SOCIAL COMPARISON AND RISKY CHOICES*

Jona Linde

CREED, Amsterdam School of Economics, University of Amsterdam

j.linde@uva.nl

and Joep Sonnemans

CREED, Amsterdam School of Economics, University of Amsterdam

J.H.Sonnemans@uva.nl

January 2011

Theories (and experiments) on decision making under risk typically ignore (and exclude) a social context. We explore whether this omission is detrimental. To do so we experimentally investigate the simplest possible situation with both social comparison and risk: participants choose between two lotteries while a referent faces a fixed payoff. Participants are more risk averse when they can earn at most as much as their referent (loss situation) than when they are ensured they will earn at least as much as their referent (gain situation). Prospect theory with a social reference point would predict the exact opposite behavior. These results show that straightforward extensions of existing theories to allow for social comparison do not provide accurate predictions.

* We would like to thank Thomas de Haan, Roel van Veldhuizen, Ingrid Rohde, Kirsten Rohde and participants of the NYU-CREED meeting, January 2009 in New York, the BaER-Lab Inaugural Workshop, April 2009 in Paderborn, the workshop Rationality in Economics and Psychology, May 2009 in Amsterdam, the 2nd Maastricht Behavioral and Experimental Economics Symposium, June 2009 in Maastricht, the IAREP Summer School in Psychological Economics and Economic Psychology, June 2009 in Trento, the Europe ESA conference, September 2009 in Innsbruck and the EER Young Economist Workshop, May 2010 in Florence for their helpful comments.

1 Introduction

Using comparison to evaluate outcomes or possibilities is a regular feature of human decision making. We compare our own situation to those of others (e.g. Clark, Frijters & Shield, 2008) and what is to what could have been (Loomes & Sugden, 1982) or to what was (Kahneman & Tversky, 1979) and these comparisons often affect our choices. The universal nature of comparison is emphasized by the importance of a reference point in two separate streams of research in behavioral economics: decision making under risk and social preferences. Reference points affect risk attitudes through loss aversion and probability weighting (Kahneman and Tversky, 1979 and Tversky and Kahneman, 1992). People's social preferences, their willingness to pay to raise or lower the payoff of others, are likewise reference dependent as they are influenced by the decision maker's earnings relative her social reference point, the earnings of a peer (Fehr & Schmidt, 1999 and Bolton & Ockenfels, 2000).

Loss aversion features prominently both in the literature on decision making under risk and in social preference theories. In individual decision making “losses loom larger than gains” (Kahneman & Tversky, 1979, p. 279) and, similarly, people care much more about being worse of than others than about being better off (e.g. Fehr & Schmidt, 1999). This similarity begs the question whether a social reference point can also cause well-established behavioral effects of individual reference points, like the reflection effect. This is not self evident; some studies have found that individual and social reference points have contrary effects. According to (Bault et al. 2008) people may actually be gain seeking relative to a social reference point in some situations. Also, what little information there is about the effect of a social reference point on the shape of the utility function suggest that it is convex in both the gain and loss domain (Vendrik & Woltjer, 2007) while for individual reference points utility is concave in the loss domain (Kahneman & Tversky, 1979).

Although the previous paragraph points to existing research that allows for some comparison between the effects of individual and social reference points the extent of their similarity remains largely unexplored. A reason for this gap in understanding is the very different focus of the decision making under risk and social preference literatures. The focus of the first line of research on risk has led to theories that are concerned with the shape of the utility function and the effect of probabilities. Social preference researchers on the other hand are mainly concerned with the existence of social preferences and with factors that strengthen or weaken social preferences such as reciprocity. Because of the different research agendas there is not nearly enough empirical information to compare the behavioral effects of social and individual reference points.

In this paper we aim to fill some of this gap in empirical information. We explore whether a well known effect of a reference point, the reflection effect, is exhibited relative to a social reference point. The reflection effect is the behavioral regularity that when all outcomes are losses risk seeking is generally observed, while risk aversion is the norm when all outcomes are gains[1] (Kahneman & Tversky, 1979). If a social reference point has this effect participants will make risk seeking choices when they know they will earn at most as much as a peer and risk averse choices when they know they will earn at least as much as a peer.

In our experiment participants are presented with such situations. Participants choose between lotteries which always yield positive earnings for the decision maker, but we manipulate the earnings of a matched participant, the referent. Particularly, we compare choices between lotteries in a loss setting (the referent earns more), a gain setting (the referent earns less) and a neutral setting (the referent earns the same). Figure 1 gives an example of the three kinds of choice situations presented to participants. The decision maker can compare her own earnings to those of the referent but can not affect her referent's earnings nor does she receive any information about the decision of others[2]. However, their decisions can be influenced by observing the earnings of another participant, their social reference point.

The rest of this paper is structured as follows. Section 2 discusses relevant empirical and theoretical literature on both individual and social decision making and related research where both social influences and risk play a role. Section 3 explains the design of our experiment, section 4 introduces our research questions and section 5 provides the results. Section 6 concludes.

2 Theoretical background and related empirical findings

2.1 Reference dependence

According to expected utility theory utility functions are defined with respect to final wealth-states. This implies that prospects that lead to the same level of wealth with the same probability are valued equally independent of a person's current wealth level. Markowitz (1952) was first to notice that this cannot explain why people with all kinds of wealth levels play lotteries, insure themselves and are generally averse to fair gambles over small amounts. This led him to conclude that utility depends on changes of wealth instead of final outcomes.

1 For small probabilities the opposite risk preferences are observed.

2 In the Neutral situations the lottery faced by the referent does depend on the choice of the decision maker. Social preferences could therefore in principal influence decisions in those situations. For that reason our main comparison will be between choices in the loss and the gain setting. However, we believe that the Neutral setting minimizes the effect of social comparison while remaining as close as possible to the Gain and Loss settings.

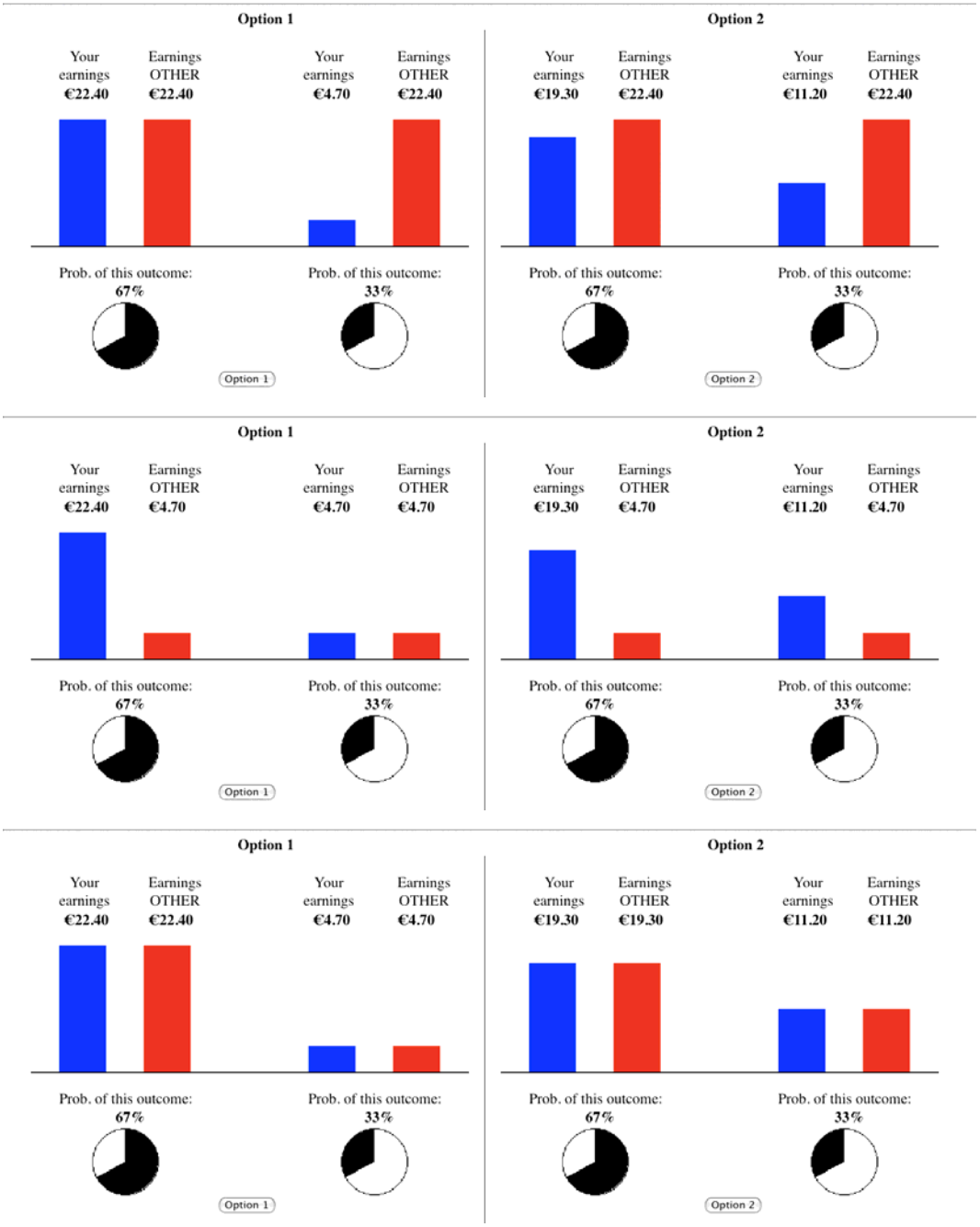


Figure I: Lottery screens.

Each panel shows a decision situation. The blue bar represents the decision maker's earnings, the red bar her referent's earnings. Participants choose between option 1 displayed on the left and option 2 displayed on the right.

Top panel: loss situation, the decision maker earns at most as much as her referent.

Middle panel: gain situation, the decision maker earns at least as much as her referent.

Bottom panel: neutral situation, the decision maker and her referent earn equal amounts.

Kahneman and Tversky (1979) examined reference dependence as part of the development of their "prospect theory". In one of their tests participants faced one of two hypothetical decision making problems. In the first problem the participant was told she gets $1,000.- and was then asked to choose between $500.- for sure or $1,000.- with 50% chance. In this case most participants opted for the sure thing, exhibiting risk aversion. In the second problem the participant was told she gets $2,000.- and was then asked to choose between losing $500.- for sure or $1,000.- with 50% chance. In this case most participants opted for the gamble, exhibiting risk seeking. The choice problems are equivalent in final wealth outcomes, but the framing of the gamble in terms of either gains or losses had a profound effect on observed risk preferences. Kahneman and Tversky labeled the behavioral regularity that risk preferences for losses are the opposite of those for gains the "reflection effect".

In their well-known "Asian disease" study Tversky and Kahneman (1981) showed the reflection effect in an entirely different context. In this study participants exhibited a preference for relatively safe policies when outcomes were framed as saving lives (gains) and for relatively risky policies when outcomes were framed as prevented deaths (losses). The reflection effect is also observed in less controlled conditions. One of these is the stock market, where investors are less willing to sell losing stocks than winning stocks. This "disposition effect" is in keeping with the reflection effect (Odean, 1998). When a stock loses (gains) value the investor is more (less) willing to take risks, i.e. hold the stock, because she perceives the situation as a loss (gain) situation. McGlothlin's (1956) finding that racehorse gamblers bet more heavily at the end of the day, when they have usually lost money, also confirms the reflection effect. A meta-analysis (Kühberger, Schulte-Mecklenbeck & Perner, 1999) corroborated the existence of the reflection effect.

The second effect of reference dependence is loss aversion which explains extreme risk aversion for gambles involving small losses and gains (Rabin 2000)[3]. Fishburn and Kochenberger (1974) were first to show that utility functions in terms of changes in wealth are steeper for losses than for gains. Numerous others studies have since confirmed loss aversion (e.g. Tversky and Kahneman (1992), Gneezy and Potters (1997) and Abdellaoui, Bleichrodt and Paraschiv, (2007)). The endowment effect (Kahneman, Knetsch & Thaler, 1991) and the equity premium puzzle (Bernartzi & Thaler, 1995) can also be seen as instances of loss aversion.

Kahneman and Tversky's (1979) prospect theory incorporates both loss aversion and the reflection effect. Their theory further explains other choice phenomena involving uncertainty,

3 Loss aversion is not the only possible explanation for this phenomenon. Some types of probability weighting (e.g. Quiggin, 1982, Segal & Spivak, 1990) also allow for risk aversion for small gambles, but these theories do not explain why risk aversion is more extreme when a gamble allows for losses than when all possible outcomes are gains.

such as the Allais (1953) and Ellsberg (1961) paradoxes. In response to objections that prospect theory's weighting scheme led to violations of stochastic dominance and is not well adapted to multiple outcome lotteries Tversky and Kahneman (1992) developed a new theory, cumulative prospect theory (CPT). This new theory incorporates rank depended probability weighting (Quiggin, 1982; Schmeidler, 1989). The driving force behind (cumulative) prospect theory is the separation of a person's strength of preference and her attitude towards risk, modeled by probability weighting. CPT is widely considered the most successful descriptive theory of decision making under risk.[4]

According to CPT the decision utility of a gamble is jointly determined by the value function, *v,* evaluating the relative preference over outcomes, and the decision weight of outcomes, π. The (decision) utility of a gamble with n possible outcomes is calculated by $\sum_{i=1}^{n} \pi_i v(x_i)$ where π_i is the difference between the weighted probabilities of two events 1) getting outcome i or an outcome further from the reference point and 2) getting an outcome further from the reference point. The probabilities of these events are weighted by the probability weighting function *W*.

The shape of both the value function and the probability weighting function follow the psychological intuition of diminishing sensitivity. The marginal impact of a deviation from the reference point becomes smaller as the deviation becomes larger. This implies a convex value function for gains and a concave value function for losses. Ignoring probability weighting such a value function implies risk aversion over the entire gain domain and risk seeking over the entire loss domain.

For the weighting function diminishing sensitivity to divergence from certainty, 0% chance or 100% chance, leads to an inverse S shape. This causes underweighting of moderate and large probabilities and overweighting of small probabilities. It further has the property that $W(0)=0$ and $W(1)=1$. The fixed point of the function ($W(p)=p$) is generally found around 1/3 (Prelec, 1998) so probabilities are generally underweighted. This type of probability weighting explains the reflection effect. People insure against losses with small probabilities and play lotteries, because for small probabilities the decision weight is larger than the probability. Most probabilities are however underweighted so people are generally risk averse for gambles involving only gains and risk-seeking for gambles involving only losses. The value function strengthens the tendency to risk aversion for gains and risk seeking for losses.

4 Other theories, such as SP-A theory (Lopes & Oden, 1999) specify different processes to account for the behavioral regularities of choice under risk, but these theories share the reliance on a reference point.

As this discussion makes clear the reference point is a driving force for risk preferences. That makes the determination of the reference point very important. According to Kahneman and Tversky: "the reference state usually corresponds to the decision maker's current position, [but] it can also be influenced by aspirations, expectations, norms and social comparisons" (Tversky & Kahneman, 1991, pp. 1046, 1047). Most studies assume that the status quo (e.g. Rabin, 2000) or the lagged status quo (e.g. Thaler & Johnson, 1990) is the relevant reference point. Expectations have however also received attention as a possible reference point (Közegi & Rabin, 2006). The reference point can also be another variable than wealth such as the price of an asset (Odean, 1998) or an income target (Camerer et al., 1997). Tversky and Kahneman (1991) develop a model with reference points in multiple dimensions to explain the endowment effect (Thaler, 1980) and the status quo bias (Samuelson & Zeckhauser, 1988). The use of many different reference points and the suggestion of Kahneman and Tversky beg the question whether the income of a peer may also play this role.

2.2 A social reference point

Although social comparison has received little attention as a driver of risk preferences its effect on other types of decisions has received ample attention from economists.[5] People are willing to raise the earnings of others in a disadvantageous position (e.g. Forsythe et al., 1994), but lower that of others in an advantageous position (Zizzo & Oswald, 2001). Kindness or unkindness of the other (e.g. Fehr and Gächter, 2000) and social ties (Sonnemans, van Dijk, and van Winden, 2006), mediate this effect. Fehr and Schmidt (2006) review much of the evidence in this field as well as models that incorporate the observed behavior.[6]

One important characteristic of a reference point, loss aversion, is also present with respect to the earnings of a peer. The influence of relative earnings on utility is stronger when others earn more than you than when others earn less.[7] This behavioral regularity forms an important part of many influential theories. In the models of Fehr and Schmidt (1999), Bolton

5 In psychology social comparison effects are also widely studied starting with Festinger (1954). Most of this research is concerned with evaluating own opinions and abilities. See Buunk and Mussweiler (2001) for a survey. As we are concerned with comparison of income or wealth and not opinions, or abilities we will not discuss this research.

6 Besides concerns about relative payoffs, concerns for status or rankings can also affect decisions. Concern for status is how social comparison entered economics (Veblen, 1899) and it is the basis of more recent models as well (e.g. Postlewaite, 1998 and Harbaugh & Kornienko, 2001). Although the mechanism is different from that posited by theories like prospect theory concerns for status can lead to behavior that is similar to reflection effect. Harbaugh & Kornienko (2001) show that concern for local status can lead to risk aversion for gains and risk seeking for losses.

Similar concerns may partly drive behavior in socially isolated decision making as well. Concern with status would be equivalent to concerns to reach or surpass the reference point in isolated decisions making. Models like that of Fishburn (1977) formalize this notion. The findings of Thaler and Johnson (1990), that for the reflection effect to be exhibited their participants had to have a chance to break even, provides evidence for such concerns.

7 Although Bault, Coricelli and Rustichini (2008), to be discussed below, show that this may not hold in situations involving risk.

and Ockenfels (2000) and Falk and Fischbacher (2006), a decision maker's willingness to pay to raise or lower the earnings of an other is strongly affected by whether the other earns more or less than the decision maker. In Fehr and Schmidt's (F&S) model decision maker i has the following utility function depending on the set of earnings *x*:

$$U_i(x) = x_i - \frac{1}{n-1}\alpha_i \sum_{j \neq i}\left[\max(0, x_j - x_i)\right] - \frac{1}{n-1}\beta_i \sum_{j \neq i}\left[\max(0, x_i - x_j)\right]$$

with $\alpha_i \geq \beta_i$ and $0 \leq \beta_i \leq 1$

Her own payoff is labeled x_i, that of her n-1 referents x_j. α_i measures the disutility from disadvantageous inequality and β_i her disutility from advantageous inequality. As Fehr and Schmidt note "$\alpha_i \geq \beta_i$ essentially means that a subject is loss averse in social comparisons: negative deviations from the reference outcome count more than positive deviations" (Fehr & Schmidt, 1999, p. 824).

The F&S model also ensures loss aversion in terms of the decision maker's own earnings around the referents earnings, her social reference point. The decision maker's preferences in case of one referent *j* with fixed earnings x_j can also be expressed by the following affine transformation of the utility function above[8]:

$$U_i(x_i, x_j) = (x_i - x_j) \text{ iff } x_i \geq x_j$$

$$U_i(x_i, x_j) = \frac{1+\alpha_i}{1-\beta_i}(x_i - x_j) \text{ iff } x_i < x_j$$

In this case $\frac{1+\alpha_i}{1-\beta_i} > 1$ ensures that negative deviations of the decision maker's earnings from the social reference point entail larger consequences in terms of utility than positive deviations. The assumptions that $\beta_i \leq \alpha_i$ and $0 \leq \beta_i \leq 1$ ensure that $\frac{1+\alpha_i}{1-\beta_i} \geq 1$. An individual is loss averse unless she does not care about inequality, i.e. $\alpha_i = \beta_i = 0$.[9]

The loss aversion observed around the referent's earnings suggests that the role of the social reference point is similar to that played by other reference points. This raises the question whether we can also observe the reflection effect around a social reference point. As discussed above the prevailing explanation for the reflection effect depends on both the shape of the utility function and probability weighting. To date no research examines the effects of a social reference point on probability weighting. There is however some research that attempts to ascertain the

8 This utility function is obtained from the original one by subtracting x_j (which is why the assumption that the referent's earnings are fixed is required) and dividing by 1-β_i.

9 Fehr and Schmidt assume $\beta_i \geq 0$, which implies people dislike advantageous inequality. There may however be individuals who rejoice in being better off than others, who gloat. Even these individuals will be loss averse relative to the referent's payoff as long as not being behind is more important to them than being ahead, i.e. if $\alpha_i > -\beta_i$.

shape of the social utility function.

Vendrik and Woltjer (2007) examined the effect of the difference between a household's income and the average income of a likely reference group on reported satisfaction. Their finding is that utility is concave in income, independent of whether the difference between own and reference income is negative of positive. The level of concavity is not significantly different for negative or positive deviations between own and reference income. As these authors observe, this is not in accordance with prospect theory where convexity is expected in the loss domain. The utility function found by Vendrik and Woltjer is steeper for negative deviations than for positive ones, confirming (social) loss aversion.[10] Because convexity in the loss domain is part of the explanation of the reflection effect the finding that utility is concave in social losses would make a social reflection effect less likely. Ignoring probability weighting, a function with this shape would predict risk aversion in both the loss and he gain domain. A steeper but equally convex utility function in the domain of negative deviations would even imply more risk aversion in that domain, reversing the reflection effect.

2.3 Related research

Although most theories and empirical investigations concern either social comparison or decision making under risk some recent studies have explored situations where both social concerns and risk are present. Such studies have, among other things, found that uncertainty caused by others, strategic uncertainty, leads to more risk averse behavior than other types of uncertainty (Bohnet & Zeckhauser, 2004). Another interesting result is that ex-post inequality is more acceptable when it results from the resolution of uncertainty, as long as the situation is equal ex-ante (Krawczyk and Le Lec, 2008, Bartling and Von Siemens, 2010 and Bolton and Ockenfels, 2010).

Most closely related to our experiment is an experiment preformed by Rohde and Rohde (2009). These authors also study risk taking in a social context where the decision maker has no influence on the payoff of the participants she is coupled with. Three aspects of this study make it difficult to link the observed decisions to a social reference point however. Firstly, a participant chooses between lotteries while all others participants in the session receive a fixed outcome, lottery or distribution. As a result of this a participant does not have one but ten referents, who may receive different amounts. Multiple referents and multiple possible outcomes lead to multiple possible social reference points so it is hard to establish the outcome against which a

[10] These results are based on reported happiness, not choices. That begs the question whether they have anything to say about decision utility. Abdellaoui, Barrios & Wakker (2007) suggests that it does. They find that when the effect of probability weighting is taken into account utility functions based on choices and introspection agree to a remarkable degree.

decision maker would compare her own payoff. Secondly, in Rohde and Rohde's experiment, if the referents do get a single fixed amount that amount is, in most periods, somewhere in between the possible lottery payoffs for the decision maker, making it impossible to classify lotteries as concerning gains or losses[11]. Thirdly, in their study participants did not interact with each other before making risky choices and anonymity was guaranteed, which may result in a less salient social reference point.

Other empirical studies show that combining ideas developed specifically for either social decisions or decisions under risk do not always predict decisions in situations where both are present. Social preference theories suggest that many people are willing to pay to improve the welfare of others. Theories on decision making under risk imply risk decreases people's welfare. Combining these ideas would suggest that people would be willing to pay to reduce the risk of others. Brennan et al (2008) and Güth, Vittoria Levati and Ploner (2008) show that this is not the case. Although their participants dislike risk for themselves and are willing to pay to increase the expected payoff of others they are not willing to pay to reduce the risk others face.

Bault, Coricelli and Rustichini (2008) examine loss aversion relative to a social reference point, commonly observed in the social preference literature, in a setting where participants make risky choices and cannot influence other's outcomes. In their experiment participants choose between two lotteries every period. The lottery only determines the decision maker's own earnings. In the private treatment participants only observe their own choice but see the outcome of the non-chosen lottery as well. In the social treatment players are told that they also observe the choice of a matched participant, although these choices are actually made by a computer program that is either a value maximizer or extremely risk-averse. Individual decision making models predict no behavioral difference between the treatments. Social preference models, which assume inequality is disadvantageous, predict that participants would try to match the choices of the matched participant. A preference for conformity or social learning models would also predict an attempt to match the other's choices. Surprisingly, Bault et al. observe the opposite behavior: if participants face an opponent more likely to select the risky (safe) lottery they are found to be more likely to select the safe (risky) lottery.

This result shows that introducing the possibility to observe the outcomes of others can indeed affect decisions and not necessarily in a way predicted by social preference models. Bault et al.'s findings can only be rationalized by a model where (at least) advantageous inequality is valued positively. Furthermore the positive effect of advantageous inequality has to dominate the negative effect of disadvantageous inequality. This is in contradiction with inequity aversion

[11] Only 1 pair of questions in Rohde and Rohde's study is comparable with our stimuli, but they find no effect for this pair.

models which hold both that inequality is perceived as negative and that the effect of advantageous inequality is smaller than that of disadvantageous inequality.

Studies about behavior in situations that involve both risk and social comparison are still rare. From the few available studies we can conclude that theories developed on the basis of behavior in situations where only risk or only social comparison is present do not always adequately account for behavior when both are present. Clearly more research is called for in order to arrive at a better picture of social effects on risk preferences.

3. Design

Our experiment is designed to observe choices under risk in situations with one fixed social reference point, the simplest possible situation that includes both risk and social comparison. Table 1 shows the experimental tasks and the order in which they where presented. Task 4, the lottery choices, is of primary interest. In this task participants choose between two lotteries, one of which is clearly more risky than the other. Our main interest is in the behavioral difference between the loss and the gain lotteries (see figure 1). The other tasks are used to establish and measure social ties which can enhance the likelihood and importance of social comparison.

The experiment starts with a social value orientation test (the circle test) with a randomly determined participant. After this first part participants are coupled with their social referent (labeled "Other"). A Bertrand game is played to make the social referent more salient and to allow participants to develop different social ties, which may affect the effect of the social reference point. After the Bertrand game a second circle-test is administered in which the participant is coupled with the Other. The second circle test is followed by the main part of the experiment where participants choose between lotteries. After this a post-experimental questionnaire is administered. To make social comparison even more focal we present participants with a photograph of their Other. Photos are shown directly after the end of the Bertrand game and on every subsequent screen, including during the lottery part[12].

Only one part of the experiment is paid out to ensure that earnings from an earlier part cannot influence behavior in the lottery part. With a probability of 50% the part where participants make choices over lotteries, with a probability of 30% the Bertrand game and with a probability of 10% each, one of the two circle-tests is paid. If the lottery part is paid, only one of the choices of one of the coupled participants is played out (determined randomly) and that choice determines the total payoff of both participants. This ensures that the decision makers perceive each lottery as independent. Participants answer control questions to confirm their

[12] Bohnet and Frey (1999) and Andreoni and Petrie (2004) show that providing a picture of matched participants increases contributions in public good games and transfers in dictator games. This suggests that visual identification increases the importance of a matched other.

understanding of this and other procedures.

An English translation of the experimental instructions is provided in appendix B, the original Dutch instructions are available upon request. All parts of the experiment are computerized (using PHP/MYSQL). We will now discuss the different parts of the experiment in more detail.

Table 1: The order of the experimental tasks

Part	**Coupled with:**	**Photo displayed**	**Payment Probability**
1. Circle-test	Random participant (*not* the Other)	No	10%
2. Bertrand Game, 10 rounds	Other	No	30%
Display of photo of OTHER and a short questionnaire	Other	Yes	
3. Circle-test	Other	Yes	10%
4. Lottery choices • 10 gain • 10 loss • 10 neutral • 12 other	Other	Yes	50% (1 of the 42 choices of one of the two coupled participants)
5. Questionnaire • Personal characteristics • Other's characteristics • Emotions during stage 2 • Decision making during stage 4.	Other	Yes	
Random determination of the part that will be paid out, and when part 4 is selected, random determination of the relevant participant of the pair and the choice.			

3.1 Photograph (Enhancing Social Comparison)

A photograph is taken of each participant before he or she enters the laboratory[13]. Participants are told that they will be matched with the same participant, the Other, during part 2, 3 and 4 of the experiment and that they will see a photo of the Other after part 2 of the experiment. Participants who know each other are requested to sit together in our reception room. We then make sure that they will not be matched[14].

[13] One participant chose not to participate in the experiment when we announced photos would be used.

[14] When participants were first shown their referent's photo they were asked whether they knew this person. Only one couple professed a casual acquaintance while ten other participants recollected having seen the Other. All other (114) participants reported having been oblivious to their referents existence prior to the experiment.

3.2 Circle-tests (Part 1 and 3, Measuring Social Value Orientation and Social Ties)

Circle-tests (Sonnemans, van Dijk & van Winden, 2006) are employed to measure the social value orientation of participants and their social tie towards the Other. In the circle-test the participant chooses a point on a circle with a radius of €15. Each point on the circle represents a combination of payoffs for herself and the participant she is matched with, the receiver. The circle-test is presented to the participant without any point selected or payoff combination displayed. When she clicks on a point on the circle's perimeter the corresponding payoff combination is shown. The participant can try as many points as she wants before confirming a payoff combination.[15]

Selecting a point on the circle involves making a trade off between the participant's own payoff and that of the receiver. As all payoff combinations lie on a circle the decision maker's earnings (x) and those of the receiver (y) have to fulfill the condition $x^2+y^2=15^2$. The slope of the circle differs along the circle, which affects the rate of transformation between one's own and the receiver's earnings. At the point of the perfectly selfish (€15, €0) payoff combination the slope is infinitely steep while it becomes ever shallower as one moves away from this point. This allows even weak, positive or negative, feelings about the receiver's payoff to influence the selected point.

A payoff combination can be represented by a vector from the origin to the point on the circle corresponding to that payoff combination. The angle between this vector and the vector representing the purely selfish payoff distribution measures the decision-maker's relative concern for the receiver. When the decision maker chooses a negative amount for the other the angle is recorded as negative.

At the start of the experiment participants perform the first circle-test in which they are randomly matched to an anonymous other participant. They are informed that they will not be matched with this same participant later in the experiment. The second circle-test is administered after the completion of the Bertrand experiment. At this point participants see their own picture and that of their Other. Subjects only get feedback on either circle-test if this part of the experiment is selected to be paid out at the very end of the experiment. The total payoff to a participant is equal to the amount she allotted to herself plus the amount allotted to her by the matched participant.[16]

The outcome of this first circle-test is a measure of the participant's concern for an anonymous other, her social value orientation. The second circle test measures a participant's

[15] An English translation of the circle test can be found on: www.feb.uva.nl/creed/people/linde/circletest.html.
[16] In theory this amount could be negative but this never happened in the experiment.

attitude towards the Other. Finally, the difference in angle between the second and first test measures the social tie to the Other; the importance of the Other's payoff relative to the payoff of an anonymous person (Sonnemans, van Dijk & van Winden, 2006).[17]

3.3 Bertrand Game (Part 2, Creating Social Ties)

In the second part of the experiment participants play a Bertrand game with so called box demand[18]. In this game matched participants simultaneously choose an integer from {0,1,...,99,100} which represents a percentage. The participant who chooses the lowest percentage gets her percentage of €5.-. The participant with the highest percentage gets nothing. If both participants choose the same percentage they share that percentage of €5.-. The game is played ten rounds without re-matching. If the Bertrand game is paid out a subject receives her accumulated earnings over all 10 rounds.

Assuming both participants are selfish, the Nash equilibriums for a one shot version of this game are both participants choosing 0%,1% or 2%. In this (finitely) repeated version of the game playing one of these equilibriums in each round is an equilibrium. Even if a pair plays the Pareto optimal of these equilibriums (2%) in all rounds both participants will earn no more than €0.50. Cooperation can increase earnings substantially. Full cooperation, both choosing 100% in all rounds, results in both participants earning €25.-.[19]

The preceding paragraphs show that cooperation is financially attractive in this game; however, defection can also be very lucrative. Choosing 99% in a round where the other player chooses 100% raises earnings in this round from €2.50 to €4.95. The attractiveness of both cooperation and defection make it likely that participants will develop many different types of social ties, depending on how the game unfolds.[20]

---

[17] A participant's social tie can be affected by something besides the Bertrand game, for example the attractiveness of the Other (Andreoni & Petrie, 2004). We measure the social ties to examine their influence on social comparison effects. The formation of these ties is not the main topic of the present study.

[18] This type of game was used in other studies of the Bertrand game, e.g. Dufwenberger and Gneezy (2000).

[19] Other equilibriums are possible using punishment strategies. In the last round it is only possible to play one of the one-shot Nash equilibriums. However because there are three different Nash equilibriums with different payoffs there is room for punishment. Punishment in the final round would consist of playing a worse equilibrium, e.g. both choosing 0% instead of both choosing 2%. This can make both players choosing higher percentages in earlier rounds an equilibrium in the repeated game. Punishment in earlier rounds consists of playing a lower percentage than in the equilibrium. The most effective punishment is reverting to the 0% equilibrium in all subsequent rounds. The equilibrium that yields the highest earnings consists of full cooperation (both players choosing 100%) in the first four rounds, both choosing 64% in round five and half the percentage of the previous round in every subsequent round. In this equilibrium both participants earn €13.15, still substantially less than the €25.- they could earn by complete cooperation. Of course, these kinds of equilibriums are very difficult to coordinate on.

[20] The possible identification by their partner after the experiment may well have affected the behavior of participants, especially in the Bertrand game. We do not find this problematic because we are not primarily interested in the Bertrand game but in the influence of social interaction and social comparison on risky choices.

3.4 Lotteries (Part 4, Main Experimental Task)

In the lottery part of the experiment participants face a total of 42 choice situations. In each of these they choose between two different lotteries that simultaneously determine their own payoff and that of the Other. All lotteries are so called simple lotteries[21] with two possible outcomes. The choice in each situation is between a safe and a risky lottery with the same probabilities but with a larger variance of the outcomes in the risky lottery. In about half of the choice situations the risky lottery is presented on the left. To prevent order effects choice situations are presented to each participant in a different, random, order. The lotteries are displayed in appendix A.

Thirty of the 42 choice situations are created by presenting five original lottery pairs in six different ways. These six presentations are based on modifications in two dimensions. The first dimension is the social reference point, the payoff of the Other. Three kinds of social reference points are used: in *loss* situations the Other's payoff is equal to the highest possible payoff for the decision maker; in *gain* situations the Other's payoff is equal to the lowest possible payoff for the decision maker and in *neutral* situations the Other's payoff is equal to the decision maker's payoff regardless of the choice and outcome of the lottery. Figure 1 shows an example of a loss, a gain and a neutral situation.

The second dimension is the expected payoff: either the safe or the risky lottery has a slightly higher expected value. The safe lottery in the original lottery pair is slightly perturbed to create two closely related lottery pairs for each original pair. This manipulation ensures that participants cannot be indifferent in both cases.

In the loss and gain situations subjects make choices that affect only their own outcome and cannot observe the choices of others. This eliminates the possibility of social learning, preferences for conformity and concerns about the other's payoff or reciprocity (as the other cannot influence your payoff either) affecting behavior. Twelve other lottery pairs are added to the aforementioned thirty lottery pairs. These are included to obscure the intentions of the experimenters and are not directly related to the research questions at hand.

3.4 Questionnaire (Part 5)

Participants are presented with a post-experimental questionnaire in which they are asked to list their field of study, their gender and their age. In addition they are asked to guess the age and field of study of the Other, to characterize the Other's personality (kindness, cheerfulness and helpfulness) and looks and to indicate how similar they think the Other is to them. Personality, looks and similarity are all rated using a seven point scale. Participants are further asked to report on the emotions they experienced during the Bertrand game (rage, irritation, envy, joy,

[21] As opposed to compound lotteries.

surprise and disappointment) and how satisfied they are with the outcome, their own decision and the Other's decisions. Regarding the choices over lotteries, participants are asked to report which aspects of the lotteries were most important when making their decisions. Emotions, satisfaction and the importance of different aspects of the lotteries are also rated using a seven point scale.

4 Research questions

Our experiment is designed to answer two research questions: first, *does a social reference point influence decisions under risk, and if so in what direction?*; and second, *do social ties or experiences in the Bertrand game influence this effect?*. We will now discuss these questions and how the observations in the experiment can answer them in detail.

4.1 Does a Social Reference Point Influence Decisions Under Risk?

In the loss and gain situations the payoff of the referent is independent of the choice of the decision-maker or the outcome of the lottery. The decision of the participant only influences her own earnings. Assuming the decision maker maximizes expected utility neither selfish preferences nor linear social preferences predict any difference in behavior between gain and loss situations. Any behavioral difference between the loss and gain situations therefore has to be attributed to the different social reference point. If the payoff of the Other is the decision maker's reference point all outcomes are gains in the gain situation and losses in the loss situation. According to the reflection effect this induces risk seeking choices in the loss situation and risk averse choices in the gain situations[22].[23]

This prediction is a natural extension of (cumulative) prospect theory to a social reference point but, it is doubtful whether such conjectures about behavior in social situations on the basis of theories based on observations of behavior in private settings hold. As Bault et al. (2008), Brennan et al (2008) and Güth et al. (2008) show, behavior in settings that include both risk and social comparison is not easy to predict by a straightforward extensions of models developed to account for either social preferences or risky choices. Furthermore the results of Vendrik and Woltjer (2007) suggest that at least one of the forces that drive the reflection effect according to prospect theory, the shape of the value function, may not be present in a social setting. Vendrik and Woltjer's value function is convex for both gains and losses, relative to a social reference

[22] If the best outcome would have a small probability, probability weighting could reverse this effect, but in our decision situations the probability of the best outcome is always at least 0.33.

[23] If participants are concerned (only) with ranking the same behavior will be observed. In gain situations participants are ensured to earn more than the Other by choosing the safe lottery. In loss situations participants can only have a chance not to earn less than the other by choosing the risky lottery. This makes the risky lottery more attractive in the loss situation than in the gain situations.

point. The level of convexity is equal for gains and losses but the slope is steeper for losses. As discussed above this implies risk aversion in both loss and gain situations, but stronger risk aversion in loss situations[24].

It is not obvious how the behavior in the neutral situations (where the payoff to decision maker and social referent will always be equal) will relate to the behavior in the gain and loss situations. In neutral situations the participant's decision also influences the earnings of the referent. The decision maker may therefore take into account the assumed (risk) preferences of the referent. However, the findings in Brennan et al (2008) and Güth et al. (2008) suggest that the risks faced by others have little impact on decisions. The differences in expected value are small, so it is unlikely that care for the other's expected payoff will influence choices. Consequently, if we accept the typical assumption of social preference theories that equal earnings is a neutral point, social comparison will not influence decisions in neutral situations. It thus seems plausible that in this case all outcomes will be coded as gains. According to (cumulative) prospect theory this means choices should be in line with those for gain lotteries. If the social reference point affects decisions through some other mechanism the effects of a high and a low social reference point are likely to run in opposite directions compared to a neutral situation. In that case the risk aversion in the neutral situation should be in between that observed in the loss and gain situations.[25]

4.2 Do Social Ties or Experiences in the Bertrand Game Influence the Social Comparison Effect?

Besides determining whether a social reference point affects decision making under risk our experiment allows us to explore factors that may determine the strength of the social comparison effect. In this section we describe these factors and the way in which they can influence social comparison.

A decision maker will only engage in social comparison when she finds her referent relevant. In the case of a positive or negative social tie the Other is apparently not irrelevant. We therefore expect a greater effect of social comparison, resulting in a greater difference in behavior between loss and gain situations, for participants with a positive or negative social tie compared to participants with a neutral social tie. Furthermore a negative social tie may influence social comparison differently than a positive social tie. Another possibility is that it is

[24] Of course probability weighting also affects choices under risk, but as the effects of a social referents income do not align with those of a reference point it is reasonable to assume all outcomes are gains so probability weighting is not different for loss and gain lotteries.

[25] Preferences for ranking would also lead to risk aversion in the neutral situation lying in between that in the loss and gain situations because in neutral situations the ranking is independent of the subject's choice. This makes risky lotteries less attractive than in the loss situation and safe lotteries less attractive than in the gain situation.

not so much the social tie to the specific Other, but the concern with the referent's payoff as captured by the second circle-test that affects the extent of social comparison.

The tendency to engage in social comparison may also depend on individual characteristics of the decision maker. For practical reasons no personality questionnaires are administered, but participants who behave more pro-socially may have more attention for the payoffs of others compared with egoistic participants. Therefore we can expect that pro-social participants, as identified by the first circle-test, are more likely to engage in social comparison.

Although the experiences in the Bertrand game are likely to be expressed through the social tie our experiment also allows us to explore the effects of these experiences more directly. In particular, the effect of social comparison may well be different for couples who cooperated (defined as both participants choosing 100 in a round) than for those who did not achieve cooperation. Moreover, when cooperation breaks down due to one participant being "betrayed" by the Other (defined as the participant chooses 100 while the Other chooses a lower percentage after the participants cooperated in the previous round) this yields yet another, distinctly different, experience. It is plausible that such different experiences lead to different social comparison effects. The self-reports on emotions experienced during the Bertrand game are also informative about how a participant views the Other. A person who experienced anger is likely to care for the Other's outcomes in a different way than someone whose partner gave her cause for joy. This motivates the analysis of the correlations between the social comparison effects and the self-reported emotions.

Social comparison is known to depend on whether an individual considers the Other to be part of her in-group or her out-group (Mussweiler & Bodenhausen, 2002). Our questionnaire allows for several measures of similarity between the decision maker and the Other. It is more likely that the participant considers the Other as a relevant peer if similarity is higher, therefore we expect a positive relation between similarity and the effect of the social reference point. We further expect that participants will be more likely to engage in social comparison when they perceive of the Other as a better person. We therefore expect that the effect of social comparison will be strengthened if a participant rates his or her Other higher on the positive attributes.

5. Results

5.1 Social Reference Point Effect

Seven sessions of the experiment were run at the CREED laboratory in Amsterdam in December of 2008. 126 people participated in the experiment. Almost all of them were students from the University of Amsterdam; 46.8% of the participants were students of economics or business and 55.6% were male.

Figure II shows the average percentage of the time participants choose the safer lottery in the loss, gain and neutral situations. The safe lottery is chosen more often in the loss situation than in the gain situation. This difference is highly significant according to a Wilcoxon matched-pairs signed-rank test (p=.0001).

For every loss/gain situation pair we compare choices. Of the 1260 observations (126 participants and 10 loss/gain situation pairs) in 937 cases (74.4%) the choice was the same in loss and gain situations, in 203 cases (16.1%) more safe choices and in 120 cases (9.5%) less safe choices were made in the loss situation compare with the gain situation. Studying each loss/gain situation pair separately we find that for 9 out of 10 pairs the safer lottery is chosen more often in the loss situation. On the level of participants we find that for 38 participants (30.2%) the social comparison effect is neutral (no switches for 22 participants and the same number of switches in both directions for 16 participants), 61 participants (48.4%) made more safe choices and 27 (21.4%) made fewer safe choices in the loss situations (binomial test p<.001).

Given these tests the effect appears to be robust over situation pairs and participants: choices are more risk averse in situations where the social referent earns more (loss situations) than in situations where the social referent earns less (gain situations). This finding is opposite to the behavior predicted when the referents income is used as a reference point. It is however in line with the prediction made by the utility function of the shape found by Vendrik and Woltjer (2007).

In neutral situations the safer lottery was chosen 74.4% of the time. This is in between the percentage of safe choices in the loss and gain situations. Choices in the neutral situations are significantly different from those in the gain situations (Wilcoxon test p=.04) and marginally significantly different from those in the loss situations (Wilcoxon test p=.09).

Result 1: Social comparison does matter for individual decision making: The risk-averse option is chosen more often in the gain situations than in the loss situations.

Result 2:Behavior in the neutral situation is in between the behaviors in the loss and gain situations.

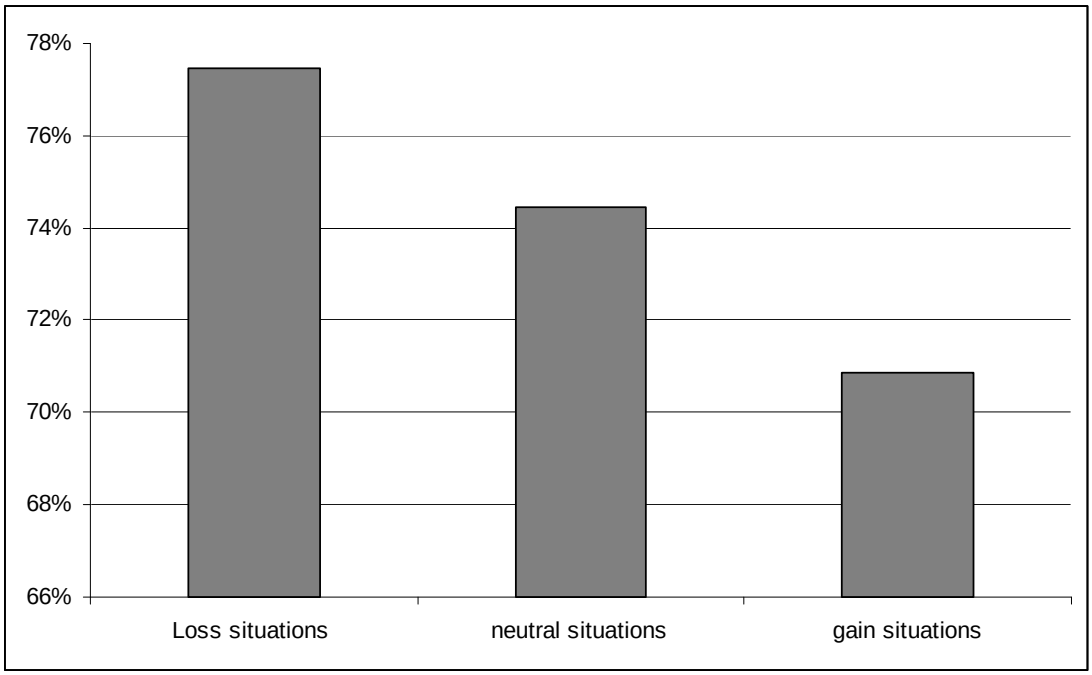


Figure 2
Average percentage of safe choices in the loss, neutral and gain situations.

A bivariate logistic individual fixed effects regression confirms these findings and allows us to control for other factors. Table 2 reports on the regression's results. Most importantly the main social comparison effects remain significant. Several other base variables have a significant effect on choices in the expected direction. Firstly, an increase in the difference in variance between the safe and the risky lottery made it more likely that a participant choose the safe lottery. This is what is expected for risk averse individuals. Secondly, a higher probability of the best outcome makes choosing the safe lottery more likely. The greater underweighting of larger probabilities, as specified by prospect theory, explains this effect. This finding strengthens the view that outcomes are coded as gains. Thirdly, the safe lottery is chosen more often when it has a higher expected value than the risky lottery. Fourthly, participants are also somewhat more risk averse in later periods.

We also find two interesting interaction effects of the gain situation with the difference in variance and with the probability of the best outcome. In gain situations the difference in variance no longer has a significant effect, while the effect of the probability of the best outcome is stronger[26]. This could suggest a somewhat different decision process for gain lotteries. Possible participants made a less careful decision for gain lotteries, paying more attention to striking features like the probability of the best outcome and less to features that require a closer examination like the difference in variance.

[26] A higher expected value for the safe lottery also has no significant effect in the gain situation, but its effect is not significantly different from the average effect.

Table 2.
Logistic individual fixed effects regression for choosing the safe lottery in loss, gain and neutral situations[a.]

Variable	*Coefficient*[b]
Gain situation	-0.25**
Loss situation	0.19*
Difference in variance between safe and risky lottery	0.02**
Probability of the best outcome in the risky lottery	1.50**
Higher expected value for the safe lottery	0.18**
Period	0.01**
Interaction effect[c] gain situation and difference in variance.	-0.03**
Interaction effect[c] gain situation and probability of the best outcome.	1.86**
Interaction effect[c] gain situation and higher expect value for the safe lottery	-0.22
Interaction effect[c] loss situation and difference in variance.	-0.01
Interaction effect[c] loss situation and probability of the best outcome.	-0.76
Interaction effect[c] loss situation and higher expect value for the safe lottery	0.21

a. Data from 11 participants is discarded as these always choose the safe lottery.

b. * signifies p-value<0.1, ** p-value<0.05

c. Interaction variables are normalized to have a mean of 0 to ensure the coefficients of the original variables are not distorted. [27]

5.2 The Influence of Social Ties and Bertrand Game

We now turn to the second research question: Do social ties or experiences in the Bertrand game influence the social comparison effect? We start by examining how the observed behavior relates to the social tie as measured by the circle-tests. If the difference between the angle chosen in the first and the second circle-tests is larger than 5 degrees we consider this as a positive or negative social tie (Sonnemans, van Dijk & van Winden, 2006). The participants with no social tie can be divided in two equally large categories: those who choose relatively selfish in both tests, or relatively cooperative in both tests. Table 3 displays the average difference between the loss and gain situations for these four categories.

[27] Due to the normalization interaction effects are relative to the effects in the neutral situations, while the main effects of the difference in variance, the probability of the best outcome and the higher expected value for the safe lottery are the average effect over loss, gain and neutral situations. There is a significant difference between loss and gain situations for the probability of the best outcome and for the effect caused by a higher value for the safe lottery, but not for the difference invariance between the safe and the risky lottery.

Table 3
The size of the experimental effect for different social ties

	Safe choices in loss situations minus safe choice in gain situations	*N*
Positive social tie	0.61	33 (26.2%)
Negative social tie	0.60	20 (15.9%)
No tie, angle<17.5 degrees	0.46	37 (29.4%)
No tie, angle>17.5 degrees	0.94	36 (28.6%)
Total	0.66	126

Interestingly, the social comparison effect seems to be smaller for selfish participants who are likely to have less attention for the earnings of others; however, this difference is not statistically significant. Spearman rank correlations between the experimental effect and the social tie, the first angle (the more general social attitude) or the second angle (the social attitude to the specific Other) are also not statistical significant at conventional levels (all p>.44).

Next we calculate Spearman's rank correlations[28] (indicated by *Rho* in the remainder of this section) between the social comparison effect and measures obtained in the Bertrand game, circle-tests and questionnaire. Rough measures of the success of the interaction in the Bertrand game are a participant's own earnings and the difference between her earnings and those of the Other. Neither of these is significantly correlated with the social comparison effect at conventional levels (p>.4). The average amount of cooperation in a pair (Rho=-.04 p=.68) or the occurrence of betrayal (Mann-Whitney test p=.85) are not significantly correlated with the social comparison effect either.

Participants report on negative emotions experienced during the Bertrand game. These emotions were rage, irritation, envy and disappointment and are combined into a single scale labeled *anger*[29]. Three questionnaire items related to the Bertrand game request participants to report their satisfaction with the outcome, their own decisions and the decisions of the Other. These are combined in a scale labeled *satisfaction*. Neither scale nor the reported joy is found to correlate significantly with the social comparison effect (p>.26).

Several questions relating to the participant's perception of the Other are combined in a scale labeled *attractiveness*. These questions relate to looks, kindness, cheerfulness, helpfulness, openness and quality of the Other's picture. Two other questions, about the intelligence of the Other and whether the Other is thought to be a thinker, are combined in a scale labeled *perceived intellect*[30]. Neither of these measures correlates significantly with the social comparison effect

[28] Whenever we mention correlations below we refer to Spearman's rank correlations.
[29] Cronbach's Alpha shows that this scale, as well as the attractiveness and satisfaction scales (mentioned below) are internally consistent measures. (Cronbach's Alpha>.69).
[30] The answers to the questions on the Other's intelligence and whether the Other is a thinker are significantly correlated: Rho = .3443, p=.0003.

(p>.25).

The perceived general similarity between the participant and her referent and the perceived similarity regarding the age and field of study of the Other, as measured in the questionnaire, are not significantly related to the social comparison effect. Similarity between the players can also be measured objectively (same sex or different sex, difference in age and same or different field of study). None of these variables is correlated significantly with behavior in the lottery part.

Result 3: No relationship is found between the size of the effect of the social reference point and

a. Social attitude or social ties as measured by the circle-tests

b. Experiences or experienced emotions in the Bertrand game.

c. Perceived characteristics of the Other

d. Similarity, either perceived or objective

5.3 Additional Analyses

As none of our measures of the experience in the Bertrand game and the beliefs about and attitudes towards the Other are found to correlate with behaviour in the lottery part, it seems legitimate to question whether this is due to the reliability or relevance of these measures. We will therefore take a closer look at the relations between these measures.

As expected the experiences in the Bertrand game are found to influence a participant's social tie. The social tie is positively correlated with the differences in the earnings of matched participants in the Bertrand game (Rho=.21, p=.017). This effect is mainly caused by participants who earn less than their referent. The correlation between earnings in the Bertrand game and the social tie is found to be marginally significant (Rho=.17, p=.063). The mean social tie of participants who are betrayed in some period of the Bertrand game is significantly smaller than the social tie of non betrayed participants (-3.19 < +3.28, Mann-Whitney test p=.02).

The anger and satisfaction scales, based on the reported emotions experienced during the Bertrand game, are found to be significantly correlated with earnings in the Bertrand game, as is the reported joy experienced during the Bertrand game[31] (Rho is -.61, .67 and .51 respectively, all p<.001)[32]. Anger is negatively related with the social tie (Rho=-.32, p<.001).

Greater perceived attractiveness and perceived similarity are positively and significantly correlated to the social tie. (Rho is .27 (p=.008) and .24 (p=.01) respectively). Perceived intellect

[31] Besides these emotions experienced surprise was reported. This, more ambiguous, emotion is not found to be correlated significantly with experiences in the Bertrand game.

[32] A higher score on all three scales signifies a stronger experience of the emotion.

is not significantly correlated with the social tie. The Other is reported as both less attractive and less similar if the respondent experienced betrayal. (Mann-Whitney test p=.011 and p=.062 respectively.)

We conclude that the social tie is related to the experiences in the Bertrand game and the perception of the referent in expected ways; the failure to find a relation between the social tie and the social comparison effect cannot result from an ineffective measurement of the social tie.

Finally, in the questionnaire we also asked about the goals of participants in the lottery part. A competitive goal ("I found it important to earn more than the Other") is negatively correlated with the attractiveness of the Other (Rho=-.31, p=.002) and correlates weakly with the social comparison effect (Rho=.16, p=.08). We find a somewhat stronger social comparison effect for participants who reported paying more attention to the amount of the Other (Rho=.169, p=.060).

6 Conclusion

Real life risky decisions are hardly ever made in social isolation: professional traders observe their colleagues, investors their neighbors and athletes their competitors. The effect of social comparison on decisions has received ample attention in social preferences theories and experiments, but the social context is remarkably ignored in the field of decision making under risk. Our experiment considers the simplest possible situation where both risky choices and social comparison are present; choosing between two lotteries while comparing ones own payoffs to the fixed payoff of one social referent, the Other. We find that participants are more risk averse when they can earn at most as much as the Other (loss situation) than when they are ensured they will earn at least as much as the social referent (gain situation).

It is well established that a non-social reference point (like present wealth) leads typically to risk seeking in the loss situation and risk aversion in the gain situation (the reflection effect), as predicted by prospect theory. Our results with a social reference point are the opposite of this prediction. We find that social comparison influences decision making under risk but that this effect cannot be explained by straightforward extensions of theories on decision making under risk to social situations.

The finding that this social reference point influences the behavior in another direction than the standard reference point is intriguing. It is however less surprising given the results of other recent studies which also find unexpected results in situations that include both social comparison and risk. Bault et al. (2008) show that while losses loom larger in individual decision making tasks, gains loom larger than losses in the social situation they study. Brennan et al (2008) and Güth et al. (2008) show that people aren’t willing to pay to reduce other’s risk despite

their social preferences over expected outcomes. More directly related is the finding by Woltjer and Vendrik (2007) on the effect of social comparison on the utility function. These authors establish that both below and above the social reference point value functions are concave, while other reference points lead to a convex value function for losses. As the value function is also steeper for losses this implies increased risk aversion in the loss domain which provides a possible explanation for our findings.

Although this provides a possible explanation for our result it is certainly early days to be definite about behavior in situations with risk and social comparison as the number of studies in this emerging field is very limited. However, our findings, together with research mentioned above, show the importance of studying such situations. It also shows that models will have to make great strides to incorporate the observed behavior.

References

Abdellaoui, M., Barrios, C., & Wakker, P. P. (2007). 'Reconciling introspective utility with revealed preference: Experimental arguments based on prospect theory' *Journal of Econometrics,* 138(1), 356-378.

Abdellaoui, M., Bleichrodt, H., & Paraschiv, C. (2007). 'Loss aversion under prospect theory: A parameter-free measurement' *Management Science*, 53(10), 1659-1674.

Allais, M. (1953). 'Le comportement de l'homme rationnel devant le risque: Critique des postulats et axiomes de l'ecole americaine' *Econometrica*, 21(4), pp. 503-546.

Andreoni, J. and Petrie, R. (2004). 'Public goods experiments without confidentiality: a glimpse into fund-raising', *Journal of Public Economics*, 88: 1605-1623.

Bartling, B. and Von Siemens, F.A. (2010), 'Wage Inequality and Team Production: An Experimental Analysis', Available at SSRN: http://ssrn.com/abstract=1532709

Bault N., Coricelli, G. and Rustichini, A. (2008). 'Interdependent Utilities: How Social Ranking Affects Choice Behavior' *PLoS ONE* 3(10): e3477.doi:10.1371/journal.pone. 0003477.

Benartzi, S. and Richard T.H. (1995). 'Myopic Loss Aversion and the Equity Premium Puzzle.' *The Quarterly Journal of Economics*, 110(1): 73-92.

Bohnet, I. and Frey, B.S. (1999), 'The sound of silence in prisoner's dilemma and dictator games.' *Journal of Economic Behavior and Organisation*, 38: 43-57.

Bohnet, I. and Zeckhauser, R. (2004). 'Trust, risk and betrayal.' *Journal of Economic Behavior and Organization*, 55(4): 467-484.

Bolton, G.E. and Ockenfels, A. (2000). 'A theory of equity, reciprocity and competition.' *American Economic Review*, 100: 166-193.

Bolton, G.E., and Ockenfels, A. (2010) 'Risk Taking and Social Comparison. A Comment on 'Betrayal Aversion: Evidence from Brazil, China, Oman, Switzerland, Turkey, and the United States'. *American Economic Review*, Forthcoming.

Brennan, G., Gonzàlez, L.G.., Güth, W. and Vittoria Levati, M. (2008) 'Attitudes towards private and collective risk in individual and strategic choice situations.' *Journal of Economic Behavior and Organization*, 67: 253-262.

Buunk, B. P., & Mussweiler, T. (2001). 'New directions in social comparison research', *European Journal of Social Psychology*, 31(5), 467-475.

Camerer, C., Babcock, L., Loewenstein, G., and Thaler, R. (1997) 'Labor Supply of New York Cabdrivers: one Day at a Time.' *The Quarterly Journal of Economics*, 112(2): 407-441.

Clark, A.E. Frijters, P. and Shields, M. A. (2008). 'Relative income, happiness, and utility: An explanation for the easterlin paradox and other puzzles', *Journal of Economic Literature*, 46(1), 95-144.

Dufwenberger, M., and Gneezy, U. (2000) 'Price competition and market concentration: an experimental study.' *International Journal of Industrial Organization*, 18: 7-22.

Ellsberg, D. (1961) 'Risk, ambiguity, and the savage axioms', *The Quarterly Journal of Economics*, 75(4), 643-669.

Falk, A. and Fischbacher, U. (2006) 'A theory of reciprocity' *Games and Economic Behavior*, 54(2), 293-315.

Fehr, E., and Gächter, S. (2000) 'Cooperation and punishment in public goods experiments' *American Economic Review*, 90(4), 980-994

Fehr, E. and Schmidt, K.M. (1999) 'A Theory of Fairness, Competition and Cooperation' *Quarterly Journal of Economics*, 114(3): 817-868

Fehr, E., and Schmidt K.M. (2006) 'The Economics of Fairness, Reciprocity and Altruism: Experimental Evidence' in *Handbook of the Economics of Giving, Altruism and Reciprocity*, Vol. 1., eds. S.-C. Kolm en J.M. Ythier. New York: North Holland.

Festinger, L., 1954, 'A Theory of Social Comparison Processes', *Human Relations*, VII: 117-40

Fishburn, P. C. and Kochenberger, G. A. (1979). 'Two-piece Von Neumann-Morgenstern Utility Functions', *Decision Sciences*, 10(4), 503-518.

Forsythe, R.; Horowitz, J., Savin, N.E. and Sefton, M. (1994), 'Replicability, Fairness and Pay in Experiments with Simple Bargaining Games' *Games and Economic Behavior*, 6(3): 347-369.

Gneezy, U. and Potters, J. (1997) 'Experiment on risk taking and evaluating periods', *Quarterly Journal of Economics*, CXII: 631-646.

Güth, W., Vittoria Levati, M. and Ploner, M. (2008) 'On the Social Dimension of Time and Risk Preferences: An Experimental Study.' *Economic Inquiry*, 46(2):261-272.

Harbaugh, R., & Kornienko, T. (2000) 'Local status and prospect theory' Claremont Colleges Working Papers,

Kahneman, D., Knetsch, J. L., and Thaler, R. H. (1991) 'Anomalies: The endowment effect, loss aversion, and status quo bias. '*The Journal of Economic Perspectives*, 5(1), 193-206.

Kahneman, D., and Tversky, A. (1979) 'Prospect theory: An analysis of decision under risk.' *Econometrica*, 47: 263–291.

Köszegi, B., & Rabin, M. (2006). 'A model of reference-dependent preferences', *Quarterly Journal of*

Economics, 121(4), 1133-1165.

Krawczyk, M. and Le Lec, F. (2008), 'Social decisions under risk: evidence from probabilistic dictator game', Working paper, CREED, Amsterdam

Kühberger, A., Schulte-Mecklenbeck, M. and Perner, J. (1999) 'The Effects of Framing, Reflection, Probability, and Payoff on Risk Preference in Choice Tasks.' *Organizational Behavior and Human Decision Processes*, 78(3): 204-231.

Loomes, G., & Sugden, R. (1982). 'Regret theory: An alternative theory of rational choice under uncertainty' *The Economic Journal*, 92(368), 805-824.

Lopes, L. L., & Oden, G. C. (1999) 'The role of aspiration level in risky choice: A comparison of cumulative prospect theory and SP/A theory' *Journal of Mathematical Psychology*, 43(2), 286-313.

Markowitz, H. (1952). 'The utility of wealth', *The Journal of Political Economy*, 60(2), 151-158.

Mussweiler, Th. and Bodenhausen, G.V. (2002), 'I Know You Are, But What Am I? Self-Evaluative Consequences of Judging In-Group and Out-Group Members' *Journal of Personality and Social Psychology*, 82(1): 19-32.

McGlothlin, W. H. (1956). 'Stability of choices among uncertain alternatives' *The American Journal of Psychology*, 69(4), 604-615.

Odean, T. (1998) 'Are Investors Reluctant to Realize Their Losses?' *The Journal of Finance*, 53(5): 1775-1798.

Postlewaite, A. (1998) 'The social basis of interdependent preferences', *European Economic Review*, 42(3-5), 779-800.

Prelec, D. (1998) 'The Probability Weighting Function.' *Econometrica*, 66(3): 497-527.

Quiggin, J. (1982) 'A Theory of Anticipated Utility' *Journal of Economic Behavior and Organization*, 3(4): 323-343.

Rabin, M. (2000) 'Risk aversion and Expected utility theory: A calibration theorem.' *Econometrica*, 68(5):1281-1292.

Rohde, I. and Rohde, K. (2009) 'Risk attitudes in a social context.' Working paper, http://people.few.eur.nl/rohde/riskinsocialcontext_july2010.pdf

Samuelson, W., and Zeckhauser, R. (1988). 'Status quo bias in decision making', *Journal of Risk and Uncertainty*, 1(1), 7-59.

Schmeidler, D. (1989) 'Subjective probability and expected utility without additivity', *Econometrica,* 57(3), 571-587.

Sonnemans, J., van Dijk, F. and van Winden, F. (2006) 'On the dynamics of social ties structures in groups', *Journal of Economic Psychology*, 27: 187-204.

Thaler, R. (1980) 'Toward a positive theory of consumer choice', *Journal of Economic Behavior and Organization*, 1(1), 39-60

Thaler, R. H., and Johnson, E. J. (1990) 'Gambling with the House Money and Trying to Break Even: The Effects of Prior Outcomes on Risky Choice.' *Management Science*, 36(6): 643-660.

Tversky, A., & Kahneman, D. (1991). 'Loss aversion in riskless choice: A reference-dependent model'

The Quarterly Journal of Economics, 106(4), 1039-1061.

Tversky, A. and Kahneman, D. (1992) 'Advances in Prospect Theory: Cumulative Representation of Uncertainty.' *Journal of Risk and Uncertainty*, 5: 297-323.

Veblen, Th. (1899) 'The Theory of the Leisure Class' New York: McMillan Co.

Vendrik, M., and Woltjer, G. B. (2007) 'Happiness and loss aversion: Is utility concave or convex in relative income?' *Journal of Public Economics*, 91(7-8), 1423-1448.

Zizzo, D. J., and Oswald, A. J. (2001) 'Are people willing to pay to reduce others' incomes?' *Annales d'Economie Et De Statistique,* 39-65.

Appendix A: The Lottery Pairs.

			Option 1				Option 2			
		Prob.	Outcome A		Outcome B		Outcome A		Outcome B	
		A (%)	SELF	OTHER	SELF	OTHER	SELF	OTHER	SELF	OTHER
1	l	67	22.40	22.40	4.70	22.40	19.30	22.40	11.20	22.40
2	g	67	22.40	4.70	4.70	4.70	19.30	4.70	11.20	4.70
3	n	67	22.40	22.40	4.70	4.70	19.30	19.30	11.20	11.20
4	l	67	22.40	22.40	4.70	22.40	19.10	22.40	11.20	22.40
5	g	67	22.40	4.70	4.70	4.70	19.10	4.70	11.20	4.70
6	n	67	22.40	22.40	4.70	4.70	19.10	19.10	11.20	11.20
7	l	56	19.40	19.40	6.30	19.40	16.30	19.40	10.40	19.40
8	g	56	19.40	6.30	6.30	6.30	16.30	6.30	10.40	6.30
9	n	56	19.40	19.40	6.30	6.30	16.30	16.30	10.40	10.40
10	l	56	19.40	19.40	6.30	19.40	16.20	19.40	10.20	19.40
11	g	56	19.40	6.30	6.30	6.30	16.20	6.30	10.20	6.30
12	n	56	19.40	19.40	6.30	6.30	16.20	16.20	10.20	10.20
13	l	67	11.40	20.80	14.70	20.80	8.30	20.80	20.80	20.80
14	g	67	11.40	8.30	14.70	8.30	8.30	8.30	20.80	8.30
15	n	67	11.40	11.40	14.70	14.70	8.30	8.30	20.80	20.80
16	l	67	11.30	20.80	14.50	20.80	8.30	20.80	20.80	20.80
17	g	67	11.30	8.30	14.50	8.30	8.30	8.30	20.80	8.30
18	n	67	11.30	11.30	14.50	14.50	8.30	8.30	20.80	20.80
19	l	67	21.10	21.10	8.90	21.10	16.20	21.10	19.10	21.10
20	g	67	21.10	8.90	8.90	8.90	16.20	8.90	19.10	8.90
21	n	67	21.10	21.10	8.90	8.90	16.20	16.20	19.10	19.10
22	l	67	21.10	21.10	8.90	21.10	16.10	21.10	18.80	21.10
23	g	67	21.10	8.90	8.90	8.90	16.10	8.90	18.80	8.90
24	n	67	21.10	21.10	8.90	8.90	16.10	16.10	18.80	18.80
25	l	56	6.90	18.40	14.40	18.40	3.60	18.40	18.40	18.40
26	g	56	6.90	3.60	14.40	3.60	3.60	3.60	18.40	3.60
27	n	56	6.90	6.90	14.40	14.40	3.60	3.60	18.40	18.40
28	l	56	6.70	18.40	14.30	18.40	3.60	18.40	18.40	18.40
29	g	56	6.70	3.60	14.30	3.60	3.60	3.60	18.40	3.60
30	n	56	6.70	6.70	14.30	14.30	3.60	3.60	18.40	18.40
31		67	21.70	10.90	21.70	15.80	21.70	7.90	21.70	21.70
32		67	7.90	10.90	7.90	15.80	7.90	7.90	7.90	21.70
33		67	21.70	10.70	21.70	15.80	21.70	7.90	21.70	21.70
34		67	7.90	10.70	7.90	15.80	7.90	7.90	7.90	21.70
35		56	23.80	22.40	23.80	9.70	23.80	19.60	23.80	13.40
36		56	9.70	22.40	9.70	9.70	9.70	19.60	9.70	13.40
37		56	23.80	22.40	23.80	9.70	23.80	19.40	23.80	13.40
38		56	9.70	22.40	9.70	9.70	9.70	19.40	9.70	13.40
39		50	6.90	11.40	22.50	18.10	11.40	6.90	18.10	22.50
40		50	6.90	11.20	22.50	18.10	11.20	6.90	18.10	22.50
41		67	14.20	18.20	14.20	18.20	12.20	18.20	18.20	18.20
42		67	14.20	12.20	14.20	12.20	12.20	12.20	18.20	12.20

The second column indicates the category of the lottery pair: l(oss), g(ain) or n(eutral). The choice situations were presented in a random order.

Appendix B: Translation of the Instructions

(original Dutch instruction available upon request)

General Instructions

This experiment consists of 4 parts. You will receive instructions on each part prior to the start of the part concerned.
If you have any questions during the experiment, raise your hand.

The OTHER

During each part you will be coupled with another person in this room who we will call the OTHER. In parts 2, 3 and 4 this is always the **same** person. The person to whom you are coupled in part 1 is an **other** person than the person you are coupled with in parts 2, 3 and 4.

Photo

Before the start of the experiment we made a photograph of all participants. After part 2 (and not before) you get to see a photo of the person you are coupled with in parts 2, 3 and 4.
When you get to see a photo of the OTHER he or she will also get to see a photo of you. When you are not yet seeing a picture of the OTHER, the OTHER will not see a photo of you either.

Payout

During this experiment you can make money. **The earnings of only 1 of the 4 parts will be paid out.** Which part this will be is determined after the end of the last part. With 10% chance this will be part 1, with 30% chance this will be part 2, with 10% chance this will be part 3 and with 50% chance this will be part 4. How much you earn in a specific part depends on the choices made by you and/or the OTHER. Besides their earnings in the experiment everyone will receive €10,-.

[Control questions: the participant had to answer questions concerning the matching process, the payout probabilities and the point in the experiment where photos would be displayed.]

Instructions for part 1

Choice

In this part you have to choose between combinations of earnings for yourself and the OTHER. All possible combinations are represented on a circle like the one shown above. Later you can click on any point on the circle. Which point you choose determines how much money you and the OTHER earn. **You can not click on the circle yet.**

Earnings

The axes in the circle represent how much money you and the OTHER earn when you choose a certain point on the circle. The horizontal axis shows how much you earn: the more to the right, the more you will earn. The vertical axis shows how much the OTHER will earn: the more to the top, the more the OTHER earns. The distribution can also mean negative earnings for you and/or the OTHER. Points on the circle left of the middle mean negative earnings for you, points below the middle mean negative earnings for the OTHER. When you click on a point on the circle the corresponding combination of earnings, in cents, will be displayed in the table to the right of the circle. You can try different points by clicking on the circle using your mouse. Your choice will only become definite when you click on the “send” button.
The OTHER is presented with the same choice situation. Your total earnings in this part consist of the amount allotted by you to yourself and the amount allotted to you by the OTHER by his or her choice.

Pay out

The OTHER's chosen combination is only made public if this part is paid out (this happens with a chance of 10%, see the general instructions on the paper on the table).

After this part you will be coupled to a different participant for parts 2, 3 and 4. (see the general instructions on paper.)

[Control questions: the participant had to choose some specified distributions on the circle.]

Instructions for part 2

The OTHER

You are now coupled to a different person than in part 1. From now on you will be coupled to this person.

Decisions

This part consists of 10 rounds. Every round both you and the OTHER make a decision. This decision consists of choosing a percentage, at least 0 and at most 100. This percentage should be a whole number. The percentages chosen by you and the OTHER determine what you and the OTHER earn in a round.

Earnings

The earnings in each round are determined in the following way:

- If you and the OTHER choose the same percentage you both get half of €5,- multiplied by the percentage chosen by you.
- If the chosen percentages are different the one who choose the lowest percentage will get €5,- multiplied by that percentage. The person who chose the highest percentage will get nothing in that case.

Total earnings in this part are equal to the earnings over all 10 rounds added together.

Pay out

This part is paid out with 30% chance; see the general instructions on the paper on the table.

[Control questions: participants had to calculate earnings of themselves and the OTHER resulting from specified percentages chosen by themselves and the OTHER]

Instructions for part 3

This part is the same as part 1 except that you are coupled to a different person, the person you were matched with in the previous part. So you again have to choose between combinations of earnings for yourself and an OTHER. The other is now the person you were coupled with in part 2.

Choice

In this part you have to choose between combinations of earnings for yourself and the OTHER. All possible combinations are represented on a circle like the one shown above. Later you can click on any point on the circle. Which point you choose determines how much money you and the OTHER earn. **You can not click on the circle yet.**

Earnings

The axes in the circle represent how much money you and the OTEHR earn when you choose a certain point on the circle. The horizontal axis shows how much you earn: the more to the right, the more you will earn. The vertical axis shows how much the OTHER will earn: the more to the top, the more the OTHER earns. The distribution can also mean negative earnings for you and/or the OTHER. Points on the circle left of the middle mean negative earnings for you, points below

the middle mean negative earnings for the OTHER. When you click on a point on the circle the corresponding combination of earnings, in cents, will be displayed in the table to the right of the circle. You can try different points by clicking on the circle using your mouse. Your choice will only become definite when you click on the "send" button.
The OTHER is presented with the same choice situation. Your total earnings in this part consist of the amount allotted by you to yourself and the amount allotted to you by the OTHER by his or her choice.

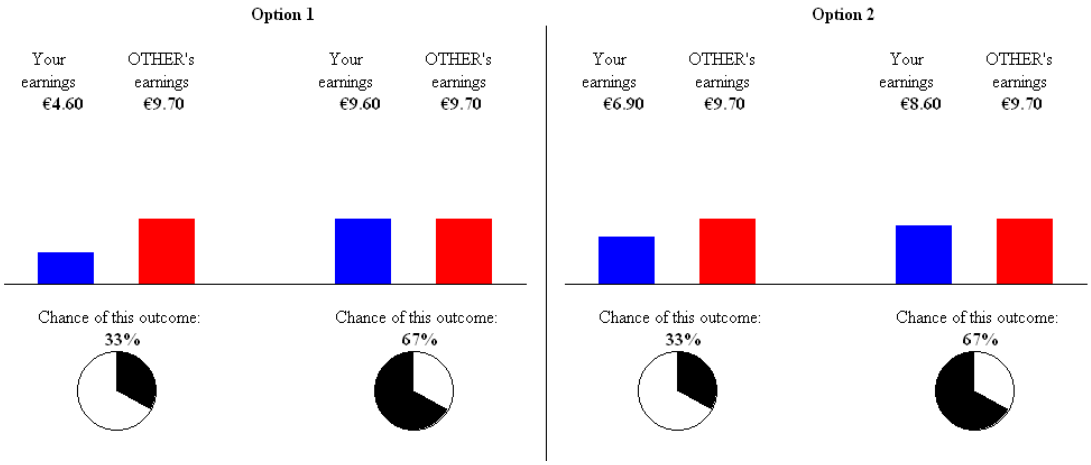
Pay out
The OTHER's chosen combination is only made public if this part is paid out (this happens with a chance of 10%, see the general instructions on the paper on the table).

[Control questions: participants had to select a specified payoff combination and answer questions concerning payout probabilities and the matching process.]

Instructions for part 4

Choices
In this part you have to choose between 2 different lotteries on every screen. In total you will be presented with such a choice situation 42 times.
The lotteries in this part determine both your earnings and those of the OTHER. Below you can see an example of a screen like the screens you will get to see later. On the screen you can see two lotteries between which you can choose. One to the left of the line in the middle of the screen, the other to the right. The blue bar represents how much you will earn in the outcome concerned. The red bar how much the OTHER will earn. The amounts are also written below the bars. The chance of a certain outcome is represented by the circle below the bars. The dark colored part of the circle represents the chance of the outcome concerned. Below the circle the chance in percentages is written.

Choice situations
The choice situation below is only an **example**. You will not be asked to choose between the lotteries you see here.
In this example the earnings of the OTHER are equal, independent of your choice or the outcome. This may be the case in the choice situations you will be presented with later, but it will not be the case in all choice situations.



Earnings
If this part is selected to be paid out it is first determined whether one of yours or on of the OTHER's choice situations will be detrimental. Thereby there is just as much chance that it will

be one of your choice situations as that it will be one of the choice situations of the OTHER. Then it will be determined which of the 42 choice situations of the selected person will be looked at. Each choice situation has an equal chance of being selected. The selected choice situation will then be looked at to determine which of the two lotteries was chosen by the selected person (you or the OTHER). This lottery is then played out and determines the total earnings of both you and the OTHER.

Pay out
The chance that this part is paid out is 50% (see the general instructions on paper which are on your table).
If one of the choice situations presented to you is selected the pay off to you and the OTHER is determined **only** by the lottery chosen by you in that choice situation. **That means that when you make a choice you can assume that only that choice determines the total earnings of you and the OTHER.**

[Control questions: participants had to answer questions regarding their understanding of the payout probabilities and presentation of the lotteries.]