SOCIAL COMPARISON AND RISKY CHOICES*

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Abstract

This experimental study combines two fields in microeconomics: individual decision making under risk and decision making in an interpersonal context. Participants make choices between lotteries with only positive outcomes. In the loss and gain context a social referent receives a fixed payoff that is respectively higher and lower than all possible payoffs of the decision maker. The decision maker has no influence on the earnings of the social referent so strategic behavior or social preferences can play no role. Risk attitude is influenced by social comparison: decision makers are more risk-averse in the loss context than in the gain context.

Keywords: Social comparison, social preferences, decision making under risk, experiment

Classification-JEL: C91, D81, D03

I. Introduction

Without too much generalization modern micro-economics can be neatly separated into two distinct fields of study. In the one field theoretical and empirical work is done on individual decision making, much of it involving risk or uncertainty. In the other field decision making in an interpersonal context is studied. Researchers tend to specialize in only one of these fields and after the seminal work of Neumann and Morgenstern (1944) the fields have developed more or less independently.

Given the paradigmatic division within micro-economics it is remarkable that influential theories from both fields concur on the central role of reference points as determinants of behavior. The most influential behavioral theory from the individual decision making field is (cumulative) prospect theory. In this theory (Kahneman and Tversky, 1979 and Tversky and Kahneman, 1992) possible outcomes are compared with a reference point; outcomes lower (higher) than the reference point are considered losses (gains). Losses are assumed to "loom larger than gains" (Kahneman & Tversky, 1979, p. 279). Probabilities are transformed by a weighting function and the type of weighting depends on whether the accompanying outcome is coded as a loss or as a gain.

From the field of interpersonal decision making comes the finding that many individuals have social preferences: they care not only for their own payoff, but for that of others as well. Social preferences models like those of Fehr and Schmidt (1999) and Bolton and Ockenfels (2000) assume that decision makers compare their own outcomes with those of others. The outcomes of others serve as a reference point. These models therefore belong to the general category of reference dependent utility models.

Theories and models in both fields abstract away from elements studied in the other field. Social preference theories typically ignore the effect of uncertainty or have retained the traditional expected utility framework. Theories on decision making under risk and uncertainty on the other hand have kept the traditional assumption of selfishness or abstracted away the existence of others. Such abstractions are logical and often unavoidable in the process of developing a theory. At the same time they limit the relevance of the theory in real life situations. Further development of economic theory therefore requires relaxation of such abstractions.

In experimental tests of models great care is taken to control the experimental environment. In practice this means that experiments in individual decision making prevent social comparison (by hiding the earnings of other participants) and social preference experiments avoid uncertainty as much as possible (to prevent risk attitudes from adding noise to the data). However, in the same way that countervailing factors can be excluded in experiments they can be included in a controlled way. This is what is done in our experiment. As a first step towards uniting theories from both fields we explore the influence of social comparison on decision making under risk. Specifically we explore whether the payoff of a referent can affect decision making under risk.

Our experiment is about individual decision making under risk in the sense that choices between lotteries are made which are irrelevant for the outcomes of others, but it is also about social comparison in the sense that the outcome for the other participant differs between choice situations. Particularly, we compare choices between lotteries in a loss setting (the other participant earns more), a gain setting (the other participant earns less) and a neutral setting (the other participant earns the same). To provide participants with a salient social referent participants play a two-person Bertrand game. To strengthen the effect of social comparison participants are provided with a photo of their referent. The effect of the Bertrand game and the photo on the social tie of the participant with her referent is measured using circle-tests.

Section II discusses relevant theories on social comparison and decision making under risk. Section III describes the experimental design; section IV poses research questions and section V reports the results of the experiment. Section VI concludes.

II. Theoretical background and related empirical Findings

The importance of reference points in both social comparison theories and theories on decision making under risk is one of the key inspirations for this study as well as an important point of departure for any attempt to merge theories from both fields. The discussion on theory and evidence from both fields will therefore focus on the role of reference points and reference point formation in both fields. Existing research on risk in social settings will also be discussed.

Social comparison is a prominent feature of many models about social preferences yet it is important to distinguish social comparison from social preferences. Social comparison refers to comparing one’s own situation with that of others and the influence of this comparison on decisions, for example when "keeping up with the Joneses". Social preferences are defined as caring about the payoff to others directly; this can be positive as with altruism or negative as with spite. Social comparison and social preferences are often interrelated. In inequity aversion models (e.g. Fehr and Schmidt, [1999] and Bolton and Ockenfels, [2000]) people put a positive weight on the payoff to individuals with a lower payoff, but a negative weight on that of individuals with a higher payoff[1]. These models combine social comparison and social preferences. The use of social comparison identifies them as reference dependent utility models.[2]

Social preference theories typically incorporate social comparison by assuming participants compare the distributions of payoffs to some (neutral) reference distribution. The effect of multiple referents is a point of discussion in the literature. Fehr and Schmidt (1999) propose that a decision maker compares her own payoff to that of each social referent individually. In this model people essentially have as many reference points as referents. Bolton and Ockenfels (2000) on the other hand propose comparison to the average payoff of all people in one's social reference group. In situations with only one referent both models agree. For a comprehensive review of theories and evidence in the field of social preferences we refer to Fehr and Schmidt (2006).

In individual decision making under risk the contributions of Kahneman and Tversky stand out. According to Kahneman and Tversky (1979) choice behavior over prospects with losses is the mirror image of the behavior when the prospects involve gains. They call this the reflection effect. More generally behavior under risk is summarized in the following way: for gains (losses) people are risk-averse (seeking), except for small probabilities. This pattern is not universally accepted. A meta-analysis of studies on behavior under risk by Kühberger, Schulte-Mecklenbeck & Perner (1999) does not fully confirm the pattern. It shows that empirical research generally confirms risk-seeking behavior for losses and risk-averse behavior for gains, but not the reverse pattern when small chances are involved. For the study at hand it is important to note that the empirical evidence concurs that behavior is significantly different for gains and losses.

Cumulative prospect theory (Tversky & Kahneman, 1992) explains the reflection effect by probability weighting. In cumulative prospect theory the weight of an outcome is determined by the difference between the weighted probabilities of two events: (1) getting this outcome or an outcome further from the reference point, and (2) getting an outcome further from the reference point. The result is decumulative weighting for losses and cumulative weighting for gains. This procedure, combined with overweighting small

[1] In some contexts it is found that some decision makers try to increase their relative payoff even if they are ahead of others (Fehr, Hoff and Kshetramade 2008; Abbink and Sadrieh 2008).
[2] Note that in principle social preferences are possible without social comparison, for example in the case of an altruist who puts a fixed positive weight on the payoff of others independent of her own (relative) payoffs or a "nasty" person who is always willing to pay in order to lower the payoff of others.

probabilities and underweighting large probabilities, results in the reflection effect. The shape of the utility function[3], concave for gains and convex for losses, strengthens the effect.

Considering the importance of the reference point in cumulative prospect theory it seems natural to investigate how a reference point is actually determined. According to Kahneman and Tversky: "*The reference point usually corresponds to the current asset position, (...)[and] can be affected by the formulation of the offered prospects, and by the expectations of the decision maker*."(Kahneman & Tversky, 1979, p. 274). Perhaps the most famous example of a shifting reference point is the Asian disease study (Tversky & Kahneman, 1981) which demonstrates that the framing of a prospect can affect risk taking behavior, apparently by affecting what is perceived as the status quo. Another often cited study (Camerer et al., 1997) uses an income target as a reference point to explain work decisions of New York cab drivers. Buying prices of stocks and observed past prices of stocks have also been shown to affect behavior consistent with these prices acting as a reference point (Benartzi & Thaler, 1995; Odean; 1998; Gneezy, 2005).

Although (cumulative) prospect theory does not explicitly mention the possibility that social comparison may determine the reference point, this possibility is also not explicitly ruled out. Our experiment explores whether a social referent's payoff can indeed take this role. This is the most basic question that needs to be answered before one can attempt to combine social preference theories and cumulative prospect theory into a single theory. If a social reference point has the same effect on choice behavior as a prospect theory reference point the reflection effect will also be observed in social contexts. In particular, if the social reference point is below all possible payoffs in the choice situation, all outcomes are treated as gains and the decision maker will exhibit risk aversion. On the other hand, if the social reference point lies above all possible payoffs all outcomes are considered losses and the decision maker will be risk-seeking, or at least less risk-averse.

This prediction is based on the assumption that the social referent's payoff is the only reference point. Cumulative prospect theory does not allow for multiple reference points, but in some cases different points can act as reference points and a decision maker has to "choose", probably unconsciously, between these points. For example, consider the situation where someone observes both her own initial wealth position and a referent's payoff. Which of these points will be used as the reference point may depend on their saliency. The saliency

[3] Tversky and Kahneman use the term value function.

of the referent’s payoff is likely to depend on the social context and the relationship between the decision maker and her referent.

However, it may be the case that not one point is used as a reference point but that several points have this role simultaneously. Having multiple referents is comparable with the models on social preferences where the decision maker compares her payoff to the payoffs of all other group members. Note that cumulative prospect theory explicitly assumes only one reference point and therefore does not provide any predictions about behavior in case of multiple reference points.

Merging social preference theories and prospect theory is not a trivial undertaking. In social situations there may be more than one referent present, the referent's payoff can be influenced by the decision maker and may be uncertain. In all these cases there are multiple possible reference points. Appendix C explores possible ways to merge the Fehr and Schmidt (1999) model with cumulative prospect theory (Tversky and Kahneman, 1992) and concludes that essential modeling choices need empirical guidance.

We know of only one experiment which explicitly studied situations with multiple possible reference points. In Sullivan & Kida (1995) managers answer questionnaires containing hypothetical scenarios in which they have to choose between a safe and a risky investment project. The scenarios offer two reference points: the current operating profit of the company (status quo) and the -higher- target performance level set by the company. In some decision situations the payoffs in the safe and the risky option are below both reference points, in others above both reference points and in still other cases in between the two reference points. They find that managers are more likely to choose the risky option if all outcomes are below both reference points than when all outcomes are above all reference points. Their most important finding in light of the current study is that in case all outcomes are in between the reference points behavior resembles behavior when all outcomes lie below both reference points. This can be explained in two ways. First, if there are multiple reference points behavior is as if the highest reference point is used as the only reference point. Second, all participants choose the target performance level as their only reference point.

As the preceding section shows most theories and empirical investigations concern either social comparison or decision making under risk. However there exist some experiments about risk taking in a social context. Brennan et al (2008) elicit participants' willingness to pay and willingness to accept for prospects that jointly determine their own payoff and that of a matched participant. They find no relationship between risk attitudes and social preferences.

Güth, Vittoria Levati and Ploner (2008) show, in a similar experiment, that some people are other-regarding when allocating expected payoffs, but this is hardly the case when allocating risk or delay. Bolton and Ockenfels (2009) find two effects of social preferences on risk taking. Firstly, disadvantageous inequality (caused by raising the referent's payoff above the decision maker's) makes a safe option less attractive, as expected by social preference theories. Secondly, people appear to be less willing to take risk if this risk also affects someone else. Note that these studies explore social preferences regarding the allocation of risk. They do not study the influence of social comparison on decision making under risk.

Rohde and Rohde (2009) study risk taking in a social context where the decision maker has no influence on the payoff of the participants she is coupled with (in some of the periods). Three aspects of this study make it difficult to link the observed decision to a social reference point. 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. Secondly in Rohde and Rohde (2009) the social referents receive a lottery or a distribution of payoffs. Multiple referents and multiple possible outcomes both lead to multiple possible social reference points[4]. If the referents do get a single fixed amount that 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[5]. 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.

Bault, Coricelli and Rustichini (2008) study emotions resulting from winning or losing a lottery in private and social situations. Participants in this experiment choose between two lotteries and observe the outcome of both. In the private treatment they only observe their own choice. In the social treatment players are told that they also observe the choice of a matched participant, however, in reality these choices are made by a computer program that is either a value maximizer or extremely risk-averse. After the realizations of the lotteries the heart rate and skin conductance response is measured and the subjective emotional state of the participant is measured on a negative-positive scale. Emotional responses to a better or worse outcome in the other lottery are found to be more intense when the matched other chose the other lottery, compared to emotional responses in the private

[4] The complications that arise in situations with multiple social reference points are explored in appendix C.
[5] Only 1 pair of questions in Rohde and Rohde's study is comparable with our stimuli, but they find no effect for this pair.

treatment. When the matched other chose the same lottery emotional responses are diminished.

Even more interesting is their finding that emotional evaluations of gains and losses are very different in private and social situations. In private situations a better outcome in the non chosen lottery leads to the largest emotional response, a finding in line with loss aversion. In contrast, in social situations gains loom larger than losses: the largest emotional response is found when the chosen lottery yields the best outcome while the other has chosen the other lottery.[6] This difference in emotional evaluation affects 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 behavior increases the chance of facing either a better or worse outcome than the other as opposed to the same outcome. Apparently the possible pleasure from being better off more than compensates for the possible pain from being worse off. Note however that reference points are not easy to determine in this study because the referent also faces a lottery (leading to multiple possible social reference points) and because of the repetition (also previous earnings may act as reference points).

III. 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 I shows the order of experimental tasks. The experiment starts with a circle test with a randomly determined participant. After this participants are coupled with their social referent (labeled "Other" in the experiment). A Bertrand game is played to make the social referent more salient. 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 the lottery part[7].

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

[6] Self-reports show that the outcome is perceived as positive, so the strong emotion is not a feeling of compassion about the other's lower payoff.

[7] 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.

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 maker will view each lottery as independent. Participants answer control questions to confirm their 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.

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.			

Table I: The order of the experimental tasks

Photograph

A photograph is taken of each participant before he or she enters the laboratory[8]. 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[9].

Circle-test and Social Ties (Part 1 and 3)

Circle-tests (Sonnemans, van Dijk & van Winden, 2006) are employed to measure the social value orientation and the 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 displayed. The participant can try as many points as she wants before confirming a payoff combination.[10]

Selecting a point on the circle involves making a trade off between the participant's own payoff and that of the receiver. As the slope of the circle differs along the circle, so does the rate of substitution between one's own and the receiver's payoff. 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.

At the start of the experiment participants perform the first circle-test in which the participant is randomly matched to an anonymous other participant. Participants know that they will not be matched with this same participant later in the experiment. The outcome of this first circle-test is the relative concern with an anonymous other, the social value

[8] One participant chose not to participate in the experiment when we announced photos would be used.
[9] 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.
[10] An English translation of the circle test can be found on: www.feb.uva.nl/creed/people/linde/circletest.html.

orientation of the individual. 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. This test measures their attitude towards the Other. Finally, the difference in angle between the second and first test measures the social tie to the Other; how much a participant is concerned with the income of the Other compared to her concern for an anonymous person (Sonnemans, van Dijk & van Winden, 2006). 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.[11]

The social tie could be affected by something besides the Bertrand game. Andreoni and Petrie (2004) for example shows that being matched to people who are found to be more attractive elicits higher contributions. We measure the social ties because of the possible influence on social comparison, how these ties are formed is not the main topic of the present study.

Bertrand Game (Part 2)

In the second stage participants play a Bertrand game with so called box demand[12]. 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.

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 always 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. Other equilibriums are possible using punishment strategies[13]. In the most efficient of these

[11] In theory this amount could be negative but this never happened in the experiment.

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

[13] In the last round it is clearly 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

equilibriums both participants earn €13.15, still substantially less than the €25 they could earn by complete cooperation.

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.[14]

Lotteries (Part 4)

In the lottery part of the experiment participants face a total of 42 choice situations. In each of these they have to choose between two different lotteries that simultaneously determine their own payoff and that of their Other. All lotteries are so called simple lotteries[15] 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 upon differences in two dimensions. The first dimension is the social reference point (the payoff of the Other). Three combinations are used: in *loss* lottery pairs the Other's payoff is equal to the highest possible payoff for the decision maker; in *gain* lottery pairs the Other's payoff is equal to the lowest possible payoff for the decision maker and in *neutral* lottery pairs the Other's payoff is equal to the decision maker's payoff regardless of the choice and outcome of the lottery. Figure I shows an example of a loss, a gain and a neutral lottery pair.

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effective punishment is reverting to the 0% Nash equilibrium in all subsequent rounds. The equilibrium that would yield the highest outcome for the players would consist 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. Of course, these kinds of equilibriums are very difficult to coordinate on.

[14] 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.

[15] As opposed to compound lotteries.

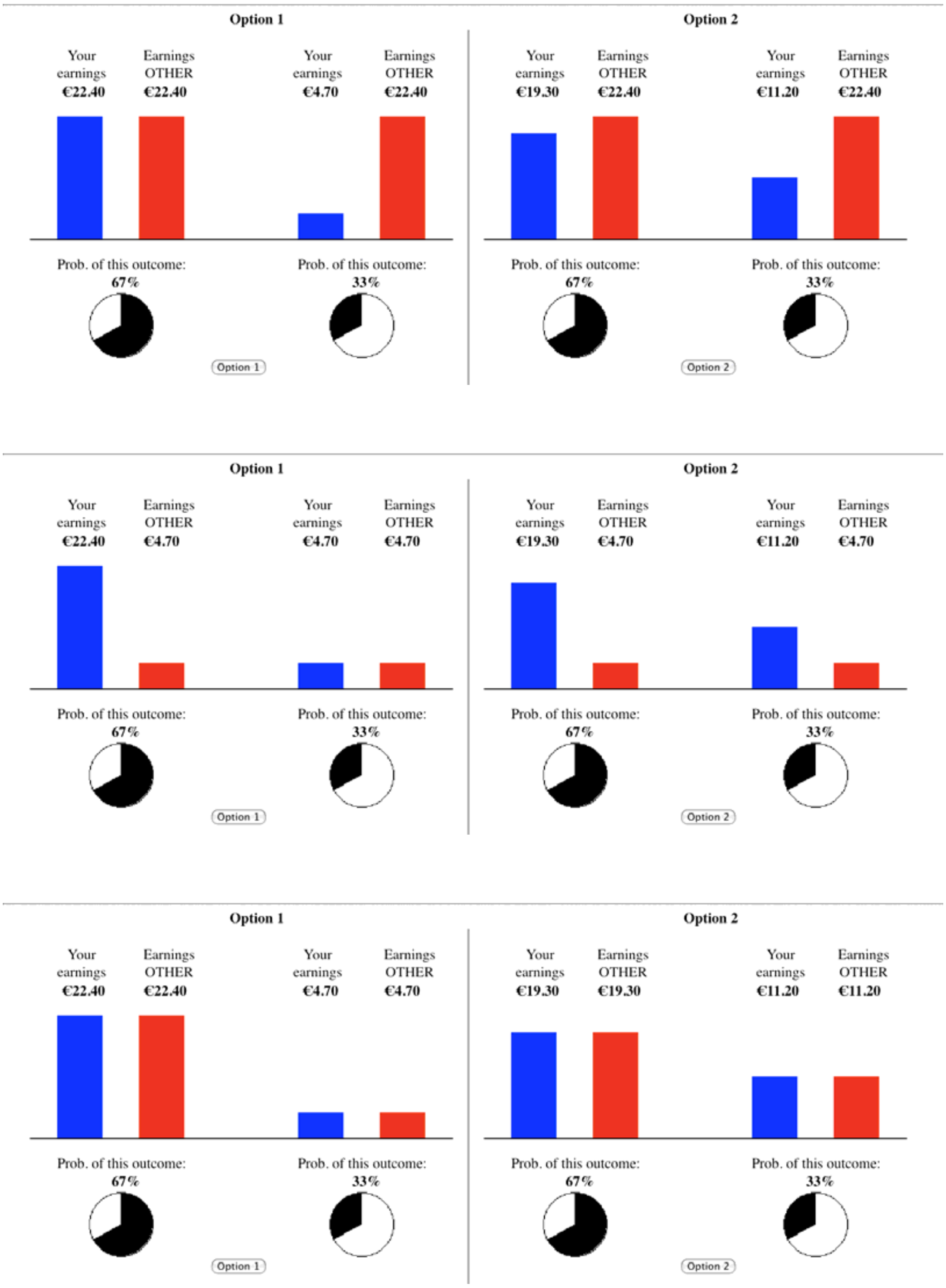


Figure I: Lottery screens.

Top panel: an example of a loss lottery, middle panel: the corresponding gain lottery and lower panel the corresponding neutral lottery. At the top of the screen photographs of SELF in a blue frame and OTHER in a red frame would be displayed. Below that the following message is displayed: "If this choice period is paid out, **only the lottery chosen by you** determines the total earnings of you and OTHER."

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 ensure that in one case the safe option had a slightly higher expected value and in the other case the risky option had a slightly higher expected value. This creates two closely related lottery pairs for each original pair. Participants cannot be indifferent in both pairs.

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. For example, some 'mirrors' of original pairs are included: the outcome for the decision maker is always the same but the options are risky or safe for the Other.

Questionnaire (Part 5)

Participants are presented with a post-experimental questionnaire in which they asked about 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 (e.g. kindness, cheerfulness and helpfulness) and looks and to indicate how similar participants think the Other is to them. Personality, looks and similarity are all rated using a seven point scale.

Participants are asked to report on the emotions they experienced during the Bertrand game (rage, irritation, envy, joy, 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 decision. Emotions, satisfaction and the importance of different aspects of the lotteries are also rated using a seven point scale.

IV Research questions

Our goal is to answer two research questions: first, does social comparison influences 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.

Does social comparison influence decisions under risk?

In the loss and gain lottery pairs the payoff to the referent is independent of the choice of the decision-maker or the outcome of the lottery. In these types of lottery pairs the decision of the participant only influences her own earnings. Therefore these choice situations can be considered an individual decision making tasks. Models with selfish decision makers and linear social preference models like Fehr and Schmidt (1999) predict no differences in behavior between gain and loss situations. From both points of view no influence of social comparison on observed choices is expected.

Although individual decision making research has not addressed social comparison it does indicate that factors not directly related to (individual) outcomes influence decisions. Framing (i.e. Tversky & Kahneman, 1981) and previous outcomes (i.e. Thaler & Johnson, 1990) are known to affect risk taking[16]. Social comparison could be another such factor. If only present wealth acts as the reference point (in the sense of prospect theory), all lotteries will be coded as gains and no effect is predicted. If the payoff to the referent acts as the (only) reference point decision-makers will exhibit risk-averse behavior in the gain situation and risk-seeking behavior (or at least less risk-averse behavior) in the loss situation.

When *both* present wealth and the social reference point act as reference points simultaneously, outcomes above the social reference point lie above both reference points and are clearly gains while outcomes below the social reference point lie in between the two reference points. Sullivan & Kida (1995, see section II) suggest that outcomes in the latter situation will result in behavior equivalent to the outcomes being coded as losses. We therefore expect qualitatively the same behavior as when only the social reference point is used as a reference point.

These predictions are a natural extension of prospect theory to social situations but, we should be cautious about making conjectures about behavior in social situations on the basis of theories based on observations of behavior in private settings. Bault, Coricelli and Rustichini (2008) show, people value outcomes differently in private and social settings. Apparently, one cannot take for granted that behavioral regularities observed in a private context can be generalized to a social context

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 choice situation is no longer an individual decision making task because the participants decision also influences the earnings of the referent. The decision maker may take into account the assumed (risk) preferences of the referent. However, the findings in Brennan et al (2008) and Güth, Vittoria Levati and Ploner (2008) suggest that the risks facing others have little impact on decisions. The differences in

[16] For more examples see section 2.

expected value are small; therefore 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 are a neutral point, social comparison will not influence decisions in neutral situations. It thus seems plausible that in this case current wealth will be used as a reference point and all outcomes will be coded as gains.

Do social ties or experiences in the Bertrand game influence the social comparison effect?

Besides determining the existence of a social comparison effect on 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.

In order to engage in social comparison a decision maker should find her referent socially relevant. In the case of a positive or negative social tie the Other is apparently not irrelevant. We would 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.

A negative social tie may influence social comparison differently than a positive social tie, but the existing literature is silent on this point. Our data allows for an analysis of this effect. Another possibility is that it is 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 depend on individual characteristics as well. For practical reasons no personality questionnaires are administered. However, 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 ingroup or her outgroup (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 social comparison. Independent of how similar a participant and his or her referent are, a participant's assessment of his or her Other may influence social comparison. We expect that participants will be more likely to engage in social comparison when they perceive their 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.

V. Results

Social comparison effect

Seven sessions of the experiment were run 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 the 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 surprising because prospect theory with a social reference point predicts exactly the opposite behavior.

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 statistically 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. Behavior in the neutral situation is in between the behaviors in the loss and gain situations.

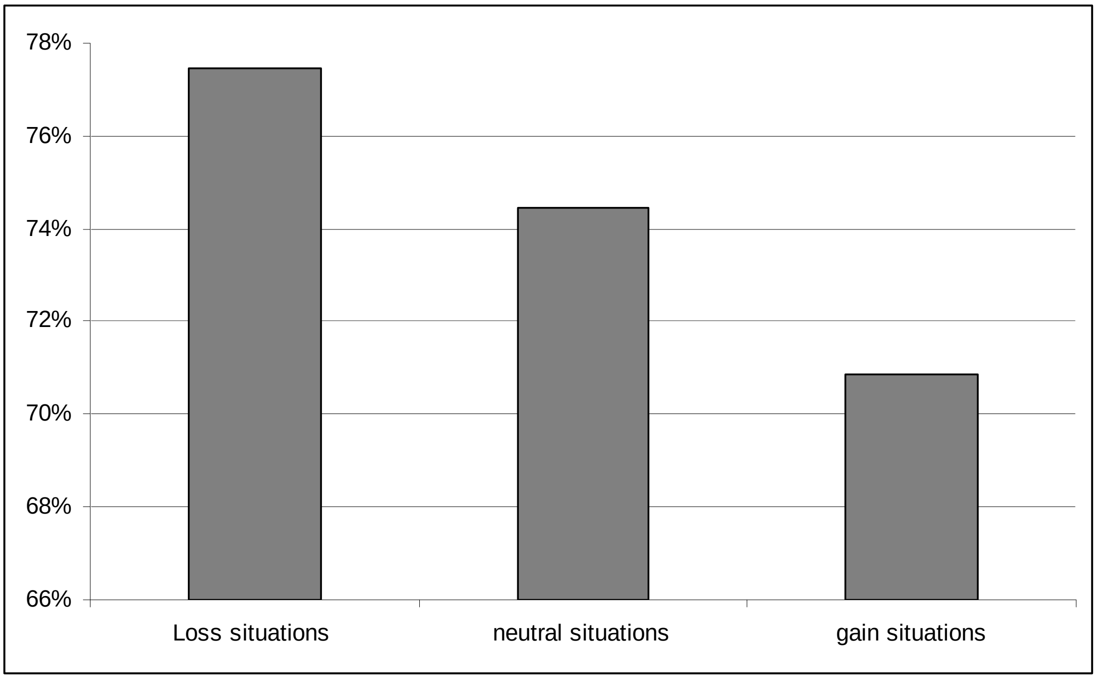


Figure II: Average percentage of safe choices in the loss, neutral and gain situations.

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 II displays the average difference between the loss and gain situations for these four categories.

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 (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 participants own earnings and the difference between her own 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.

Next we calculate Spearman's rank correlations (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 participants own earnings and the difference between her own 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.

	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

Table II: The size of the experimental effect for different social ties

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*[17]. 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*[18]. Neither of these measures correlates significantly with the social comparison effect (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.

[17] Cronbach's Alpha shows that this scale, as well as the attractiveness and .satisfaction scales are internally consistent measures. (Cronbach's Alpha>.69).
[18] The answers to the questions on the Others intelligence and whether the Other is a thinker are significantly correlated: Rho = .3443, p=.0003.

Result 2: No relationship is found between the size of the experimental effect 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

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 to the 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 the 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[19] (Rho is -.61, .67 and .51 respectively, all p<.001)[20]. 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 is not significantly correlated with the social tie. The Other is reported to be both less attractive and less similar if the respondent has 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

[19] Besides these emotions experienced surprise was reported. This, more ambiguous, emotion is not found to be correlated significantly with experiences in the Bertrand game.
[20] A higher score on all three scales signifies a stronger experience of the emotion .

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 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 stronger social comparison effect for participants who reported paying more attention to the amount of the Other (Rho=.169, p=.060).

VI. Conclusion

Many economic decisions can be described as individual choice under uncertainty in the sense that the (uncertain) consequences of the choice will only be felt by the decision maker. However, most decision makers will not be socially isolated and will compare their own situation with those of relevant others. Unfortunately theories of individual decision making tend to ignore the social context, while social preference theories generally ignore the effect of uncertainty. This study sought to combine these theories. In doing so we benefit from the happy circumstance that in both theories reference points play an important role. In prospect theory current wealth is considered to be the likely reference point to which outcomes are compared, while in social preference theories the decision maker compares her own payoff to the payoffs of others.

The merging of theories from both fields is not trivial. Introducing social reference points in models of individual decision making creates a multiplicity of reference points. Moreover it is not clear whether decision makers will use one of these points, or construct one new reference point based on the set of possible ones. The problem can become more complicated if more than one social referent is present, if the outcomes of the referents can be influenced by the decision maker or if the referent faces a lottery. The analysis in appendix C shows that the question how to merge these theories is in essence an empirical one.

Our experiment starts this empirical analysis by considering the simplest possible situation. An individual chooses between a risky and a safe lottery in three different social contexts. In the loss (gain) context the payoff of the social referent is fixed and higher (lower) than all possible outcomes of the lotteries. In the neutral context the social referent and the decision maker always earn the same amount. If the payoff of the social referent acts as a reference point is the sense of prospect theory, one would expect risk seeking in the loss context and risk aversion in the gain context. The results are diametrically opposite: the safe lottery is chosen more in the loss context than in the gain context (with the neutral context in between).

This study thus establishes that social comparison influences decision making under uncertainty and that the (fixed) payoff to a relevant other can act as a social reference point. The finding that this social reference point influences the behavior in another direction than the standard reference point in prospect theory is intriguing. However, we should see this result in the context of other recent exciting studies that show that decision making in social situations is distinctly different from decision making in social isolation. Bault, Coricelli and Rustichini (2008) show that while losses loom larger in individual decision making tasks, gains loom larger than losses in the social situation they study. Betrayal aversion studies like Bohnet and Zeckhauser (2004) show that consequences are experienced in a different way depending on whether they are caused by chance or by other people. A related finding is that deciding to trust is different than taking a gamble (e.g. Eckel and Wilson, 2004). Given these findings it is not possible to simply extrapolate theories based on individual decision making to social situations. We can only conclude that more empirical research is needed to explore how exactly social surroundings influence human decision making.

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.

Not for Publication

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.**

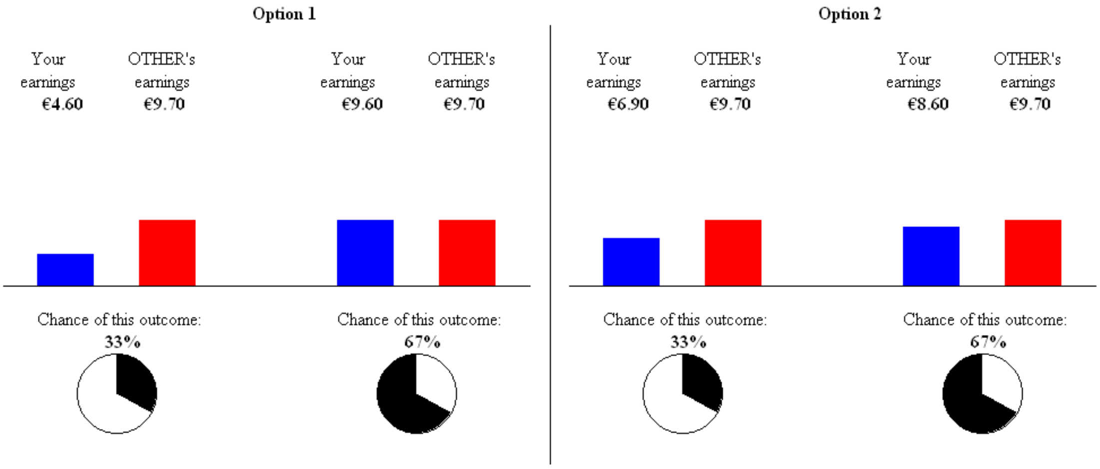
Earnings
The axes in the circle represent how much money you and the OTEHR earn when you choose a certain point on the circle. The horizontal axis shows how much you earn: the more to the right, the more you will earn. The vertical axis shows how much the OTHER will earn: the more to the top, the more 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.]

Appendix C: Merging cumulative prospect theory and the Fehr Schmidt social preference model

Risky choice with one social referent

In this appendix we will develop a model that extents prospect theory in order to describe behaviour in situations that involve both uncertainty and social comparison. We will start by modelling behaviour in the simplest situation that involves both social comparison and uncertainty, a decision maker evaluates prospects using the **fixed** payoff of **one** referent as a reference point. Extensions to situations with multiple referents and where the referent's payoff can be affected by chance or the decision maker are discussed. The aim of this exercise is to illustrate the possibility of and the problems encountered when merging descriptive theories on uncertainty and theories on social comparison.

The model is based on the utility function proposed by Fehr and Schmidt (1999) (from now on F&S) and the weighting of uncertain outcomes as proposed by Tversky and Kahneman, (1992) in their cumulative prospect theory (from now on CPT).

Let us first consider the utility function of a decision maker with a single referent. Her own payoff is labelled x, that of her referent x_j. The F&S utility function can than be written as:

$$u\left(x, x_j\right) = x - \alpha\left[\max(0, x_j - x)\right] - \beta\left[\max(0, x - x_j)\right]$$

With $\beta \leq \alpha$ and $0 \leq \beta \leq 1$

α represents the decision maker's disutility from disadvantageous inequality and β her disutility from advantageous inequality.

As the referent's payoff is assumed fixed we can perform an affine transformation on the utility function without changing the underlying (cardinal) preference structure. Subtracting x_j and dividing by $\left(1-\beta\right)$ results in:

A.1
$$\begin{aligned} u\left(x, x_j\right) &= (x - x_j) \text{ iff } x \geq x_j \\ u\left(x, x_j\right) &= \frac{1+\alpha}{1-\beta}(x - x_j) \text{ iff } x < x_j \end{aligned}$$

Subtracting x_j ensures that utility is normalized to be 0 when $x = x_j$. This is necessary when introducing the CPT type weighting function as will be discussed below.

Fehr and Schmidt compared the assumption $\beta \le \alpha$ [21] to the concept of loss aversion (Fehr and Schmidt, 1999, p. 824). $\beta \le \alpha$ concerns loss aversion in terms of the absolute effect of inequality. If we consider loss aversion relating to the marginal utility of ones own payoff equation A3.1 shows that the presence of loss aversion is determined by the value of $\frac{1+\alpha}{1-\beta}$. A utility function exhibits the distinct loss aversion kink at the reference point if $\frac{1+\alpha}{1-\beta} > 1$. To fulfil this requirement the assumption $\beta \le \alpha$ is neither necessary nor sufficient. A utility function will however exhibit loss aversion around the reference point if $\alpha > -\beta$. The assumptions of the F&S model, that both α and β are non-negative, prevent gain seeking but do not ensure loss aversion.

A difference between equation A3.1 and the CPT value function is that A3.1, in line with F&S, assumes linear utility while CPT proposes diminishing sensitivity as one moves away from the reference point. The fact that diminishing sensitivity is common in all kinds of human perception makes this an attractive characteristic, but when social comparison is involved the question is: diminishing sensitivity to what? The whole linear part, or the selfish and social part independently, or, when there are multiple referents, all social comparisons independently? All these representations have different implications and choosing the correct one is a complicated empirical question. Given the illustrative goal of this appendix we will stick with the linear utility function.

To incorporate the utility function into a model of decision making under uncertainty evaluation of prospects in the manner of CPT is introduced. Let *S* be the set of all possible states of the world considered by decision maker *i*. A prospect $f(x_k, A_k)$ which yields outcome x_k for *i* if event $A_k \subseteq S$ occurs and with outcomes indexed:

$x_{-m} \le x_{-(m-1)} \le .... x_{-1} \le x_j \le x_1 \le .... \le x_n$ is evaluated by:

$$U(f, x_j) = \sum_{k=-m}^{n} \pi_k u(x_k, x_j)$$

with

[21] This assumptions in the F&S model exclude gain seeking, but do not ensure loss aversion.

$$\pi_n = w\left(A_n\right), \pi_{-m} = w(A_{-m})$$
$$\pi_k = w\left(A_k \cup ... \cup A_n\right) - w\left(A_{k+1} \cup ... \cup A_n\right) \text{ iff 0<k<n}$$
$$\pi_k = w\left(A_{-m} \cup ... \cup A_k\right) - w\left(A_{-m} \cup ... \cup A_{k-1}\right) \text{ iff -m<k<0}$$

and

$$u\left(x_k, x_j\right) = (x_k - x_j) \text{ iff } x_k \geq x_j$$
$$u\left(x_k, x_j\right) = \frac{1+\alpha}{1-\beta}(x_k - x_j) \text{ iff } x_k < x_j$$

w assigns a number to each set of events in S satisfying $w\left(\varnothing\right) = 0$, $w\left(S\right) = 1$ and $w\left(A\right) \geq w\left(B\right)$ if $A \supset B$.

If $f(x_k, A_k)$ has a probability distribution, $p\left(\mathrm{A_k}\right) = p_k, \pi_k$ becomes:

$$\pi_n = w\left(p_n\right), \pi_{-m} = w(p_{-m})$$
$$\pi_k = w\left(p_k + ... + p_n\right) - w\left(p_{k+1} + ... + p_n\right) \text{ iff } 0 < k < n$$
$$\pi_k = w\left(p_{-m} + ... + p_k\right) - w\left(p_{-m} + ... + p_{k-1}\right) \text{ iff } -m < k < 0$$

In this case w is a strictly increasing function with $w(0) = 0$ and $w(1) = 1$, w is further assumed to have an inverse s shape which insures that small values of *p* will be overvalued and large values of *p* will be undervalued.

This method of evaluating probabilities described above is similar to CPT, but there are two differences. The first is a simplification. We do not allow for different weighting functions for positive and negative prospects. This is a common assumption and seems no great loss as this is empirically substantiated, for example by Tversky and Kahneman (1992) themselves. The second difference is more substantial and forms the core of the model presented in this appendix. In CPT outcomes are indexed $x_{-m} \leq x_{-(m-1)} \leq ....x_{-1} \leq 0 \leq x_1 \leq .... \leq x_n$ while in our model x_j takes the role of the 0. Together with the utility function of equation A3.1 this results in CPT with x_j instead of 0 as a reference point and with the F&S utility function as its value function.

Multiple referents with fixed payoffs

Using Fehr and Schmidt's (1999) original formula the model put forward above can be extended to allow for a larger group of referents. Let us assume that a decision maker, *i*, has a reference group N consisting of n individuals indexed $j \in \{1, ..., n\}$ with corresponding payoffs $x_j \in \{x_1,...,x_n\}$. *i*'s utility function can than be written as:

$u(x, x_1,...,x_n) = x - \alpha \frac{1}{n}\sum_{j=1}^{n}\left[\max(0, x_j - x)\right] - \beta \frac{1}{n}\sum_{j=1}^{n}\left[\max(0, x - x_j)\right]$ which can be rewritten:

$$u = \left(1 + \frac{1}{n}\left(|H|\alpha - |L|\beta\right)\right)x - \frac{1}{n}\left(\alpha\sum_{j\in H} x_j - \beta\sum_{j\in L} x_j\right)$$

with $j \in H$ iff $x < x_j$, $j \in L$ iff $x \geq x_j$. ($|H|$and $|L|$signify the cardinality of set *H* and L respectively)

To evaluate prospects in the way of CPT a single reference point is required. With one referent the payoff of this referent was a natural reference point, but with multiple referents this is less clear. The F&S utility function contains as many reference points as there are referents, because the decision maker compares herself to all referents one by one.

The social reference point would per definition be a point where an individual feels herself to be in a neutral position compared to her reference group, but this does not give a definitive answer. One aspect that could be important in determining the reference point is the reason why the decision maker compares her outcomes with those of her reference group. On the one hand the reference group can give the decision maker an indication of what she could or should expect. In that case the mean would be a reasonable reference point. On the other hand it can also be a group in which relative payoff levels are important for intra-group status. In that case the rank of the decision makers is relevant, making the median a likely candidate for the position of reference point.

A second aspect that is likely to be relevant is whether or not the asymmetry between advantageous and disadvantageous inequality is taken into consideration when determining the reference point. It is well established that people suffer more from disadvantageous inequality. For that reason it is likely that payoffs that can "objectively" be perceived as neutral will be regarded as losses. To take this asymmetry into account two other possible reference points are constructed, the asymmetry weighted mean and the asymmetry weighted median.

The asymmetric nature of inequality is captured by the assumption that $\beta \leq \alpha$ in the F&S model. By weighting referents payoffs above the reference point by α and those below it by β this asymmetry can be taken into account. Because these weights depend on the reference point, it is not possible to assign weights before calculating the weighted mean. This transforms the calculation of the weighted mean into a search problem for the point $\hat{x}$ where $\sum_{j\in H}\alpha\left(x_j-\hat{x}\right)=\sum_{j\in L}\beta\left(x_j-\hat{x}\right)$. This formula shows an attractive feature of this reference point, namely that it selects the point where the utility loss resulting from advantageous inequality is equal to that resulting from disadvantageous inequality. Intuitively this is a nice property for a neutral point.

Although taking asymmetry into account may very well be important it also depends on how a decision maker perceives her reference group. As explained earlier the mean is a natural reference point when an individual uses her referents' payoffs to form beliefs about the payoff she can expect to get. For the formation of such beliefs the asymmetry is unlikely to be important.

Taking into account asymmetry for the median can be accomplished by the following procedure: First order the referents in order of payoff and number them from 1 till n, where n is the total number of referents, as with the ordinary median. Then calculate $\frac{\alpha}{\alpha+\beta}\left|N\right|$ and round up to the next integer. This is the number of the referent whose payoff is the weighted median reference point. An advantage of this measure is that it selects a point where the total disutility from inequality is minimized. A point that minimizes the disutility caused by inequality can rightfully be called the fairest payoff level from the point of view of the decision-maker.

All four of the reference points discussed above can be incorporated into the model in a similar way. If we call the reference point $\hat{x}$ the normalized function becomes:

$$u_{\hat{x}}(x,X_N)=\left(1+\frac{1}{n}\left(\left|H\right|\alpha-\left|L\right|\beta\right)\right)x-\left(1+\frac{1}{n}\left(\left|\hat{H}\right|\alpha-\left|\hat{L}\right|\beta\right)\right)\hat{x}-\frac{1}{n}\left(\alpha\sum_{j\in H}x_j-\alpha\sum_{j\in\hat{H}}x_j+\beta\sum_{j\in\hat{L}}x_j-\beta\sum_{j\in L}x_j\right)$$

To

$j\in H$ iff $x<x_j$, $j\in L$ iff $x\geq x_j$, $j\in\hat{H}$ iff $\hat{x}<x_j$, $j\in\hat{L}$ iff $\hat{x}\geq x_j$

evaluate outcomes as gains or losses outcomes can be indexed according to $x_{-m}\leq x_{-(m-1)}\leq........x_{-1}\leq\hat{x}\leq x_1\leq....\leq x_n$. The rest of the evaluation procedure is the same as in the basic model.

The preceding section shows that in a situation with multiple referents a reference point can be constructed in several ways. What the correct model is can only be determined by empirical investigations.

Referent with stochastic payoff

The problem with situations where the referent's payoff is not fixed, is that there is no obvious single reference point. One possibility is to classify situations where *i* receives a payoff larger than *j*'s as a gain and outcomes where her payoff is below that of *j* as a loss. However, this type of reasoning can lead to strange situations. In a lottery containing both $\left(x, x_j\right) = (1,0)$ and $\left(x, x_j\right) = (5,6)$ the first outcome would then be perceived as a gain and the second as a loss. This is very counter intuitive and for most reasonable values for α and β the utility value of the second outcome will be higher. The fundamental problem with this approach is that it does not use a single reference point for the entire prospect, but a different one for each possible outcome.

If both x and x_j are variable every normalization of the utility function at some level of x will suffer this problem. A solution is to normalize the utility function at some neutral **combination** of x and x_j. This is actually not dissimilar to the method used in the basic model. In case of a fixed payoff for the referent outcomes can also be indexed $u\left(x_{-m,}x_j\right) \le u\left(x_{-(m-1)}, x_j\right) \le ....u\left(x_{-1}, x_j\right) \le u\left(x_j, x_j\right) \le u\left(x_1, x_j\right) \le .... \le u\left(x_n, x_j\right)$ instead of $x_{-m} \le x_{-(m-1)} \le ....x_{-1} \le x_j \le \ x_1 \le .... \le x_n$ while using the same utility and weighting functions and classifying all outcomes for which $u\left(x, x_j\right) < u\left(x_j, x_j\right) = 0$ as losses and outcomes for which $u\left(x, x_j\right) \ge 0$ as gains. This would yield exactly the same results as the basic model.

When the outcome x_j is also stochastic, outcomes $u\left(x, x_j\right)$ can still be ranked according to their utility. To classify outcomes as gains and losses a utility level has to be specified that is used as the reference point. What this point is, is an empirical question. There are however qualities that seem important as properties of a reference point. The first of these is that it should be a point where the payoff of *i* is equal to that of her referent. Note that this reference outcome is not necessarily a possible outcome of the prospect (like the reference point "status quo" in CPT is not necessarily a possible outcome).

A more complicated question is what would be a likely value for x_j at the reference point. An attractive candidate is *i*'s expectation of x_j, but this does not provide a definitive answer because it leaves the question open how *i* determines her expectation of *j*'s payoff. This could be the (rationally) expected value, but as *i* normally uses her weighting function to evaluate prospects it is possible that she will also do so when determining her expectation of *j*'s payoff. This may depend on the nature of the weighting function. If it is considered as a preference over uncertain outcomes it is not necessarily used to consider objective probabilities. If on the other hand it is a heuristic or a cognitive bias for dealing with probabilities it will be relevant whenever probabilities are involved.

Whatever method *i* uses to determine her expectation of *j*'s payoff we can call this value $E_i\left(x_j\right)$. If we further call the combined payoffs of *i* and *j* associated with event *k*, $\left(x_k, x_{j,k}\right)$, X_k, prospects with a stochastic outcome for both *i* and *j* can then be evaluated in the following way: Outcomes X_k are indexed according to: $u\left(X_{-m}\right) \leq u\left(X_{-(m-1)}\right) \leq \ldots\ldots\ldots$ $u\left(X_{-1}\right) \leq u\left(E_i\left(x_j\right), E_i\left(x_j\right)\right) = 0 \leq u\left(X_1\right) \leq \ldots. \leq u\left(X_n\right)$ and then evaluated using the same method as before.

Influence over the referent's payoff

So far it has been assumed that the expected payoff of the referent is the same independent of the decision maker's choice. This is a serious limitation as there are many situations where the payoff of a referent can be influenced. A decision maker can compare her choices in such a situation by separately evaluating prospects with different (expected) payoffs for the referent using the methods proposed above and then comparing the valuations. Alternatives cannot be directly compared in this way because the normalisation of the utility function means different utility functions are used to evaluate different prospects. To make the valuations comparable the normalization will somehow have to be undone.

The most straightforward way of undoing the normalization is by adding the non-normalized utility value of the point where $x = x_j$, or $E_i\left(x_j\right)$ if *j*'s payoff is stochastic, to the value of each prospect. For prospects containing only loss or only gain outcomes it is even difficult to think of another way of undoing the normalization. For mixed prospects on the other hand it is less obvious. The reason is that for mixed prospects the total weights of the prospect's outcomes do not have to add up to one. An alternative way to undo the normalization would therefore be adding $\sum_{k=-m}^{n} \pi_k u\left(x_k, x_j\right)$ to the value of the prospects.

From these preliminary theoretical investigations we can conclude that there are several ways in which social preference models and prospect theory can be merged. Which model is the most accurate description of human behavior can only be determined by systematic empirical research.

References

Abbink, Klaus, and Abdolkarim Sadrieh. “The Pleasure of Being Nasty.” Working paper. University of Amsterdam. 2008.

Andreoni, James, and Ragan Petrie. 2004. “Public goods experiments without confidentiality: a glimpse into fund-raising.”. *Journal of Public Economics*, 88: 1605-1623.

Bault Nadège, Giorgio Coricelli, Aldo Rustichini. 2008. “Interdependent Utilities: How Social Ranking Affects Choice Behavior.” *PLoS ONE* 3(10): e3477.doi:10.1371/journal.pone. 0003477.

Benartzi, Shlomo, and Thaler, Richard H. 1995. “Myopic Loss Aversion and the Equity Premium Puzzle.” *The Quarterly Journal of Economics*, 110(1): 73-92.

Bohnet, Iris, and Bruno S. Frey. 1999. “The sound of silence in prisoner’s dilemma and dictator games.” *Journal of Economic Behavior and Organisation*, 38: 43-57.

Bohnet, Iris and Richard Zeckhauser. 2004. “Trust, risk and betrayal.” *Journal of Economic Behavior and Organization*, 55(4): 467-484.

Bolton, Gary E., and Axel Ockenfels. 2000. “A theory of equity, reciprocity and competition.” *American Economic Review*, 100: 166-193.

Bolton, Gary, E., and Axel Ockenfels. Forthcoming. “Risk Taking and Social Comparison. A Comment on ‘Betrayal Aversion: Evidence from Brazil, China, Oman, Switzerland, Turkey, and the United States’.” *American Economic Review*.

Brennan, Geoffrey, Luis G. Gonzàlez, Werner Güth, and Maria Vittoria Levati. 2008. “Attitudes towards private and collective risk in individual and strategic choice situations.” *Journal of Economic Behavior and Organization*, 67: 253-262.

Camerer, Colin, Linda Babcock, George Loewenstein, and Richard Thaler. 1997. “Labor Supply of New York Cabdrivers: one Day at a Time.” *The Quarterly Journal of Economic*s, 112(2): 407-441.

Dufwenberger, Martin, and Uri Gneezy. 2000. “Price competition and market concentration: an experimental study.” *International Journal of Industrial Organisation*, 18: 7-22.

Eckel, Catherine C., Rick K. Wilson. 2004. “Is trust a risky decision?.” *Journal of Economic Behavior and Organization*, 55(4): 447-465.

Fehr, Ernst, Karla Hoff, and Mayuresh Kshetramade. 2008. "Spite and development." The World Bank Policy Research Working Paper 4619.

Fehr, Ernst, and Klaus M. Schmidt. 1999. “A Theory of Fairness, Competition and Cooperation.” *Quarterly Journal of Economics*, 114(3): 817-868

Fehr, Ernst, and Klaus M. Schmidt. 2006. “The Economics of Fairness, Reciprocity and Altruism: Experimental Evidence.” in *Handbook of the Economics of Giving, Altruism and Reciprocity*, Vol. 1., eds. Serge-Chirstophe Kolm and Jean M. Ythier. New York: North Holland.

Gneezy, Uri. 2005. “Updating the reference level: Experimental evidence.” in Experimental Business Research: Marketing, Accounting and Cognitive Perspectives, vol. 3, eds. Ammon Rapoport, and Rami Zwick. Berlin: Springer.

Güth, Werner, Maria Vittoria Levati, and Matteo Ploner. 2008. “On the Social Dimension of Time and Risk Preferences: An Experimental Study.” *Economic Inquiry*, 46(2):261-272.

Kahneman, Daniel, and Amos Tversky. 1979. “Prospect theory: An analysis of decision under risk.” *Econometrica*, 47: 263–291.

Kühberger, Anton., Michael Schulte-Mecklenbeck, and Josef Perner. 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.

Mussweiler, Thomas and, Galen V. Bodenhausen. 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.

Neumann, John von, and Oskar Morgenstern. 1944. “Theory of games and economic behaviour.” Princeton: Princeton University Press.

Odean, Terrance. 1998. “Are Investors Reluctant to Realize Their Losses?” *The Journal of Finance*, 53(5): 1775-1798.

Rohde, Ingrid, and Kirsten Rohde. 2009.“Risk attitudes in a social context.” Working paper.

Sonnemans, Joep, Frans van Dijk, and Frans van Winden. 2006. “On the dynamics of social ties structures in groups.” *Journal of Economic Psychology*, 27: 187-204.

Sullivan, Kathryn, and Thomas Kida. 1995. “The Effect of Multiple Reference Points and Prior Gains and Losses on Managers’ Decision Making.” *Organizational Behavior and Human Decision Processes*, 64(1): 76-83.

Thaler, Richard H., and Eric J. Johnson. 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, Amos, and Daniel Kahneman. 1981. “The Framing of Decisions and the Psychology of Choice.” *Science*, New Series, 211(4481): 453-458.

Tversky, Amos and Daniel Kahneman. 1992. “Advances in Prospect Theory: Cumulative Representation of Uncertainty.” *Journal of Risk and Uncertainty*, 5: 297-323.