk taking between the treatments allows us to draw causal inference about the impact of social reference points. Our design rules out the influence of other peer effects—e.g., imitation, learning, or social pressure: decision makers cannot observe other decision makers; decision makers know that their outcomes and behavior are not revealed to others.

Additionally, we ask both subjects to indicate whether they know each other prior to the experiment. This allows us to restrict our analysis to pairs of decision maker and peer that do not know each other previous to the experiment.

1.1 Second stage

The decision makers participate in additional choice tasks 1-2 weeks after the first part of the main experiment. First, a risky choice task elicits the risk attitude of each decision maker, which is used as a control variable in the analysis of the first part of the main experiment. Each decision maker faces 20 price-list styled decisions. Each decision is a choice between Alternative Y, a certain amount of money, and Alternative X, a binary lottery. Alternative Y is always 3 euros. Alternative X is a different lottery for each decision. Along the 20 decisions, Alternative X is getting more risky. Subjects are expected to start choosing Alternative X and to switch to Alternative Y according to their risk attitude. Table 3 lists all 20 decisions.[5]

Secondly, another risky choice task elicits the impact of private, expectation-based reference points on individual risk taking. We use this task to compare the impact of

[5]This price-list elicitation method allows decision makers to switch multiple times. In fact the choices of 33% of the decision makers do not result in one unique switching point. The mean switching point of these subjects is used to proxy their risk attitude.

social and private, expectation-based reference points on the same risky choice. Each decision maker chooses his preferred lottery from the same set of lotteries as in the first part of the experiment. This time, their preferred lottery is payoff relevant only with a likelihood of 50%. If their preferred lottery is not implemented, they receive r instead, a fixed amount of money. Decision makers choose their preferred lottery before knowing whether their choice counts or they receive r, with $r_{\text{HI}} = 8$ and $r_{\text{LO}} = 2$. Following expectation-based, reference-dependent preference models (Kőszegi and Rabin, 2007), r is part of their expected payoff when choosing their preferred lottery and capable of affecting their risk taking. For every decision maker, we set $r_i = s_i$, for $i \in \{\text{HI,LO}\}$.

Thirdly, two dictator games measure whether decision makers tend to be inequity averse. We use this task to investigate whether the degree of inequity aversion of decision makers is correlated with their risk taking in the LO treatment. This allows us to test a predication of our social-comparison-based, reference-dependent preferences model. Section 4 discusses this in detail.

1.2 EX experiment

We conducted another experiment with a new set of subjects to investigate a potential connection between social and private, expectation-based reference points. It is conceivable that decision makers expect to receive the same earnings as their peer when they observe their peer's earnings in our main experiment. In the EX experiment, we test whether such lagged expectations impact risk taking without a social context. Section 4 discusses the motivation, design and results of the EX experiment in detail.

1.3 Procedures

Both experiments were conducted at two rooms of the Bonn Graduate School of Economics in fall 2012 and early 2013. By using two rooms, both treatments were conducted simultaneously. In total, 144—72 decision makers and 72 peers—subjects participated in 72 sessions of the main experiment and 138—72 active and 68 passive—subjects participated in 138 sessions of the EX experiment. No subject participated in more than one experiment and/or treatment. We invited only male subjects to keep the sample homogenous. Each session lasted for 12 to 20 minutes. Each subject earned on average 8.5 euros. The second part of both experiments was conducted at the BonnEconLab. The second part of the main (EX) experiment consisted of 5 (3) sessions, in which 68 (62) subjects participated; attrition rate of 5,6% (13.9%). Each session lasted for 40-60 minutes. Subjects earned on average 12.7 euros. Both parts of both experiments were computerized using the softwares z-Tree and ORSEE (Fischbacher, 2007, Greiner, 2004).[6]

[6] We focus on the sample of 67 (62) decision makers in the main (EX) experiment. In the main (EX) experiment, four (ten) subjects did not complete both stages and one decision maker knew his peer previous to the experiment. The results are the same when including all subjects when possible.

2 Predictions

This section examines how subjects are predicted to behave in the main experiment. We consider two cases: subjects do not or do care about their earnings relative to their peer. Our setup can be described as follows: a decision maker learns that his peer earns s. Then, he chooses a binary lottery from a set of lotteries $\{(x_i, q_i)\}_{i=0}^{100}$, with $x_i = m - rq_i$ and $q_i = i/100$. He faces a tradeoff between choosing a riskier lottery—that combines a large upside with a low upside likelihood—or a less risky lottery—that combines a lower upside with a higher upside likelihood: choosing a lottery over another lottery with a grater upside likelihood by one percentage point, implies choosing a smaller upside by $r/100$. In the HI treatment, we set $s = s_{\mathrm{HI}}$, and in the LO treatment, $s = s_{\mathrm{LO}}$, with $\frac{1}{2}\overline{x} > s_{\mathrm{HI}} > \underline{x} > s_{\mathrm{LO}} > 0$. This implies that lotteries with a relatively low upside are above (below) the social reference point in the LO (HI) treatment. Additionally, the social reference point in the HI treatment is "reachable." Decision makers do not need to accept extremely risky lotteries in oder to be able to catch up with their peer.

First, we consider a standard model of risky decision making. An individual maximizes his expected utility, $U(x, q) = qu(x)$, under the restriction of $x = m - rq$. This decision problem is independent of s, their social reference point. Therefore, the standard model predicts no difference in risk taking between our treatments.

Based on the evidence that relative concerns affect the subjective well-being of individuals (see Clark, Frijters and Shields, 2008, for an overview), we designed and conducted our experiment under the hypothesis that the relative concerns of decision makers shape their risk taking. In the following, we examine a simple social-comparison-based, reference-dependent preference model to guide this hypothesis. The utility function of our model uses piecewise, ex post comparisons between potential outcomes and the social reference point. Following Fehr and Schmidt (1999), Bolton and Ockenfels (2000), Charness and Rabin (2002) and Falk and Fischbacher (2006), we use peer earnings as reference points. Following Kőszegi and Rabin (2006, 2007), we weight the ex post comparisons between outcomes and reference points by the likelihood of their occurrence. Our model abstracts from other reference points, since our treatment manipulation involves a variation of social reference points only. However, Section 4 discusses a potential connection between private and social reference points in our setup.

The decision maker is modeled to evaluate a lottery by considering both the "consumption utility" he derives from the lottery and the "social-gain-loss utility" relative to his peer earnings. The expected consumption utility is the expected utility of the lottery, i.e. $qu(x)$. Assuming that utility is approximately linear in x, the expected consumption utility reduces to the expected outcome of the lottery, i.e., qx. The social-gain-loss utility, $\mu(\cdot)$, captures the two ex post earnings comparisons, $x - s$ and $0 - s$. For small arguments z, it is assumed that $\mu(z)$ is piecewise linear: $\mu(z) = z$ for $z \geq 0$ and $\mu(z) = \lambda z$ for $z < 0$. Our model assumes that decision makers like earning more than their peers and dislike earning less. It captures social loss aversion with $\lambda > 1$, i.e., social losses loom larger than equal-sized social gains. The expected utility of choosing a lottery with $x > s$ is

$$U(x, q|s) = qx + q(x - s) + (1 - q)\lambda(0 - s). \tag{1}$$

The first term on the right-hand side is the expected consumption utility of the lottery. The second term is the expected social gain, and the third term is the expected social loss. The social loss is weighted by the social loss aversion parameter λ.

For lotteries with $x < s$, the expected social gain-loss utility collapses to losses only,

$$U(x, q|s) = qx + q\lambda(x - s) - (1 - q)\lambda(s). \tag{2}$$

Consider first the LO treatment. Because a decision maker can only choose lotteries with an upside above his peer's earnings, i.e., $\underline{x} > s_{\mathrm{LO}}$, he maximizes his expected utility of eq. (1) under the restriction of $x = m - rq$, yielding

$$\frac{\partial U(q|s_{\mathrm{LO}})}{\partial q} \stackrel{!}{=} 0 \Leftrightarrow q^*_{\mathrm{LO}} = \frac{m}{2r} + s_{\mathrm{LO}}\frac{\lambda - 1}{2r}.$$

Compared to the standard model of risky choice—with $\lambda = 1$—, social loss aversion induces the decision maker to choose a less risky lottery, i.e., $s_{\mathrm{LO}}\frac{\lambda-1}{2r} > 0$. By increasing q, the decision maker decreases the likelihood earning less than his peer.

In the HI treatment, a decision maker can choose lotteries with upsides above his peer's earnings, since $\overline{x} > s_{\mathrm{HI}} > \underline{x}$. Consider his marginal utility of taking risk:

$$x > s_{\mathrm{HI}} : \frac{\partial U(q|s_{\mathrm{HI}})}{\partial q} > 0 \tag{3}$$

$$x < s_{\mathrm{HI}} : \frac{\partial U(q|s_{\mathrm{HI}})}{\partial q} < 0. \tag{4}$$

First, assume the decision maker contemplates on an upside that exceeds the earnings of his peer, $x > s_{\mathrm{HI}}$. Eq. (3) states that the marginal utility of taking risk is negative: for any value of x above s_{HI}, the decision maker prefers to reduce his risk taking—choose a larger q—in order to avoid the occurrence of a social loss. In case the decision maker considers a lottery such that $x < s_{\mathrm{HI}}$, the marginal utility of taking risk is positive, eq. (4). This reflects the following: if a decision maker chooses a lottery that leaves him in a unfavorable relative position, he reverts to choose the lottery with the maximal expected value. However, the maximal expected value of the lottery is larger than the earnings of his peer. Therefore, a social loss averse decision maker settles at setting $x^*_{\mathrm{HI}} = s_{\mathrm{HI}}$. He modifies his risky behavior to match ex post earnings between his peer and himself for the case of receiving the lottery's upside:

$$q^*_{\mathrm{HI}} = \frac{m}{2r} + \frac{m - 2s_{\mathrm{HI}}}{2r} \tag{5}$$

The model predicts that sufficiently social loss averse decision makers choose riskier lotteries in the HI than in the LO treatment, i.e., $q^*_{\mathrm{LO}} > q^*_{\mathrm{HI}}$.[7] In the LO treatment, social loss aversion induces decision makers to reduce their risk taking in order to secure their favorable relative earnings and avoid falling behind their peer by too much risk taking. In the HI treatment, decision makers behave more risky to be able to "catch up" with their peer by matching their upside with their peer's earnings.

Hypothesis 1 *The preferred lottery in the HI treatment is riskier than in the LO treatment, i.e.* $\hat{q}_{LO} > \hat{q}_{HI}$*, for social loss averse subjects.*

3 Main Result

The main result supports Hypothesis 1. In the LO treatment with peer earnings of 2 euros, the decision makers choose on average a lottery that pays off 6.69 euros with a likelihood of 72.67%. In the HI treatment with peer earnings of 8 euros, the preferred lottery of the decision makers pays off on average 8.01 euros with a likelihood of 62.89%.

Result 1 *Decision makers take more risk on average in the HI treatment compared to the LO treatment.*

Comparing the HI to the LO treatment, decision makers reduce their risk taking by increasing their average upside likelihood by 9.78 percentage points. This mean difference in the risky choice across treatments is significant in an OLS regression. Column 1 of Table 1 shows the results of regressing the risky choice of each subject on a treatment dummy, which is equal to one for subjects in the HI treatment. The treatment dummy remains significant when controlling for risk attitudes of the decision makers (column 2).

Figure 1 shows a histogram of the preferred upside likelihoods per treatment—larger values imply a lower willingness to take risk. Reflecting Result 1, the distribution of upside likelihoods in the LO treatment is statistically larger than in the HI: subjects are more likely to choose less risky lotteries in the LO treatment than in the HI treatment.[8]

Figure 1 shows two more findings. First, subjects in the HI treatment are more likely to choose lotteries that do not imply risk aversion—upside likelihoods below 62%.[9] Second, we do not observe "bunching" in the HI treatment around the (8,0.63)-lottery. No subject chooses the (8,0.63)-lottery and only two choose the (8.13,0.62)-lottery.[10]

Result 1 indicates that social outcomes serve as—behaviorally relevant—reference points for individuals. This findings contributes to the literature on reference-dependent

[7] Sufficient social loss aversion is $\lambda > 1 + \gamma$, with $\gamma = (m - 2s_{\mathrm{HI}})/s_{\mathrm{LO}} = 1/4$. In private settings, the loss aversion coefficient is typically estimated to be around 3, see e.g., Sprenger (2011).

[8] A Mann-Whitney U-test yields a p-value of 0.0035. A Kolmogorov-Smirnov test comes to the same conclusion (p-value of 0.013). The p-values in this study refer to two-sided tests.

[9] In order to test this, we construct a binary outcome variable which equals 1 in case of $\hat{q} \leq 61$ and zero otherwise. A probit (logit) regression of this binary outcome variable on the treatment dummy yields a p-value of 0.02 (0.03): In the HI treatment, subjects are less likely to choose risk averse lotteries.

[10] For private, expectation-based reference points, Abeler et al. (2011) find bunching in effort provision. However, Gneezy et al. (2013) do not find bunching in their replication of Abeler et al. (2011).

Table 1: Treatment Difference in Risk Taking, Regression

	OLS: risky choice with *social* reference point		OLS: risky choice with lagged expectations	
	(1)	(2)	(3)	(4)
1 if HI condition	−9.78***	−8.92***	−1.80	−2.23
	(3.21)	(3.29)	(4.24)	(3.59)
Risk attitude		−0.81*		−2.14***
		(0.42)		(0.39)
Constant	72.67***	80.14***	68.18***	90.77***
	(2.28)	(4.43)	(2.44)	(5.03)
Observations	67	67	62	62
Adjusted R^2	0.11	0.15	−0.01	0.12

Notes: In columns 1 and 3, we regress risk taking on a treatment dummy (equal to 1 for the HI and EX-HI treatments, respectively). In columns 2 and 4, we additionally control for risk attitudes. Robust standard errors are in parentheses. Significant at the 1 (5) [10] percent level: *** (**) [*].

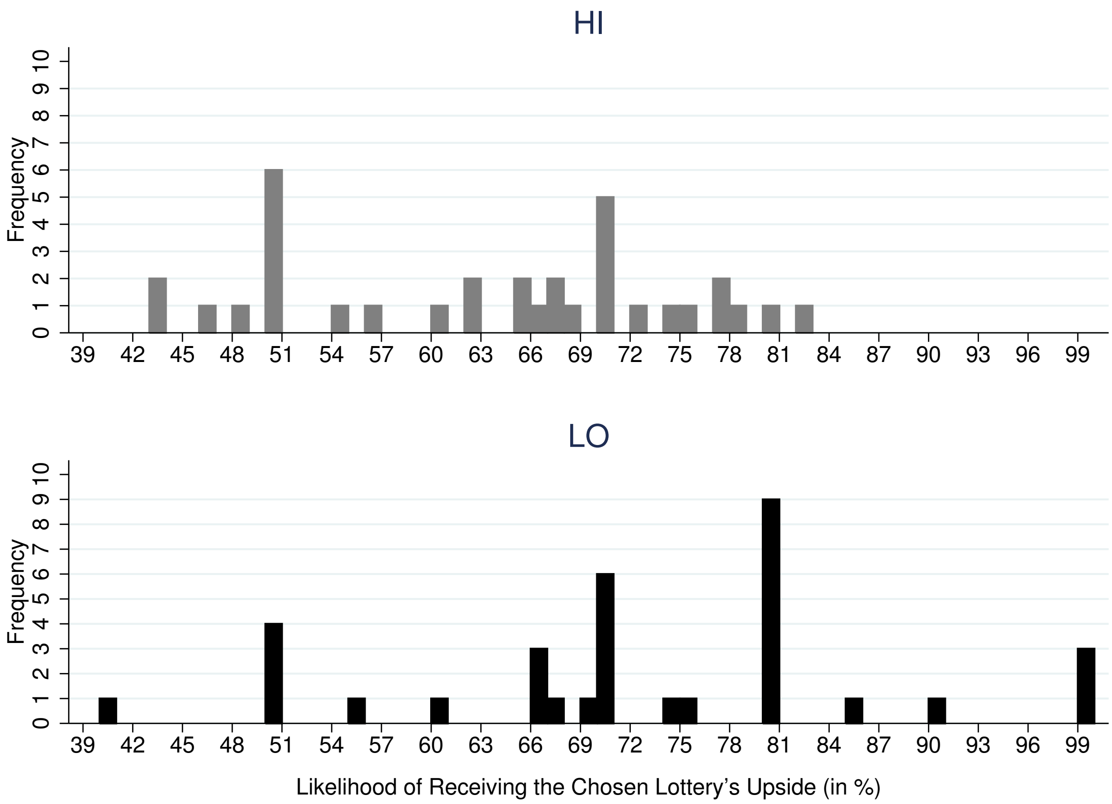
preferences, which previously focused on the behavioral implications of private outcomes based reference points, such as status quo or expected outcomes. In order to assess the relative importance between social and private reference points, we compare Result 1 with how private, expectation-based reference points impact risk taking. In the second part of the main experiment, each decision maker chooses his preferred lottery from the same set of lotteries as in the first part of the main experiment—but this time in light of a private, expectation-based, reference point. Models with expectation-based, reference-dependent preferences predict the same qualitative impact on risky behavior as the model of Section 2 does for social reference points. In fact, subjects in the second part of our main experiment choose on average a larger (lower) upside likelihood when being confronted with a lower (higher) expectation-based reference points, i.e., they are less risk taking in light of lower (higher) expectations. The average difference in the upside likelihood is 7.50 percentage points.[11] This indicates that the impact of social reference points on risk taking is as substantial as private, expectation-based, reference points.

4 Mechanisms

The previous section shows that decision makers respond to social reference points by taking more risk in case the earnings of their peer are relatively great. This result supports the prediction of the social-comparison-based, reference-dependent preference model. This section discusses another experiment and an additional result of the second stage of the

[11]This difference in risky behavior due to private reference points is statistically significant in an OLS regression with a p-value of 0.045.

Figure 1: Frequencies of Risk Taking per Treatment



main experiment. The second experiment tests whether lagged expectations—a potential channel through which social reference points may be behaviorally relevant other than by triggering relative concerns—are able to explain Result 1. The second part of the main experiment tests whether inequity aversion motivates decision makers in the LO condition in their risk-taking behavior—rather than social loss aversion.

4.1 Lagged Expectations Experiment

In this section, we investigate a channel through which social reference points may impact the willingness to take risk of individuals other than relative concerns. It is conceivable that decision makers may expect to receive the same earnings as their peer after they learn of their peer's earnings—an expectation that differs between treatments of the main experiment. Despite the fact, If decision makers fail to revise their expectations after receiving information about their risky choice, the differences in their expectation may impact their willingness to take risk.

The EX experiment tests whether the provision of information on counterfactual earnings serve as reference point and impact individual risk taking without a social context. In order to do so, the EX experiment replicates both parts of the main experiment with one essential change: only one subject participates in each session. The experimenter tosses a coin in front of the subject to randomly assign him to either an active or a passive role. Passive subjects receive 8 euros in the EX-HI and 2 euros in the EX-LO treatment. Active subjects receive the outcome of a lottery they choose. Their choice set is identical to the one in the main experiment. Before active subjects receive any information on their risky choice, they learn what they would have earned if they had been assigned to the passive role. Thus, active subjects choose their preferred lottery while knowing they just missed to earn 8 euros in the EX-HI or 2 euros in the EX-LO treatment.

The only element that differs between the control and the main experiment is the presence of the subject that receives the fixed payment of either 8 or 2 euros, and his mentioning in the instructions. Thus, the EX experiment allows the active subjects to form earnings expectations conditional on the information about the earnings of the passive role. If decision makers are more willing to take risk in the EX-HO compared to the EX-LO treatment, this would indicate that Result 1 of the main experiment may be explainable by differences in expectations and not due to relative concerns.

The results of the EX experiment do not support the conjecture that lagged expectations in isolation of a social context can fully amount to explain Result 1. In particular, the average risk taking across treatments is not significantly different. Table 1 reports the results of regressing risk taking on a treatment dummy (column 3). The coefficient of the treatment dummy is not significantly different from zero (p-value of 0.67). This does not change when, additionally, controlling for risk attitudes (column 4; p-value of 0.47).

Result 2 *The risky choices in the EX-HI and EX-LO do not differ significantly.*

Note that the EX experiment constitutes a conservative test: we explicitly direct attention of the decision maker to think about the earnings of the passive role as earnings he could have earned himself. On the contrary in the main experiment, we do not remind the decision maker that he could have been assigned to the peer role. This may increase the likelihood that decision makers treat the information as relevant for their expectation formation. While we intended this difference between main and EX experiment to be able to test the impact of lagged expectations on risk taking, our EX experiment may overstate the relevance lagged expectations play in the main experiment.

4.2 Inequity Aversion

Hypothesis 1 is derived from a model of social-comparison-based, reference-dependent preferences that employs social loss aversion: individuals like social gains and dislike social losses. In contrast to social loss aversion, inequity aversion characterizes individuals who dislike both social gains and losses.

Inequity aversion also predicts Result 1 of our main experiment: in the HI treatment, decision makers increase their risk taking to match their lottery's upside with the earnings of their peer; in the LO treatment, decision makers reduce their risk taking in order to avoid falling behind their peer in earnings. In contrast to social loss aversion, inequity averse decision maker reduce their risk taking even further in the LO treatment in order to avoid getting to far ahead of their peer in earnings.

In the second part of the experiment, we use two choice tasks to measure whether decision makers tend to be inequity averse. This allows us to test the different predictions of inequity aversion and social loss aversion for the LO treatment: decision makers that tend to be inequity averse in the second part of the experiment are less risk taking in the LO treatment of our main experiment than non-inequity averse subjects.

Table 2: Inequity Aversion and Social Risk Attitudes

	OLS: risky choice with *social* reference point, LO condition		OLS: risky choice with social reference point, HI condition	
	(1)	(2)	(3)	(4)
Standard dictator game	−1.32 (1.47)		−1.08 (0.99)	
Risky dictator game		−1.26 (1.72)		0.67 (1.01)
Constant	75.67*** (3.87)	74.74*** (3.99)	64.69*** (2.50)	62.16*** (2.57)
Observations	33	33	34	34
Adjusted R^2	0.003	−0.010	0.010	-0.023

Notes: The dependent variable is the risky behavior of the decision makers in the main experiment. In columns 1 and 2, we regress risk taking on the two inequity aversion measures for all subjects in the LO treatment. Columns 3 and 4 report the same regression is carried out for decision makers in the HI treatment. Significant at the 10 percent level: *. Significant at the 5 percent level: **. Significant at the 1 percent level: ***.

Two dictator games, a standard and a risky version (Brock, Lange and Ozbay, 2013), measure the tendency of each decision maker to be inequity averse. In both games, they act as dictators who are endowed with 10 euros. In the standard dictator game, dictators allocate the 10 euros with a recipient. In the risky dictator game, any amount the dictator shares with the recipient increases the chance of the recipient to win 5 euros instead of nothing. More precisely, for each 10 cent the dictator allocates to the recipient, the recipients' likelihood of receiving 5 euros increases by 2%.[12] In both dictator games, the amount of money dictators allocate to their recipient measures their tendency to be inequity averse.

As briefly discussed above, inequity averse decision makers are predicted to choose less risky lotteries in the LO treatment than social loss averse decision makers. Thus, if

[12] For instance, if the dictator allocates 2.5 euros (5 euros) to the passive subject, his likelihood of earning 5 euros in the lottery is 50% (100%).

inequity aversion drives decision makers in the main experiment, we should find a positive association between giving in the dictator games and less risk taking in the LO treatment. We test this prediction as follows: we regress the decision makers giving in the dictator games on their risk taking in the LO treatment. Table 2 reports the results of this OLS regression in columns 1 and 2, respectively. For both measures, we do not find a positive association between dictator giving and less risk taking: subjects that behave inequity averse in the second stage are not less willing to take risk in LO treatment of the main experiment. The signs of the coefficients even suggest that inequity averse subjects are more risk taking. Table 2 also reports the same regressions for decision makers in the HI treatment. Their degree of inequity aversion is also not significantly correlated with their risk taking behavior in the first stage of the experiment. Therefore, we do not find support that our social-comparison-based reference point model should assume inequity aversion rather than social loss aversion.

Result 3 *The risk-taking behavior of decision makers is not correlated with their degree of sharing in a dictator game.*

5 Conclusion

In a simple laboratory experiment that allows decision makers to engage in social comparisons over experimental earnings, this study tests whether relative concerns impact risk taking. The main result is in line with a social-comparison-based, reference-dependent preference model that assumes social loss aversion: decision makers are more willing to take risk in order to surpass their peer (HI treatment) and less willing to take risk in order to stay ahead of their peer (LO treatment) in earnings. Thus, this study indicates that the insights of the reference-dependent preference literature, which typically assume the reference point to be determined by private outcomes, extend to social settings. Outcomes of others are a behaviorally relevant source of reference for individuals.

In a second experiment, we show that the impact of social reference points on risk taking is not explained by differences in expectations that decision makers hold. While it is conceivable that social reference points influence the expectation formation of individuals, our EX experiment shows that differences in lagged expectations are not sufficient to impact the risk taking of individuals in our experimental set up.

The results of this study are applicable to the recent literature on the use of relative concerns at the workplace (Moldovanu, Sela and Shi, 2007, Barankay, 2011, 2012). Performance rankings may incentivize workers to increase their effort in order to improve relative performance—independent of additional pecuniary incentives. This study suggests, that apart from effort, the willingness to take risk of workers may also be affected by such social comparisons. Any principal that may want to make use of social incentives should, therefore, take the potential effect on risk taking into account as well.

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A Instructions

A.1 Main Experiment, Decision Maker—HI [LO] Treatment

In this experiment, your task is to complete a survey. Participant B completes the same survey.

The both of you receive the show-up fee for your participation in this experiment. Participant B receives an additional payment of 8 [2] euros. You can also receive an additional payment. Your additional payment is not determined yet. Your additional payment depends on your decision-making before you start completing the survey.

Notice, participant B does not learn your additional payment and leaves the lab before you do.

Your additional payment depends on your choice between different options.

One option is the certain payment of 3 euros.

All other options are binary lotteries. Among all options, one outcome is 0. You can choose the other outcome freely between a minimum and maximum outcome. The higher you choose this outcome, the lower is the likelihood that you receive it.

We use urns to display lotteries graphically in this experiment. If you choose a lottery, then the computer randomly chooses which outcome you receive as your additional payment. This happens at the end of the experiment, after you completed the survey and are paid in cash.

A.2 EX Experiment, Active Subject—EX-HI [LO] Treatment

In this experiment, your task is to complete a survey. If you would have been participant B, you would have to complete the same survey.

The both of you receive the show-up fee for your participation in this experiment. If you would have been participant B, you would receive an additional payment of 8 [2] euros. As participant A, you can also receive an additional payment. Your additional payment is not determined yet. Your additional payment depends on your decision-making before you start completing the survey.

Your additional payment depends on your choice between different options.

One option is the certain payment of 3 euros.

All other options are binary lotteries. Among all options, one outcome is 0. You can choose the other outcome freely between a minimum and maximum outcome. The higher you choose this outcome, the lower is the likelihood that you receive it.

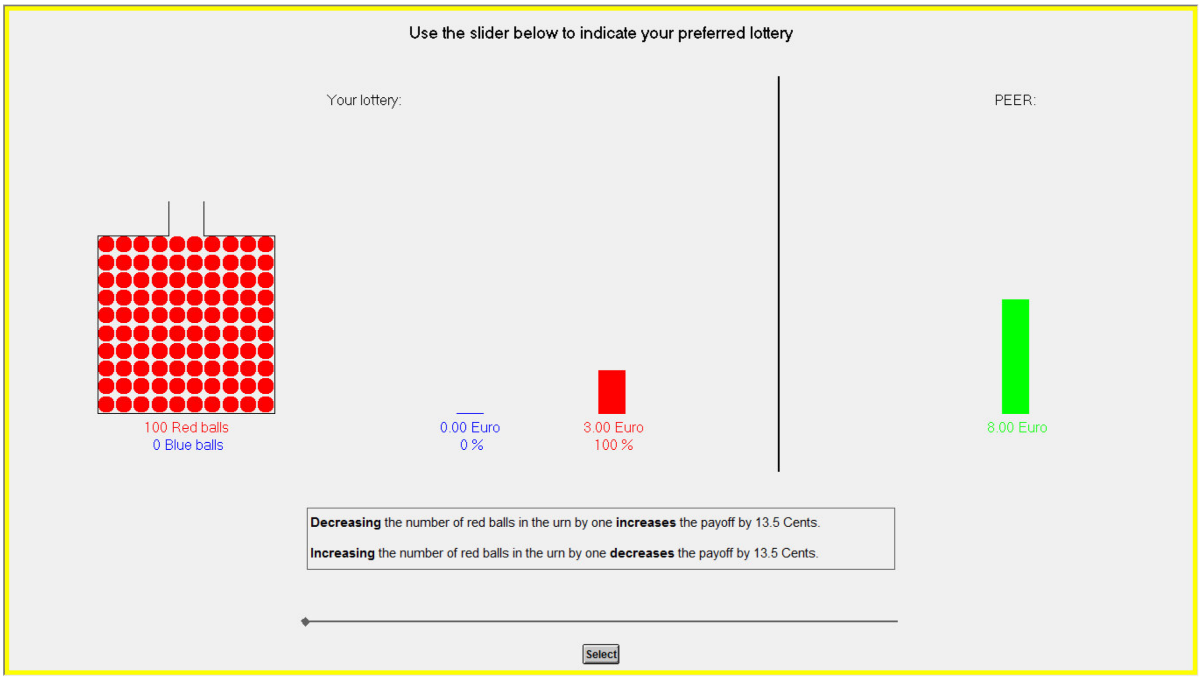
We use urns to display lotteries graphically in this experiment. If you choose a lottery, then the computer randomly chooses which outcome you receive as your additional payment. This happens at the end of the experiment, after you completed the survey and are paid in cash.

B Figures & Tables

Table 3: Choice List of the Risk Attitude Measure

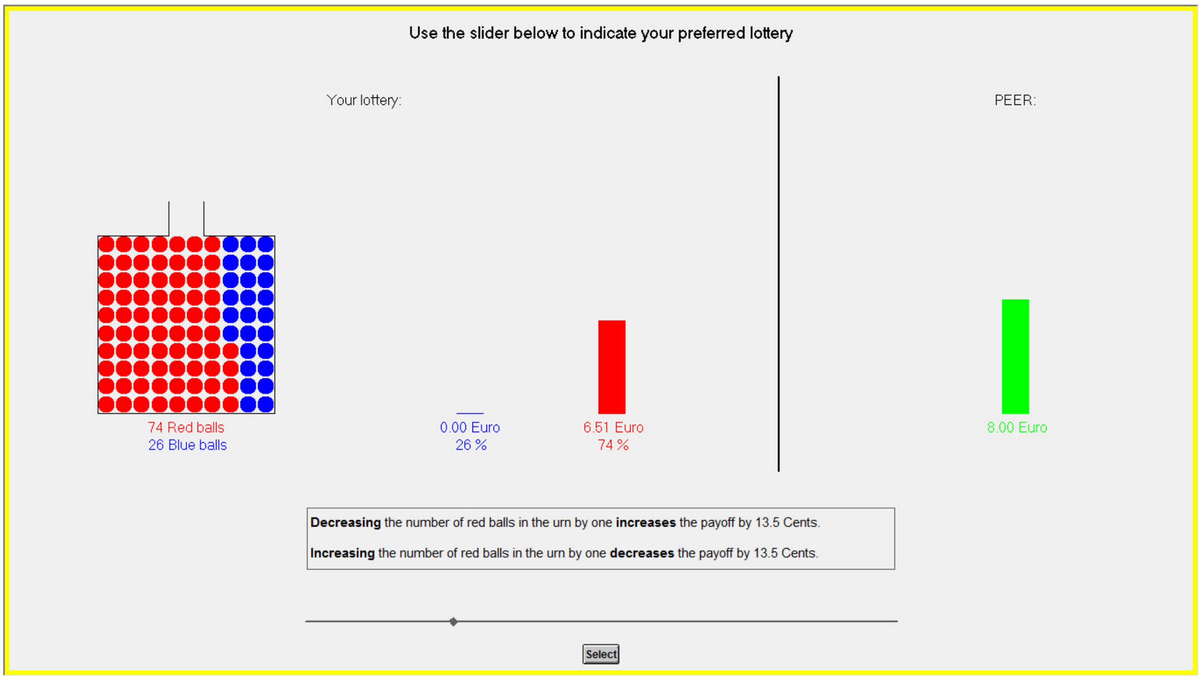
Decision	Alternative Y					Alternative X
1	3.40 euros	with 97%	or	0 euros	with 3%	3 euros
2	4.08 euros	with 92%	or	0 euros	with 8%	3 euros
3	4.76 euros	with 87%	or	0 euros	with 13%	3 euros
4	5.43 euros	with 82%	or	0 euros	with 18%	3 euros
5	6.10 euros	with 77%	or	0 euros	with 23%	3 euros
6	6.78 euros	with 72%	or	0 euros	with 28%	3 euros
7	7.45 euros	with 67%	or	0 euros	with 33%	3 euros
8	8.13 euros	with 62%	or	0 euros	with 38%	3 euros
9	8.80 euros	with 57%	or	0 euros	with 43%	3 euros
10	9.48 euros	with 52%	or	0 euros	with 48%	3 euros
11	10.15 euros	with 47%	or	0 euros	with 53%	3 euros
12	10.83 euros	with 42%	or	0 euros	with 58%	3 euros
13	11.50 euros	with 37%	or	0 euros	with 63%	3 euros
14	12.18 euros	with 32%	or	0 euros	with 68%	3 euros
15	12.86 euros	with 27%	or	0 euros	with 73%	3 euros
16	13.53 euros	with 22%	or	0 euros	with 78%	3 euros
17	14.20 euros	with 17%	or	0 euros	with 83%	3 euros
18	14.88 euros	with 12%	or	0 euros	with 88%	3 euros
19	15.56 euros	with 7%	or	0 euros	with 93%	3 euros
20	16.23 euros	with 2%	or	0 euros	with 98%	3 euros

Figure 2: Decision Screen of the Main Experiment, HI Treatment



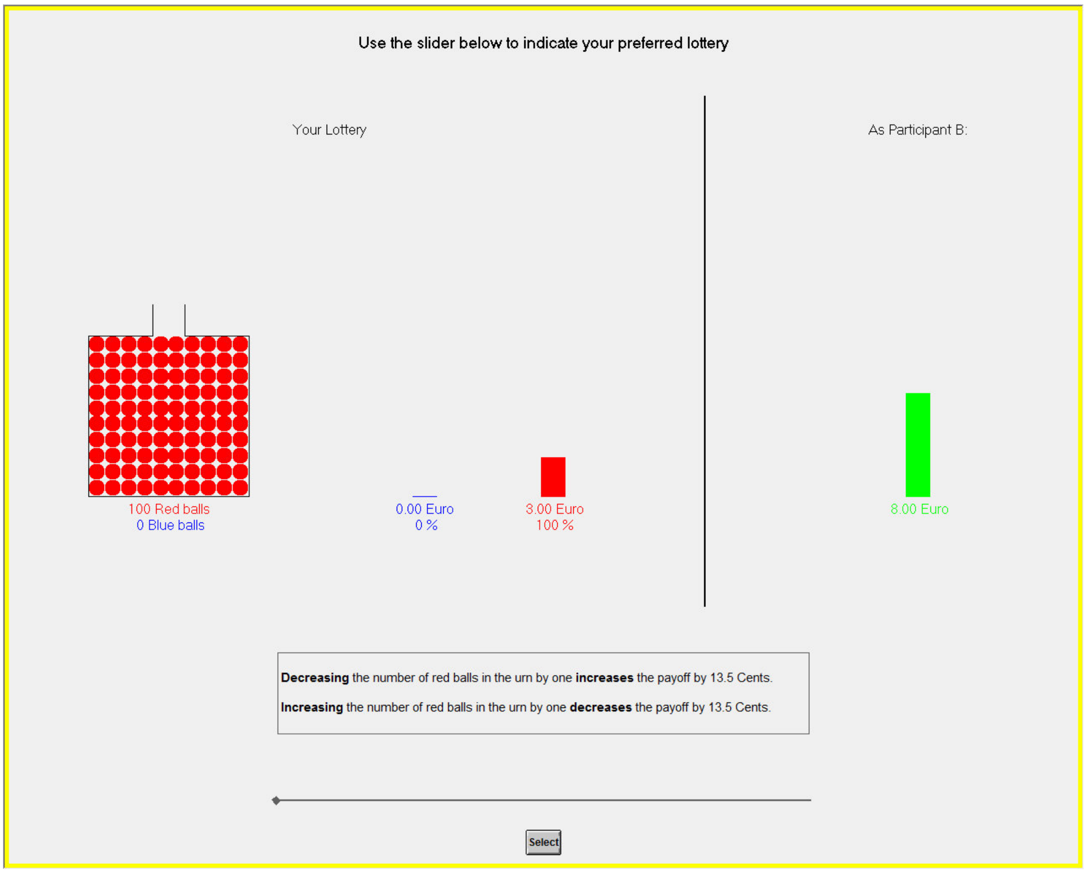
Notes: The position of the slider indicates a preferred certain payment of 3 euros.

Figure 3: Decision Screen of the Main Experiment, HI Treatment



Notes: The position of the slider indicates a preferred lottery that pays 6.51 euro with a likelihood of 74%.

Figure 4: Decision Screen of the EX Experiment, EX-HI Treatment



Notes: The position of the slider indicates a preferred certain payment of 3 euros.