SOCIAL INFLUENCES ON RISK ATTITUDES: APPLICATIONS IN ECONOMICS*

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January, 2011

Abstract

Economic research on risk attitudes has traditionally focused on individual decision making issues, without any consideration for potential social influences on preferences. This has been changing rapidly over the last years, with economists often taking inspiration from earlier psychological research in their increasing consideration of social aspects in decision making under risk. We provide a broadly conceived overview of the recent literature, defining four different categories of social influences on economic decisions under risk: 1) the observation of other agents' outcomes; 2) the observation of the decision maker's outcomes by other agents; 3) the direct effect of the decision maker's choices on other agents' outcomes; and 4) the direct dependency of the decision maker's outcomes on other agents' choices. While many promising insights have been gained over the last few years, several shortcomings and inconsistencies in our current understanding of social influences on decision making under risk are pointed out. The overview concludes with a discussion of two real-world applications—agency in financial markets and climate change—that prominently show the importance of furthering our knowledge in this area. In order to achieve such increased knowledge, a much deeper integration of currently dispersed disciplinary knowledge in the social sciences seems crucial.

* To appear as: Trautmann, S. T. and F.M. Vieider (2011). Social Influences on Risk Attitudes: Applications in Economics. In: S. Roeser (ed.), Handbook of Risk Theory, Springer, Chapter 29.

Gideon Keren, Jona Linde, and Luc Wathieu made helpful suggestions.

Introduction

Decision making under risk has traditionally been considered an *individual* decision problem in the economics literature. The decision maker considers the outcomes in the uncertain possible future states of the world for different courses of action available, and then chooses the alternative that maximizes some function of the outcomes and the probabilities involved. While individual preferences will always be central for decisions under risk, we argue that *social influences* are also crucial in many economic decisions. Most economic decisions involve situations where agents interact in markets, or strategic situations where the decision maker's own actions affect others, and, *vice versa*, her actions are affected by others' choices. Even where an agent's outcomes are not directly affected by, or do not directly affect, others, more subtle social issues may play a role. Indeed, the observation of others as well as the awareness of (potentially) being observed by others may influence the agent's actions. Nevertheless, social influences on the evaluation of risky alternatives have not been studied or formalized by economists until recently.

Before delving any deeper into the topic, it appears imperative to introduce some elementary distinctions and definitions. While the concept of risk is taken in a broad sense in keeping with the spirit of this handbook, it may not always be obvious what studies can be considered as *economic* in a sprawling social science literature in which traditional boundaries between disciplines are becoming increasingly blurred. In first approximation, we can define as economic studies all those that have as their primary object of study transactions that affect an agent's wealth, monetary and non-monetary. This in turn entails a necessary focus on *outcomes* of decisions—as opposed for instance to the focus on the decision making *processes* themselves typical of the psychology literature. Indeed, this explains at least in part the different conceptions of rationality that serve as normative benchmarks in the different disciplines. While these issues also produce methodological differences, we will be as inclusive as possible, considering any studies on decisions that may result in the creation or transfer of value or wealth.

In this chapter we will first illustrate the traditional neglect of social issues in risky decisions in economics, and discuss some earlier contributions in neighboring fields, especially psychology, that have influenced the more recent attempts in economics to model decisions under risk as a social decision task (section "History"). We then turn to current research in economics. Various social aspects of risky decisions have received attention in recent years, and we suggest a classification within which to discuss the different approaches and organize the quickly growing literature. We distinguish four broad classes of social influences, based on the relationship between the parties involved and the means by which the influence is transmitted. Each of these classes subsumes different theoretical and empirical approaches. The four classes can be summarized as follows:

1) The decision maker observes other agents' outcomes
2) The decision maker's outcomes are observed by other agents
3) The decision maker's choices affect other agents' outcomes
4) The decision maker's outcomes depend on other agents' choices

In the first class, where the decision maker observes other agents' outcomes and his own choices depend on this observation, there is generally no direct interdependency between agents. For instance, Paul's choice between a job with a sure annual income of $50K and a job with a risky income between $40K and $65K may be influenced by whether Peter, his brother in law, earns $48K or $52K. Such social influence is purely

psychological, and involves factors like fairness, social reference points, social regret, or conformity. A similar, yet more explicit, situation may be the one in which an agent is given explicit advice on actions to take (e.g. investment advice). Both experimental studies and theoretical models have been advanced to include these factors in models of risky decisions.

The second class, encompassing cases in which the decision maker's outcomes are observed by others, also concerns psychological mechanisms, and mainly relates to *accountability*—the implicit or explicit expectation on the side of the decision maker that she may have to justify her decisions to somebody else. For instance, a risky investment that looks attractive from an individual decision perspective may be less acceptable when anticipating the possibility that negative outcomes are observed by others. To the extent that people care about their reputation, a potential observer's possible judgment of the agent's decision making competence becomes a crucial aspect in the decision between risky alternatives. This in turn may lead to deviations from the type of behavior observed in the isolated and purely individual decisions typical of laboratory experiments, in which subjects are assured as much anonymity as possible. Since such isolated decisions will rarely be found outside the economist's or psychologist's laboratory, a thorough understanding of the impact of such social influences seems crucial for our ability to generalize laboratory findings to the real world.

The third and the fourth class of influences refer to situations in which there exists true interdependence between agents which goes beyond their influences on prices and the functioning of markets. Normatively, these situation may still be, and have been, studied as an individual decision problem. Both empirical research and recent real world events strongly suggest, however, that explicitly modeling the social aspects of these decisions is warranted. The third class summarizes situations where an agent's decision affects not only her own outcomes, but also those of another agent or group of agents. Financial intermediation and delegation of decision making power when ownership of assets is diffuse constitute an important class of situations in real world decision making under risk, for which many problems have been revealed during the recent financial turmoil. Economists have become interested in the question how risk taking on behalf of others differs from risk taking for oneself, and have begun to study these situations in more controlled environments that allow for the examination of different sorts of influences which may all be important in the real world.

The forth class of situations looks at the other side of the relationship in the third class, with the decision maker assuming the role of a principal delegating the final decision power to an agent. This class of influences is also important in strategic interactions and for the empirical analysis of game theoretical models, where agents move simultaneously and hold beliefs about the likelihood of the opponent's strategies. Empirical research has shown that in such situations choices deviate from those in which the agent faces the same outcomes and probabilistic beliefs, in which however the uncertainty is due to nature rather than another agent. Findings in this category also concern the kind of incentives that a principal can put in place in order to make the agent's decisions coincide as much as possible with her own preferences. This principal-agent issue has attracted much interest in economics, and a host of models, as well as an increasing number of empirical studies, exist on how the risk attitude of agents can be influenced by the principal.

The state of the economics literature on social influences in risk taking is summarized under the Current Research heading according to the four classes of situations just described. While this conceptual separation will be maintained as much as possible, this is done for expositional clarity and it should be well understood that the four classes of influences will not be strictly separate in empirical applications. In particular in the latter two classes with true interdependence, the purely psychological motives deriving from observation of

other agents, or by other agents, will also affect decision making, leading to interesting interactions of motives. When applicable, we will discuss research studying such interaction effects.

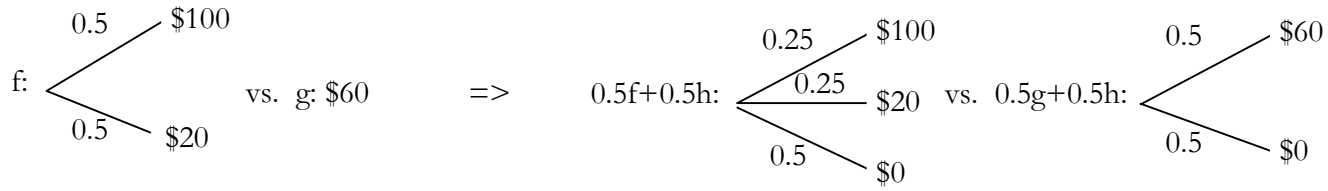
In the final section of this chapter open questions will be identified, as well as applications of the new insights on social influence to economic problems (in the broadest sense) involving risk. Particular attention is devoted to the issue of agency in risky decision making, with a focus on financial decisions. The latter involves all four classes of social influences and has not been widely explored so far. We will point out applications to common resources problems in environmental and climate policy. This section will also discuss how the related fields that provided the initial insights inspiring the study of social influences in economics may contribute additional inputs to improve the first generation of models and empirical studies in economics.

Finally, a warning is in place. While we have attempted to provide a broad overview of the existing economics literature on social influences, this study cannot aspire to being comprehensive. The speed at which new research emerges, as well as the space-limits imposed by the current format, forced us to make some difficult choices both on the number of studies to be included and on the level of detail to be reported on those studies. This chapter is thus driven at least in part by the particular interests of the authors, as well as the desire of providing a wide-spun overview rather than an in-depth analysis of some particular aspects.

History

Economists have long studied risk in the tradition of Bernoulli (1738), who introduced the idea of expected utility. A prospect (or lottery) representing a probability distribution over possible outcomes is evaluated by a weighted sum of a function of the outcomes, often called utilities, the weights being the probabilities with which the different outcomes are expected to occur (*expected utility theory*). In the mid-twentieth century, behavioral foundations were laid for the expected utility model that defined the model in terms of axioms describing simple observable preferences between risky prospects (von Neumann and Morgenstern 1947, Herstein and Milnor 1953). For instance, the so-called independence condition has proved crucial for preferences to be describable by expected utility theory. It stipulates that the preference between two prospects *f* and *g* should not be affected if we probabilistically mix both of these prospects with a third prospect *h*. Figure 1 illustrates the independence condition.

Figure 1: Mixing and Independence



Notes: Independence stipulates that the preference between the left hand prospects f and g should not be affected if both prospects are probabilistically mixed with the same prospect h. The figure shows a 0.5 mix with a prospect h resulting in a sure zero payoff.

Foundations have also been given for the technically distinct case in which no objective probabilities are known, a situation often referred to as *uncertainty* (Knight 1921). In this case, the decision maker evaluates a prospect by using her own, subjective estimates of the relevant probabilities (Anscombe and Aumann 1963; Savage 1954). Such behavioral foundations of decision making models have typically focused on observable individual preferences, and have made no reference to social influences. More generally, dependence of decisions on a particular context has usually been excluded from the economic definitions as well as being avoided in empirical investigations, because it may give rise to ad hoc explanations and lack of predictability. In the case of social context, a model that allows for different behavior for each possible social context was long considered unfalsifiable and empirically useless.

Remarkably, social influences have also been excluded when studying situations explicitly concerned with social decisions. The well-known foundation of utilitarianism laid by Harsanyi (1955) employs individual agents' expected utilities over risky distributions of their own social positions to derive the social planner's utilitarian welfare function. While explicitly concerned with social comparisons, individual evaluations of risky social allocations are assumed to exclude any social comparisons (Diamond 1967; Trautmann 2010). Similarly, game theoretic analyses of strategic interactions involve both risk due to nature and risk due to the decisions made by other players. No distinction between such different types of risks has been made until recently, even though these two kinds of risks may be perceived very differently by the decision maker (Fox and Weber 2002). Von Neumann and Morgenstern (1947) introduced their expected utility model of individual risk taking to analyze strategic game situations and mixed equilibria, where randomization of strategies by other players introduces an element of risk into each player's decision problem. As we will show in the next section, the economics literature has only recently started to capture systematic aspects of social influences and to improve the realism of such models, while maintaining predictive power and empirical refutability.

In contrast to the economics literature, psychologists have long been aware of social influences and tried to take these explicitly into account in their theorizing. Indeed, the issue of social influences is important enough as to have given rise to the whole subfield of social psychology. A host of different forms and shades of social influences have thus systematically been explored in social psychology, ranging from the conformity paradigm (Asch 1955), to social facilitation or mere presence (Bond and Titus 1982; Zajonc 1965), accountability in its various forms (Lerner and Tetlock 1999; Shafir, Simonson and Tversky 1993), and many more (Cialdini 1993). This long research tradition on social influences has produced over the years a huge pool of knowledge from which economists can draw inspiration. One aspect of this research tradition that has complicated the interdisciplinary exchange is the divisive nature of many of the research efforts in social psychology, often aimed at further subdividing established effects rather than at searching for commonalities between existing research paradigms. Such aggregation could indeed benefit the dialogue between disciplines in the social sciences. Furthermore, while a huge body of evidence has been produced on social influences on decisions in general, the case of decisions under risk appears to play a relatively minor role in this tradition.

There are exceptions, however, and a non-negligible body of psychological evidence on social aspects influencing behavior under risk has emerged over the years. A prominent example is *risky shift*, which is defined as a level of risk tolerance in a group that is larger than the average level of individual risk tolerance of its members (Stoner 1961). Wallach, Kogan and Bem (1964) examine the causes of the risky shift phenomenon, and find that the diffusion of responsibility in the group leads to increased risk taking. They also find the opposite effect, a *cautious shift*, however. The latter occurs if individual members are personally responsible for the welfare of the group. A very similar result is obtained by Weigold and Schlenker (1991) who examine these effects through the lens of the social facilitation paradigm. Having elicited subjects' risk

attitude, they found that subjects became more extreme in their original positions when they were told that they would be required to justify their choices, with risk averse subjects becoming more risk averse, and risk seekers increasing their preference for risk. Below we show that there is converging evidence from the more recent economics literature that responsibility for others often leads to reduced risk tolerance, as would be predicted if people are predominantly risk averse in isolated decisions.

Other approaches in psychology have been closer to economics in the sense that their focus centered on individual preferences, accounting for individual level biases. Kahneman and Tversky's (1979) prospect theory, for instance, unmasks various deviations in risky choices from those predicted by expected utility theory. These deviations, however, are explained through individual-level psychophysical aspects like diminishing sensitivity, reference dependence, and a larger impact of negative outcomes (losses) than of positive outcomes (gains), in comparison to some reference point. Nevertheless, social aspects can be incorporated naturally into this framework, for instance through the undetermined origin of the reference point or various editing processes. Boles and Messick (1995) showed that the selection of the decision maker's reference point in the presence of multiple possible reference points depends on social comparisons. These authors find that social reference points are often more influential than individual reference points, like the status quo. In one experiment, compared to the status quo of $0, people preferred gain of $90 when another person simultaneously received a gain of $500 less than a much smaller gain of $10 when the other person experienced a loss of $100.

Psychologists have also studied how the anticipation of being evaluated by others can affect attitudes under uncertainty. We have already mentioned Weigold and Schlenker's (1991) result showing how accountability amplifies pre-existing risk attitudes, making risk averters more risk averse and risk seekers even more risk prone. Mere formulation differences or frames have often been found to influence decisions under risk and uncertainty. Takemura (1993, 1994) showed that making subjects accountable by announcing that they will have to justify their decisions in front of somebody else reduced incoherence between different frames, thus increasing the consistency of preferences. Similar effects were obtained by Miller and Fagley (1991) and Sieck and Yates (1997). Studying a problem in which subjects' decisions had consequences for others, Tetlock and Boettger (1994) found that subjects were more reluctant to approve a risky drug for a hypothetical market when held accountable. Indeed, accountability pushed subjects to procrastinate as well as to try to pass the responsibility on to others, so that potentially useful drugs were not approved for use in a timely manner because of the idiosyncratic risks they entailed.

Ambiguity aversion—the preference of known-probability outcome generating processes over normatively equivalent processes entailing unknown probabilities (Fox and Tversy 1995, Frisch and Baron 1988)—is a classic example of how economists often arrive late to the study of social decision aspects. The phenomenon itself has been of interest to economists ever since the publication of the famous Ellsberg paradox in 1961. While economists have studied the issue as a purely individual problem, psychologists have taken a wider approach to the issue. Curley, Yates and Abrams (1986) studied a wide array of potential causes of ambiguity aversion. They found that being observed by a group of people when making a choice between a bet on a known-probability prospect and a bet on an ambiguous prospect, decision makers became more ambiguity averse (a similar finding was reported by Taylor (1995)). Economists became interested in social influences on ambiguity attitudes only very recently. This parallels developments in the literature on the effects of social reference points and other influences, in which economists did not develop an interest until more than a decade later than psychologists. For this reason, the psychological findings often form the basis for economic studies. It should be noted however that—in addition to having a different focus deriving from the different

underlying research paradigm—economists studying social influences in decisions under uncertainty are not always aware of previous work by psychologists. In the following section, we will therefore also refer to findings in the psychological literature that are of direct relevance to problems studied more recently in economics.

Current Research

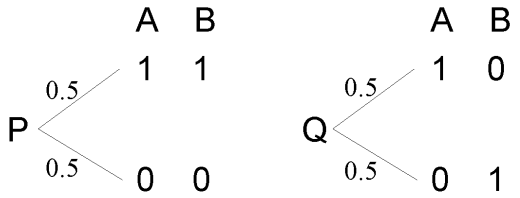
In this section we review current research in economics. We follow the structure laid out in the introduction and discuss any overlaps between the classes of influence where applicable.

The decision maker observes other agents' outcomes

A variety of social influences fall into this class. We discuss three different types of models. First, fairness motives have been shown to interact with uncertainty if the decision maker observes the payoffs of other agents whose outcomes she considers relevant. Second, the outcome of another person may act as a social reference point even in the absence of fairness considerations. And third, conformity with the behavior of their peers has been shown to affect people's decisions under risk.

Process Fairness. Fairness motives may alter a decision maker's risk attitude when other people's decisions and outcomes are observable. Consider the risky decision for person A shown in Figure 2. Person A faces a choice between two risky lotteries P and Q. For person A, each lottery gives a payoff of 1 or a payoff of zero, with equal probability 0.5. If player A considered only her own payoffs in her decision, she would be indifferent between the two lotteries—indeed, they would be exactly the same. If, however, the outcome of person B is observed and equality concerns matter to person A, then lottery P will be strictly preferred to lottery Q. For either state of the world, equality obtains for prospect P and inequality obtains for prospect Q, even though the expected value of the two prospects is equal for both agents.

Figure 2: Risky Decision for Person A who Observes the Risky Outcome of Person B.



The importance of such fairness motives in risky decisions was illustrated empirically by Kroll and Davidovitz (2003), Bolton, Brandts and Ockenfels (2005) and Krawczyk and Le Lec (2010). Zizzo (2004) and Cappelen et al. (2009) on the other hand show the inverse effect, namely that individual risk taking influences fairness evaluations. Interestingly, the interaction of risk and fairness has also led to the new concept of *process fairness* in economics. Process fairness explicitly considers the risk borne by all agents and does not evaluate the equality of outcomes, but the equality of expected outcomes. In the above example, person A is indifferent between prospects P and Q if she is motivated by process fairness because her own payoff is identical under both prospects, and the expected payoffs of both agents are equal and identical under both prospects. Theoretical models accounting for allocation risk and process fairness have been proposed by Bolten et al. (2005), Trautmann (2009), Sebald (2010), Krawczyk (2010) and Borah (2010). Trautmann (2010) discusses an application of individual level process fairness to social choice problems involving risk. Bolton and Ockenfels

(2009) report experimental evidence for the relevance of process fairness considerations in choice situations similar to those in Figure 2, where person A makes choices for herself and for a passive person B (see below). Aldashev et al. (2010) show process fairness effects in real world settings. In the risky allocation of more or less desirable tasks to workers, they show that process fairness influences the effort that these workers exert in their task.

Social influences due to process fairness concerns can be employed to justify the concept of *resolute choice* in risky decisions, introduced by Machina (1989) to restore dynamic consistency of non-expected utility preferences. If their choices violate the independence axiom, non-expected utility maximizers may change their preference after the resolution of the uncertainty, violating dynamic consistency. Trautmann and Wakker (2010) show that process fairness preferences imply a similar rejection of consequentialism and lead to dynamic inconsistency. In Figure 2, process fairness implies indifference between prospects P and Q. Let us assume that Q is chosen and resolved. Obtaining the poor outcome under prospect Q after the resolution of uncertainty, however, the agent faces a sure allocation and may reconsider her preference. In particular, she may now prefer the poor outcome under prospect P rather than prospect Q, because of ex-post fairness concerns. Under process fairness, however, resoluteness becomes convincing, because agents explicitly consider risks borne in the past and will not adjust their preferences ex-post. Trautmann and Wakker (2010) argue that process fairness can thus give a justification of resolute risky choice in social settings. Under process fairness the risks borne in the past by the players become meaningful in terms of social comparison and should be considered also ex-post, enforcing dynamic consistency.

Social reference points. A related but slightly different view holds that another agent's outcome may act as a reference point in risky choice, similarly as in the psychological work by Boles and Messick (1995). Linde and Sonnemans (2009) and Rohde and Rohde (2009) provide theoretical models and empirical tests of this paradigm. Consider prospect P in Figure 2, but now assume that agent B receives an outcome of at least 1 in both states (instead of the given numbers). Linde and Sonnemans call this a social loss frame for agent A. On the other hand, if B receives an outcome smaller than 0 in both states, the prospect is evaluated in a social gain frame for agent A. The situation depicted in Figure 2 for prospect P, with a stochastic outcome for B equal to the outcome of A is called a neutral frame. In contrast to fairness-based influences on risk attitude, here the social comparison is thought to influence risk attitude by providing a reference point. Building on prospect theory's reference-dependent evaluation function, risk seeking is predicted in loss frames while risk aversion is expected to prevail in gain frames.

The empirical evidence does not support this prediction unequivocally, however. Linde and Sonnemans observe more risk aversion when decision makers find themselves in a social loss frame than under the gain frame, reversing the typical prospect theory pattern. In contrast, in a field experiment devised to test this idea, Haisley, Mostafa, & Loewenstein (2008) found that poor people are more likely to buy lottery tickets after being shown income brackets that place them at the bottom of the income distribution, as compared to when the income brackets employed place them somewhere in the middle ground. That is, these people become more risk seeking when their placement in a perceived peer-group puts them in a social loss frame. These different findings may be explained by the role of the reference point as an aspiration level (Diecidue and van der Ven 2008). People put additional value on outcomes that help them to achieve their aspiration level, for instance a social comparison outcome. While a simple loss frame may not elicit risk seeking per se, it may do so if the aspiration level can be met or surpassed by assuming greater risks, which is surely the case for the lottery ticket in the Haisley et al. study.

A related concept, introduced by Delgado et al. (2008), is social loss aversion. Delgado et al. studied social loss aversion for first-price auctions in the presence of multiple social reference points. Consider once more prospect Q in Figure 2. This allocation lottery can be interpreted as a situation where either person A or person B receives a desirable item (with 1 indicating the person obtaining the item). Auctions provide a example of such situations, with uncertainty deriving from other bidders' behavior. The auction winner receives the item while all other bidders receive nothing. Bidding behavior in auctions has widely been studied in economics both theoretically and empirically. An empirical phenomenon that has attracted much interest is the fact that people tend to overbid in first-price auctions with respect to the theoretical prediction of the Nash equilibrium. In the first-price sealed bid auction, each bidder simultaneously submits a bid, and the winner with the highest bid wins the auction and has to pay her bidding price. To make a positive profit, the buyers have to submit bids that are lower than their valuation of the good. The lower the bid submitted, the higher the profit but also the higher the risk that another bidder will submit a larger bid. Nash equilibrium predicts the optimal tradeoff between these two forces, but empirically people usually bid too high relative to the Nash prediction. Risk aversion has sometimes been used to explain this overbidding. More recently, using both behavioral and neuroeconomic evidence, Delgado et al. (2008) showed that it is mainly the perception of non-winning of the auction (lower branch of prospect Q) as a *social loss* that influences overbidding.

These examples show that straightforward extrapolation from individual to social reference points is not always warranted. Some individual effects may be amplified in social contexts as was the case with loss aversion; others may be reversed as in the risk aversion for social loss frames. Furthermore, by moving from individual to social reference points, complexity increases because of the multiplying of reference points (individual and social reference points usually co-exist), and stochastic reference points if other agents also face risky prospects resulting in different outcomes in different states of the world. The development of descriptive models with social reference points will therefore have to draw upon psychological insights about the aggregation of multiple references points (e.g. Kahnemann and Miller 1986) and theoretical work in economics on stochastic reference points (Sugden 2003, Schmidt et al. 2008).

Conformity and Peer Effects. Recent research has shown that conformity with the behavior of relevant others is an important driver of economic decisions (Sacerdote 2001; Duflo and Saez 2002; Falk & Ichino, 2006). An early theoretical model is provided by Bernheim (1994). There is no clear-cut evidence in economics on the effect of conformity on risky decisions yet. Goeree and Yariv (2006) study situations where agents have to predict the distribution of colors in an urn after either observing one sample from the urn or observing other agents' predictions. In particular, either an urn with three red and seven blue balls, or an urn with seven red and three blue balls is randomly selected, but subjects do not know which urn was chosen. Before predicting the distribution, subjects can either draw a sample ball with replacement from the selected urn at zero cost, or observe the betting choices of 4 other persons who had no information before making their bet. That is, while a sample draw is informative from a Bayesian viewpoint, observing the uninformed choices of the other four people does not reveal any information about the distribution in the urn. Goeree and Yariv observe clear preferences for observing the uninformed choices of others. Between thirty and fifty percent of the subjects preferred observing others' choices, and this pattern is robust if the authors control for equality and efficiency concerns. Further, conformity with the uninformed majority choice becomes stronger for larger majorities, consistent with the psychology of social impact (Latane 1981). Goeree and Yariv therefore interpret their result as a preference for conformity.

While this interpretation seems the obvious explanation in the simple setting used by Goeree and Yariv, the result may obtain even under rather weak conformity preference if subjects have no clear concept of the

Bayesian learning from sampling with replacement. A recent study by Trautmann and Zeckhauser (2010) indeed suggests that many people have no proper understanding of the concept of learning under uncertainty and do, consequently, often completely neglect learning opportunities. If people get offered a chance to observe others, they may choose to do so even if conformity preferences are weak, or out of pure curiosity.

Another study finding strong peer effects was conducted by Cooper and Rege (2008). These authors asked subjects to make a set of simple choices between risky prospects. The whole set of choices was made three times. In the first instance, subjects made simple individual choices. In the second and third repetition they were either informed only about their own past choices or additionally about the past choices of 5 other people in their group. The authors found strong effects of the additional peer group information on risk attitudes. Two theoretical accounts were put forth: one based purely on conformity pressures, and another one based on social regret. Under pure conformity, the option chosen initially by a majority of peers yields an additional social utility component, such that groups are predicted to converge towards the initial majority choice over time.

The social regret model for peer effects on the other hand is based on the assumption that decision makers anticipate regret in risky decisions (Loomes and Sugden 1982; Bell 1982). Consider the right-hand situation Q in Figure 2, and assume that A and B represent the outcomes of two distinct prospects. If a person has to decide between these prospects A and B, she may anticipate that after choosing prospect A she feels regret in case the lower branch should obtain. In this case prospect B would have been the better choice ex-post. Similarly, after choosing prospect B the upper branch outcome would lead to decision regret.

In many situations prospects are asymmetrically affected by regret, which then strongly influences choice behavior. Cooper and Rege assume that subjects evaluate risky prospects by an evaluation function that consists of an "inherent utility" term, for instance the expected utility of the prospect, and an additive punishment for anticipated regret. Importantly, the weight of the regret term in the evaluation inversely depends on the expected number of people choosing the same gamble—misery loves company. This model is similar in spirit to the above-discussed amplification of individual level biases in social circumstances.

Studying the dynamic behavior in their experiment, Cooper and Rege find evidence for the social regret model of peer effects and reject the pure preference for conformity model. There is no simple convergence toward the initial majority as predicted by conformity, but rather a bias against more risky prospects in the peer choice information treatments compared to the individual information only treatments. This bias is predicted by social regret, because the risky options involve more potential for regret than safer options. Thus, in contrast to Goeree and Yariv (2006), this study does not find a pure conformity effect in risky choices. Another study that does not support conformity is Corazzini and Greiner (2007). In their study, subjects choose between two identical gambles A and B one after the other. That is, by definition individual attitudes toward risk cannot imply a strict preference between the gambles, allowing conformity to potentially exert as strong an influence as possible. Subjects making decisions later in the sequence should thus tend to the majority choice of subjects who previously revealed their preference. Corazzini and Greiner report significant non-conformity: observing a sequence of choices of one type by other subjects, subjects are more likely to choose the other prospect. This pattern is also observed if prospect A is strictly better than prospect B. Still about 25% of the subjects prefer to choose B after observing a sequence of A choices. Corazzini and Greiner's result is consistent with earlier evidence in psychology reported by Arkes, Daws, and Christensen (1986), who executed a experiment on learning under uncertainty in which subjects were given a decision making rule which would allow them to maximize their payoff. They found that subjects displayed a strong

tendency not to follow that rule, but rather tried to beat the system—with the consequence of a substantial loss in payoffs as compared to subjects who did follow the rule.

On the whole, the existing evidence on the role of conformity is thus inconclusive and more research is needed to uncover the reasons underlying the widely differing results. As Cooper and Rege show, it is often difficult to separate different explanations with purely behavioral data. New methods in economics including data from brain-scans executed while decisions are taken may help to study such difficult-to-identify social influences. For example, Engelmann et al. (2009) conducted a neuro-economic study of advice in financial decision making under risk. They find that brain regions involved in the value tradeoffs typical for decision making under risk, become less activated if advice by an expert is given. On the other hand, regions involved in strategic thinking and mentalizing others' intentions become more active (see also Bossaerts, 2010, section 6). This shift in processes results in behavioral change. Identifying underlying neurological processes can thus help to identify changes in social decision making under risk where behavioral observations are inconclusive.

The decision maker is observed by others

Situations in which a decision maker is observed by others, and the effects that such observation may conjure about, has been widely studied in social psychology. Once again, the interest for the topic in economics surfaced much more recently. In early studies of the issues of observability of donations, Hoffman et al. (1996) showed that in a dictator game subjects offered lower sums of money when nobody could observe the amount donated than when donations were to some degree observable. Even under complete anonymity, however, donations remained superior to the predicted zero result implied by the selfishness assumption typical of economics. While subsequently other experiments used similar concepts of social observability (referred to with a variety of names such as justification need, anonymity, double blind procedures), they mostly concerned behavior in interactive games rather than individual decisions under risk (e.g., Bohnet and Frey 1999; Dufwenberg and Muren 2006)

The overall evidence on the effect of being observed on the decision maker's choices under risk are mixed. In an early psychological study, Weigold and Schlenker (1991) found that subjects' original risk attitudes were enhanced when they anticipated the need to justify them—with risk averters becoming more risk averse and risk lovers becoming more risk seeking. The economic consequences of this are difficult to pin down, however. Vieider (2009) found an effect of accountability on loss aversion, which was decreasing when subjects were held accountable. In this case economic consequences are clear, since loss aversion is commonly perceived as a decision bias that may lead people to pass over potentially lucrative opportunities. Excessive loss aversion is often thought to occur because of narrow bracketing of decision problems, whereby decisions are considered one by one rather than in the larger perspective of lifetime decisions (Read, Loewenstein, and Rabin 1999; Rabin and Weizsäcker 2009). Accountability seems effective inasmuch as subjects realize the irrationality of their instinct to avoid losses, and try to correct it when they anticipate having to justify their decision. In contrast, in an experiment on framing, Vieider (2010) presents evidence that accountability may not be effective at changing risk attitudes either in the gain or the loss domain. This is an issue that is conceptually separate from the loss aversion results just discussed, which require mixed prospects over gains and losses to be addressed. These results do, however, contradict the earlier results by Weigold and Schlenker if one accepts that a majority of subjects is typically risk-averse for gains. Weigold and Schlenker's results would then lead us to predict an overall increase in risk aversion for gains under accountability. Overall, the verdict is thus not clear.

Accountability, on the other hand, has been found to increase the coherence between different decision frames—thus increasing the alignment of risk attitudes for gains and for losses. In the same spirit, accountability has been found to push decisions closer to the normative economic prediction when subjects are called to choose between different prospects, one of which is clearly superior to the other. The commonly observed failure of rational decision making in such choice problems derives generally from the differential complexity of the prospects, so that subjects seem to forego potential gains in expected utility to avoid the cognitive effort required for the discovery of the optimal decision (Huck and Weizsäcker 1999; for a psychological perspective see Inbar, Cone and Gilovich 2010). Accountability has been found to increase cognitive effort in such situations, and thus to improve decision making (Kruglanski and Freund, 1983). Vieider (2010) showed that improvements due to accountability also occur when at the same time financial incentives are provided for the decisions, so that the effect is not due to particularly low cognitive effort when decision do not carry real consequences. Rather, he found that the provision of monetary incentives may, paradoxically, sometimes impair the decision making process, pushing them farther away from the benchmark of economic rationality.

As mentioned in the History section, accountability has also been found to have effects on ambiguity aversion (Ellsberg 1961). Curley, Yates, and Abrams (1986) compared a group for which the decision was performed in relative privacy in front of the experimenter only to one in which the decision was performed in front of the experimenter and the whole group of subjects partaking in the experiment. They found a significant increase in ambiguity aversion when a group of subjects could observe the choice and the outcome of the choice. More recently, Mutukrishnan et al. (2009) successfully used the accountability effect to induce increased ambiguity aversion as a treatment variation in a marketing study.

To test whether social influences may in some settings be necessary for ambiguity aversion, Trautmann, Vieider and Wakker (2008) implemented the opposite manipulation by completely excluding the possibility of observation of the decision maker's preferences over outcomes, and thus ultimately of whether the decision maker ends up winning or losing. This was done by using outcomes over which the typical decision maker exhibits a clear preference (in this case, two movies on DVD), whilst such preferences cannot be guessed by the experimenter. The authors found that subjects who had to declare their preference before making their decision exhibited the usual pattern of ambiguity aversion, while subjects who did not reveal their preference beforehand were no longer ambiguity averse. On top of the results obtained by Curley et al., this shows on the one hand that the potential observability of outcomes is sometimes necessary for ambiguity aversion to be strong. On the other hand, it also shows a more subtle fact. Indeed, in Curley et al.'s experiments the size of the audience was increased, while both the decision itself (i.e., the decision making process) and the outcomes that obtained from that decision were observable in both conditions. Trautmann et al. on the other hand vary the observability of *outcomes* alone (or of preferences over outcomes to be precise) across conditions, while the decision making *process* was always observed by the experimenter. This goes to show that the effect is indeed produced by a focus on outcomes.

Field evidence also points in the direction of increased ambiguity avoidance under observability. In financial investment the advent of online brokerage has provided an environment of increased anonymity compared with traditional forms of brokerage. Barber and Odean (2001, 2002) showed that people invest more heavily in growth stocks and high-tech companies, investments that are associated with higher ambiguity in the finance literature, when they use online brokerage rather than traditional brokerage. Similarly, Konana and Balasubramanian (2005) found that many investors use both traditional and online brokerage accounts, and hold more speculative online portfolios. Consistent with the proposed accountability effect on ambiguity

attitude, one of the investors they interviewed noted in the context of online trading (p. 518): "I don't have to explain why I want to buy the stock." Barber et al. (2003) showed that group decisions (investment clubs) similarly lead to a stronger preference for easy to justify investments.

Economists have just begun to study accountability effects in decision under risk. While so far we have considered purely psychological accountability effects, in economics accountability often takes the form of incentive structures in agency problems. We discuss risk taking is such situations in more detail in the following sections.

The decision maker's choices determine or influence other agents' outcomes

A relatively common situation is the one in which a decision maker's choices and actions determine not only her own outcomes, but also the outcomes of others—beyond any influence they may have on market prices (a fact that has always been studied in economics, and that we do not consider a social issue). This happens for instance whenever the decision maker is hired to make decisions for someone else, or makes decisions for a group of people as in a business decision affecting various stakeholders. This category also includes decision making within the family regarding such issues as saving and investment, pension and life insurances, or buying a house. The social aspects of such decisions are often overlooked. Decisions for others furthermore occur in strategic game settings where the choices of players affect each other's outcomes, and therefore constitute a risk in the sense that choices are made simultaneously and chosen strategies are unobservable ex-ante. We first discuss the literature on decisions with responsibility for others' outcomes under risk due to nature, and then under the more implicit risks stemming from strategic interactions in games. Potential differences in behavior between situations of risk due to nature and of risk due to other people's choices in strategic settings will be dealt with in the following section. We do not review group decision making in detail in this section, but focus on situations of responsibility. Group decisions are complex and involve voting rules and dynamic decision processes that make it potentially difficult to identify effects on risk attitudes. For details on group decisions we refer the reader to Conradt and List (2010) for a broad overview, and to Isenberg (1986) for a focus on risky decisions.

Risky decisions on behalf of others. Risky decisions on behalf of others have been studied in a number of different contexts recently, including household and group decisions. An example is the study by Bolton and Ockenfels (2009) on fairness effects on risk taking discussed above. A problem with this type of studies is that the pure effect of responsibility for others often cannot easily be separated from other influences. If people decide for others as well as themselves, fairness or spitefulness issues become important. If people make decisions in groups, the preference aggregation and joint decision process influences behavior irrespective of potential social influences (de Palma, Picard, and Ziegelmeyer 2010; Wallach, Kogan and Bem 1964). We can nevertheless draw some initial conclusions about the effects of responsibility for others from the literature.

Bolton and Ockenfels (2009) included one set of questions in their study where fairness aspects are held constant although the risk affects both the decision maker and another person. They find increased risk aversion in this situation of responsibility relative to the individual benchmark, even though their result falls short of statistical significance. This finding is consistent with evidence from two studies from the financial management literature, which explicitly ask subjects to make decisions for others which do not affect their own outcomes. Eriksen and Kvaloy (2010) study amounts invested in a risky asset using a task popularized by Gneezy and Potters (1997), and Reynolds et al. (2009) study simple choices between risky and safe lotteries. Both studies find increased risk aversion in decisions for clients compared to the benchmark of decisions for

oneself. Interestingly, Eriksen and Kvaloy find myopic loss aversion, a violation of the expected utility model that has been shown for individual investors (Gneezy and Potters 1997), also in decisions for others. This evidence is consistent with findings in Bateman and Munro (2005) that joint household decision making suffers from the same violations of expected utility as individual decisions do, as well as with the finding that professional traders incur this bias more than the typical student populations employed in experiments (Haigh and List 2005).

While these results support the idea of more cautious decision making under conditions of responsibility, there are also studies that obtain the opposite finding of less risk aversion in decisions for others than for oneself. Chakravarty et al. (2010) find more risk seeking by people who make decision for others in lottery choices and bidding in auctions when decisions do not affect the agent's own payoff. Sutter (2009) finds that teams invest more in the Gneezy and Potter's investment task than individuals, thus pointing in an opposite direction than the findings by Erikson and Kvaloy (2010), although these differences may be affected by the group decision features of Sutter's experiment. Relatedly, Lefebvre and Vieider (2010) found that compensation through stock-options made experimental executives take risks that were excessive from their shareholders' point of view, with a substantial loss of revenue for the latter. When executives however knew that they might be called to justify their decisions in front of a shareholder reunion, they sacrificed their own payoff to act in the interest of shareholders, whose returns were increased considerably. The latter study differs from the ones described previously on the point that the compensation of agents and principals is determined through different mechanisms—an important class of relationships in the real world, on which little clear evidence exists to date (see future research section for a discussion).

An interesting variant of risk taking for others was studied in Haisley and Weber (2010). These authors offered subjects choices between more or less selfish allocations between themselves and a passive other person, with the latter affected by uncertainty. In particular, the passive person's payoff depended on either a risky or an ambiguous lottery.

Table 1: Social Allocations with Risk or Ambiguity (adapted from Haisley and Weber (2010))

	Self	other
Option A (selfish)	$2.25	Risky lottery (50%-50% chance to win either $0 or $1.00) or Ambiguous lottery (unknown probabilities of winning either $0 or $1.00)
Option B (other-regarding)	$2	$1.50

If subjects choose the other-regarding option they receive $2 while the other person receives $1.50. This decision problem effectively puts a price of $.25 on the morally more acceptable choice of providing a higher payoff to the other person. It is thus interesting to see whether the type of uncertainty affecting the other person's payoff influences the moral decision. Haisley and Weber reported an increase in selfishness if the probability with which the payoff of the other person obtains is ambiguous rather than a known 50% chance to win $1, or else nothing. They found evidence that in the ambiguous situation, the decision maker assumes an optimistic interpretation of the risk, thus in fact making a trade-off between ($2, $1.50) and ($2.25, "most likely" $1.00). Under the known 50% chance to receive nothing, the moral constraint is much stronger because self-serving interpretations are not as easy in that case. Interestingly, if subjects first make a simple

choice between an ambiguous and a risky gamble of the kind proposed by Ellsberg (see History section) before making the social allocation choice, the effect is eliminated. In the initial choice many subjects reveal ambiguity aversion, thus low evaluations of an ambiguous chance to win $1.00. The self-serving positive interpretations thus cannot as easily be constructed in the subsequent moral decision.

Strategic decisions for others. A different class of phenomena is the one of decisions that affect others, whereby the risk derives from strategic uncertainty in games (this form of social risk is discussed in more detail also below for the case of individual decision makers). Gong et al. (2009) and Sutter et al. (2010) studied how individuals versus teams act in games in which they had to choose between a low payment Nash equilibrium strategy and a more profitable, but also more risky, non-equilibrium strategy. Both papers find more coordination, and thus risk seeking, for individuals than for groups. As discussed before, from group decisions we cannot easily draw conclusion regarding social influences on risk preferences per se, because of the influence of the joint decision making process. Charness and Jackson (2009) study coordination in Rousseau's famous stag hunt game by players who individually choose their strategy, which will affect not only themselves but also the individual paired with them. Because the stag hunt game nicely illustrates how risk obtains from strategic uncertainty, we show the normal form of the game in the following table.

Table 2: Payoffs in the stag hunt game (Charness and Jackson 2009)

Player 2 / Player1	Stag	Hare
Stag	(9,9)	(1,8)
Hare	(8,1)	(8,8)

Note: (x,y) refers to player 1's payoff of x and player 2's payoff of y.

As can be seen from the table, both players would prefer to coordinate on hunting stag together. However, decisions are made simultaneously and anonymously. Hence, for each player it is very costly should the other player choose hunting hare instead, possibly because of spitefulness, or simply because she makes a mistake. Depending on player 1's beliefs about the probability of player 2 choosing stag, denoted p, she has to make a choice between a sure payoff of 8 for strategy *Hare* and a uncertain payoff of $p\times9+ (1-p)\times1$ for strategy *Stag*, thus constituting a decision under uncertainty.

Charness and Jackson let people play the game individually or accompanied by an anonymous and passive dependent other person whose payoffs are identical to the decision maker's payoffs. They find that people on average become more risk averse, and thus cooperate less, when they are responsible not only for themselves but also for the other person's payoff. Using within-person observations, they also find that this shift is mainly due to 1/3 of the population who is strongly affected by the responsibility, while 2/3 are not affected at all, suggesting systematic heterogeneity in risky decision making for others. Notice also how this effect is consistent with the findings on ambiguity aversion discussed in the previous section, where accountable subjects have been found to shy away from the ambiguous option—which is generally perceived as "riskier" by subjects. The following subsection examines in more detail the effect of risk due to strategic uncertainty if compared to risk caused by neutral events.

The decision maker's outcomes depend on other agents' choices

This class of social influences is concerned with the concept of strategic uncertainty (Van Huyck et al. 1990), in which players' outcomes depend on the choices of other players. The stag hunt game discussed above is an example. More generally, coordination games where the optimal social outcome provides no incentive for deviation, but players cannot make binding agreements, are a widely studied group of games involving such social risk. In economics, an important application of such coordination games concern depositors' decisions on whether to keep their money in a distressed bank. If all depositors stay calm, the bank will survive. If a few depositors withdraw their money prematurely, however, the bank will fall and the remaining depositors lose their money. From a game theoretic perspective, all depositors staying calm as well as all depositors withdrawing (a bank-run), both constitute Nash equilibria. Game theory makes no prediction which equilibrium will obtain, and equilibrium selection in such settings therefore creates strategic uncertainty.

Empirical evidence has shown that, although seemingly obvious, the coordination problem is often too difficult for players to solve. After a few rounds of repeated play (with new pairings) the game usually converges to the Pareto-dominated equilibrium of all players withdrawing. The result suggests that strategic uncertainty may be difficult for people to deal with. In a comprehensive study, Heinemann et al. (2009) investigated risk taking in coordination games. Two important results were obtained. First, they found a strong correlation between risk taking in a simple gambling task, and coordination (and thus the acceptance of strategic uncertainty). Second, the authors showed that coordination is more likely the smaller the percentage of people necessary for successful implementation of the Pareto-efficient outcome. Note that because of the multiplicity of equilibria, it is not theoretically the case that a smaller percentage implies a higher chance of an efficient outcome. People seem to perceive it as such, however. Another interesting finding shows that risk averse people also expect others to be risk averse (see also Kocher and Trautmann (2010) for a similar effect for ambiguity attitude in a market setting). This finding helps to explain the poor outcomes of coordination games. In a risky decision, attitudes toward risk should be independent of the perception of the lottery itself. Due to the above-stated correlation, however, in a coordination game the expected probabilities of the favorable outcome are reduced inasmuch as the decision maker's own risk aversion creates an expectation of others also shying away from the risk of coordinating on a superior equilibrium.

The conclusion of increased risk aversion under strategic uncertainty compared with risk due to nature is not unchallenged. Fox and Weber (2002) let subjects choose between either playing a 2-player coordination game, or making a risky coin flip. The game is similar to the one described above with two pure equilibria, and with a mixed equilibrium in which both strategies are played with equal probability. Most subjects preferred to play the game rather than flipping a coin. Obviously, the expected probability of successful coordination can be larger than 50%, such that even if risk aversion is stronger under strategic uncertainty than under pure randomization, subjects may still opt for playing the coordination game. In a slightly different game, called the matching pennies game, the same authors find a preference for the coin flip, however, replicating a finding in Camerer and Karjaleinen (1994). In this game there exists only a mixed equilibrium with in which both strategies are played with equal probability: this is the case because for each event where player 1 wins money, player 2 loses the same amount, and vice versa. Fox and Weber (2002) also found that the perceived competence of the opponent/partner affects the choice between the game and the risky lottery. A similar result is reported in Eichberger et al. (2008) for more complex games played against opponents with a different perceived degree of rationality. These findings imply that the perception of the game structure and the perception of the opponent strongly influence attitudes toward strategic uncertainty, showing the importance of subtle social influences.

The situation of strategic uncertainty is common to other games as well. Two-player examples include the ultimatum game and the trust game, also known as investment game. In the ultimatum game an endowment is given to one player, called the proposer, whose task it is to proposes a division of the endowment between herself and the second player, called the responder. Given this proposal, the responder has to make a binary decision between accepting and rejecting the proposal. In the former case, each player receives her share as specified in the proposal. In the latter case, both players receive nothing. Assuming pure self-interest, any positive amount is preferable to a zero payoff, and the subgame perfect Nash equilibrium therefore predicts that the responder accepts any positive amount. Hence, the proposer proposes the smallest positive unit to the responder, keeping the rest of the endowment to herself. If players have distributional or reciprocal preferences, however, proposers may offer significant amounts to the responder. Similarly, responders may reject small offers because of such preferences. A risky decision situation obtains for the proposer because of the uncertainty regarding social preferences of the responder, and thus the possibility of rejection and loss of the endowment. Bellemare et al. (2008) show that proposers perceive the situation as a risky decision problem, and make proposals according to their beliefs about the probability of a rejection by the responder for each potential proposal of shares. This implies that proposers will offer more in situations where the responder is able to reject offers as described above, compared to situations where the responder is forced to accept any proposal (i.e., a dictator game). This prediction is empirically confirmed by Bellemare et al. (2008, see also Bolton and Zwick 1995).

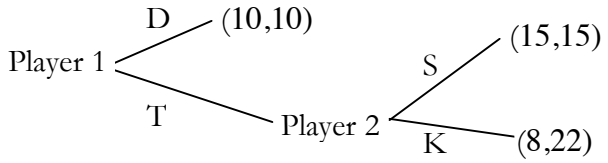
The above evidence from coordination games that a risk averse person may be even less inclined to take social risk than an equivalent lottery risk has been tested intensively in the trust game. In the trust game, the first player receives an endowment e and can submit any part x of it to the second player, the trustee. The remaining amount (e-x) she keeps for herself. For any amount x that is entrusted to her, the trustee then receives an amount b×x from the experimenter, with b typically set equal to 2 or 3 in experiments. The real-world equivalent for the multiplication factor b is that the trustee may have access to more profitable investment opportunities than the first player, but she has not enough funds to make the investment with her own money. After receiving b×x, the trustee in turn decides how much to send back to the first player, denoted y. The final payoffs for the first and the second player are, respectively, e-x+y and (b×x)-y. The game is either played with x and y to be freely picked by the players, or in a binary form with only two possible amounts for x and y, respectively. In the latter case, for example, the first player can submit either the full endowment or zero, and the second player may either keep the full amount b×x or send back the equal split (b×x/2).

The decision to trust by player 1 in the trust game is a decision implying social risk, and the relevant payoff probabilities depend on her beliefs about the trustee's behavior. A variety of studies tried to identify whether first players in the trust game indeed perceive the game as a simple decision under risk, or whether there is an additional, social component. Using behavioral measures of trust game choices and risk decision behavior, Eckel and Wilson (2004) find no correlation between various measures of risk attitude from lottery choices, and trust game behavior. Schechter (2007) finds evidence for a positive correlation between trusting and risk-seeking, using a risky decision task that matches the structure of the trust game as closely as possible. Schechter's results show that the relation between trusting and risk-seeking is far from one-to-one: one unit invested in a risky lottery increases the amount submitted in the trust game by 0.28 units. Kosfeld et al. (2005) study the trust game from a biological perceptive. They administer either the peptide oxytocin or a placebo to first players in the trust game. They find that oxytocin increases trust behavior, but does not affect risk-seeking behavior in a matched risky decision lottery task. Their result thus shows that trust includes an

additional social risk component that is not related to risk seeking in uncertainty deriving from nature, and is uniquely affected by the administered hormone.

Bohnet and Zeckhauser (2004) and Bohnet et al. (2008) devise a clever experimental design to clearly separate the pure risk aspect from the additional social component using behavioral data. They call the latter component *betrayal aversion*, and show that it is substantial and that it exists across a wide range of cultural groups. Bohnet and Zeckhauser separate betrayal aversion from risk aversion by the following task. Given a certain payoff structure in the trust game (see figure 3), they ask player 1 to indicate the lowest acceptable probability of a randomly matched trustee playing equal split (instead of keeping most of the pie) such that she (player 1) would choose trusting. Given the same game structure, in a control group player 2's choice is replaced by a random lottery draw with unknown probability. Here they ask first movers what the lowest probability of the equal split is that would make them choose the risky strategy.

Figure 3: Trust game used to identify betrayal aversion



Notes: The game is played sequentially. Player 1 either distrusts (D) or trusts (T). Conditional on strategy T by player 1, player 2 either shares equally (S), or betrays the trust, keeping (K) most of the pie for herself. (x,y) indicates a payoff of x for player 1 and y for player 2.

Clearly, the more risk averse a subject is, the higher will be the lowest acceptable probability of the good outcome. If trust is simply determined by risk attitude, this probability should be equal in both questions. In fact, Bohnet and coauthors find that people require much higher probabilities in the trust game than in the pure risk game to make them accept the more risky trust option. The difference between a typical minimum acceptable probability in the trust game and that in the risk game measures betrayal aversion. The authors report probability differences in the range of 10 to 20 percentage points more requested in the trust game, indicating a much stronger aversion to social risk than to natural risk from a impartial random device.

In sum, there is clear evidence that people perceive strategic uncertainty as a risky decision problem. Attitudes toward this uncertainty deviate strongly from individual choice setting, however, and depend on the social content of the game. There is some indication that risk attitudes and beliefs are correlated, amplifying risk aversion in social contexts.

Further Research

The previous sections have explored recent research efforts in economics that bring social factors to the forefront of decision making under risk. While we have seen many interesting findings that increase the realism and descriptive power of traditional theories of decision making under risk and uncertainty, one element that has become apparent are the many contradictions between different studies. Since effects may

often be subtle and this literature is still in its infancy, this is not surprising: as the research field becomes more mature, more of these contradictions will be explained, and the discovery of the underlying causes will greatly improve our understanding of social influences in risk taking. Beyond resolving the underlying controversies in the baseline research, there is also a wealth of applications to real-world phenomena to be explored. Since such real-world applications may be more interesting—and are generally the drivers behind the baseline research we have already discussed—the present section will pay heed to the latter in order to pinpoint lacunae that remain in our understanding of social influences on risk attitudes. We will thereby focus on two areas that are currently highly debated—financial agency and climate change.

Principal-agent relationships in financial markets constitute an especially promising terrain for future research. As discussed briefly before, such relationships can be complex, involving potentially different payoff mechanisms for the agent and the principal. A better empirical understanding of such asymmetric compensation mechanisms seems fundamental for the design of agency contracts, in which the principal tries to induce an agent to represent her interests. Influencing the agent's risk attitude in such a way as to be aligned with the interests of the principal can be quite challenging and the mechanisms needed to achieve this are still poorly understood, as shown by the results of Lefebvre and Vieider (2010) discussed above. Many other—even more involved—relationships exist in the real world, which we are only starting to study and understand. One important question that has emerged from the recent financial turmoil is for instance how the agency relationship can be reformed in cases where agents are employed by one principal (e.g., a bank or a financial advisor), but take decisions for or provide advice to another principal (e.g. a private investor). Indeed, incentives of such agents to act exclusively in the interest of the permanent employer have been blamed for advice that has often been excessively risk-laden from the point of view of clients, and which is at least partially to blame for the escalating risk spiral culminating in the 2008 financial crisis. While models and theories on how to fix such relationships do exist, it seems crucial to obtain empirical evidence to test such models and investigate subtleties that may have been missed in the deductive process of their construction.

The imitation of others around us is one of the most natural and common ways of learning about the world and improving oneself. This imitation may however take very different forms. One could learn from someone else how to better perform a given task—or one could learn how not to perform a task from observing somebody else's success or failure (Offerman and Schotter 2010 and references therein). Since actual decision making processes are rarely observable in sufficient detail a focus on the outcomes of such decision making processes can generally be considered a more accessible substitute. Problems may arise from this approach, however, when outcomes are largely dependent on chance, and observers are more likely to observe successful decision makers than unsuccessful ones. This is sometimes known as a *survivor bias*, whereby only successful actors may stay in the market long enough to be observed, while unsuccessful ones tend to drop out and disappear from sight relatively quickly. When survival depends largely on chance, imitating the behavior of survivors may not lead to better decision making processes, and may sometimes lead to worse decisions. A typical example of this may be bubble formation in financial markets. When markets get artificially inflated, observers may imitate the behavior of early-movers and buy increasing amounts of stocks, thus pushing their price even higher and thus increasing the risk of a painful burst. Unfortunately, the social element in these types of behavior is still poorly understood, such that it is unclear what part of such behavior is due to uninformed following, and which part is instead caused by rational speculation (as long as this self-enforcing mechanism continues the price will continue going up, even though the asset is already overpriced).

Whenever the linkage between actions and outcomes is poorly understood, delegating decisions involving risk or uncertainty creates complex issues of incentives and accountability of agents. This derives at least in part from the fact that in an uncertain world it is often difficult to determine what outcomes result from skill and what outcomes result from pure luck (Maboussin 2010), with consequent difficulties for the establishment of effective incentive and responsibility mechanisms. Moreover, perceptions by the principal of the control that agents have over outcomes in different contexts and the subsequent preferences for accountability regimes resulting from such perceptions may depend crucially on the principal's ideological world-view (Tetlock and Vieider 2010). Bartling, Fehr and Schmidt (2009) gave principals a choice between a low-trust strategy leaving little room for employee discretion and a high-trust strategy that gave employees substantial freedom, but also provided the possibility of substantial rent sharing. They found that the trust strategy resulted in substantial benefits for both employers and employees when there was competition between employees who could build up reputations. Notwithstanding this clear advantage, some employers never switched to the trust strategy, thus sacrificing potential payoffs. These employers may have been deterred by the risk that employees may turn out to be untrustworthy and shirk.

While the latter examples show how important social perceptions and mechanisms can be, they also provide an indication of how poorly understood some of the mechanisms involved still are. Reputation formation, different accountability regimes, reporting requirements, etc. all play into the equation and interact with the pure incentive mechanisms on which economic theory has classically focused. Expanding the traditional focus and allowing for more complex interactions which are generally present in the real world promises to improve our understanding of existing processes, as well as opening up new directions for contract design. In this sense, integrating the variety of findings from different social science literatures seems a promising direction for moving forward. Huge parallel literatures on principal-agent relationships exist in economics and organizational science, and even sociology and organizational and social psychology. To mention but one example, organizational scientists have long called for abandoning the simplistic assumption of invariant risk aversion by agents still central to the agency literature in economics (Wiseman and Gomez-Mejia 1998)—an assumption whose anachronism has been dramatically unveiled by recent events. Unfortunately, such communication between different disciplines in the social sciences is still rather the exception than the rule, be it because of the different taxonomies or methodologies adopted that make their integration arduous work, or because of turf-wars between scientific communities driven by narrow self-interest.

Financial markets are by no means the only real-world phenomenon on which a better understanding of social aspects of decision making under uncertainty promises to shed some light. Let us take another issue that currently occupies a prominent position on international policy agendas: climate change. It is often repeated how humanity's failure to control emissions of greenhouse gases constitutes a classic tragedy of the commons problem (Hardin 1968). Such problems have been intensively studied in economics under the label of public good games, and the large body of evidence clearly rejects the economically selfish prediction of zero contributions to the common good (Andreoni 1995). Nevertheless, this large body of knowledge only offers poor guidance for the complex phenomenon of emission reductions, for the simple reason that the issue differs from the classic public good problem on several dimensions that may be expected to be relevant for the decision making process.

First of all, climate change is a public bad rather than a public good, and there is solid evidence that different frames significantly influence people's decisions. Perhaps more importantly from the point of view of the present chapter, the public bad of climate change—or alternatively, the public good of emissions reductions—involves risks that do not derive only from the possible failure of other group members to

contribute. Mounting levels of greenhouse gas concentrations in the atmosphere increase global average temperatures. In turn, such mounting temperatures produce changes in global weather patterns, resulting in increased likelihoods of catastrophic events such as prolonged droughts, floods, increased storm frequency and intensity, and even potential migrations and wars resulting from such events. Finally, the likelihoods of different events themselves are often poorly understood because of previously unexperienced feedback cycles such as the recession of the permafrost zones in northern Siberia, etc.

All this shows the point that we are here considering a risky public good involving unknown and highly uncertain probabilities—a type of phenomenon on which virtually no evidence exists (Zeckhauser 2006). To this, one needs to add the social connotations of the problem that go far beyond the classical social issues involved in public good games as studied in the experimental economics literature. The asymmetric wealth of the actors involved (with some of the poorer actors also being the largest emitters of greenhouse gases; see Reuben and Riedl (2009) for the effects of such asymmetries on public good contributions), the fact that some of the largest emitters are unlikely to face the highest risks (Sunstein, 2008), different historical responsibilities for stocks of greenhouse gases present in the atmosphere, and different cultural backgrounds all constitute social elements that complicate the process, and which are still often poorly understood in isolation, let alone combined. For instance, how may risk attitudes—and hence the willingness to reduce existing or future risks—depend on income or wealth of the involved actors? And how does this dependency interact with historical responsibility for current risks by the richest actors, combined with a power for stopping increases in risk level that rests mainly with relatively poor actors? Obtaining better evidence on the drivers of decision making processes in situations that have complex social and risk dimensions appears to be crucial for a better understanding of involved decision making processes and international coordination on these complex issues.

While the examples provided here are by no means exhaustive, they seem apt at providing a snapshot of how more evidence on the social drivers of decision making processes under risk can help us to better understand—and thus potentially improve—complex real-world interactions. The challenge will be to dissect these complex issues in such a way as to be able to draw causal inferences on single aspects in isolation, as well as to later reassemble the collected evidence in order to understand their interaction. One discipline or research methodology will hardly be able to rise to this challenge. Classical laboratory experiments from economics aimed at understanding basic decision making processes will need to be integrated with evidence from more complex decision environments in the field. A better understanding of social interactions from social psychology will be just as important as a solid underpinning from organizational science, and deeper insights into the legal aspects necessary for binding international agreements and their implementation into national law. Finally, philosophy can come into the picture by highlighting the intercultural common ground of ethical thought and shared principles on which the indispensable closer international cooperation can be founded. Paraphrasing a famous scientist from another discipline: everything should be made as simple as possible, but not simpler.

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