# Cooperation in Risky Environments: Decisions from Experience in a Stochastic Social Dilemma

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**Abstract**

Often in cooperative situations, many aspects of the decision-making environment are uncertain. We investigate how cooperation is shaped by the way information about risk is presented (from description or from experience) and by differences in risky environments. Drawing on research from risky choice, we compare choices in stochastic social dilemmas to those in lotteries with equivalent levels of risk. Cooperation rates in games vary with different levels of risk across decision situations with the same expected outcomes, thereby mimicking behavior in lotteries. Risk presentation, however, only affected choices in lotteries, not in stochastic games. Process data suggests that people respond less to probabilities in the stochastic social dilemmas than in the lotteries. The findings highlight how an uncertain environment shapes cooperation and call for models of the underlying decision processes.

**Keywords:** Decisions from Experience; Cooperation; Risky Choice; Public Good.

## Cooperation in Risky Environments

When people face an opportunity to cooperate, such as when opening a business together or pursuing a joint research project, the outcomes of these enterprises are frequently uncertain. On the one hand, joint enterprises often constitute a social dilemma, where it is in the collective interest of the group to cooperate, yet individually rational to free ride. Despite these incentives, there is overwhelming evidence that many people still engage in cooperation (e.g., Ostrom, 1990). On the other hand, even if people cooperate outcomes often are uncertain due to a risky environment. For instance, even if all business partners cooperate, a new start-up may fail due to external events, such as natural disasters disrupting supplier shipments. Laboratory experiments show that when social dilemmas are embedded in a stochastic environment, cooperation declines sharply (for a review see E.Van Dijk et al., 2004). What has not been addressed is how different levels of environmental risk and the format in which it is presented affect cooperation.

Studies on risky choice find a pronounced difference in behavior depending on how information in lotteries is presented: whether people sample the distribution of outcomes (*decisions from experience*) or decide based on a summary description of outcomes and probabilities (*decision from description*) (for a review see Rakow & Newell, 2010). In conventional lotteries with described probabilities, people choose as-if they overweight small probabilities as reflected in Prospect Theory (Kahneman & Tversky, 1992). In contrast, people decide as-if they underweight small probabilities if they acquire risk information sequentially by sampling (Hertwig et al., 2004). The difference in choice patterns between decisions from description and experience has been labeled the *description-experience gap* (DE gap).

In lotteries, outcomes depend on environmental risk alone, whereas outcomes in social dilemmas also depend on the choices of other individuals. Stochastic social dilemmas thus combine social uncertainty and environmental risk. Yet our understanding of cooperation in stochastic environments is currently limited to situations in which environmental risk is described by outcomes and probabilities (e.g., Bereby-Meyer & Roth, 2006; Gong et al., 2009; Levati et al., 2009). We argue that real-world risky choices often involve experiencing the outcomes and probabilities of choices rather than receiving their summary statistics. Therefore, examining how risk presentation influences people's decisions is critical to understand how and when people cooperate in risky environments.

There is one important presupposition: risk presentation can influence cooperation only if people are responsive to differences in environmental risk. In lotteries, people's decisions have been found to vary with *different levels of risk*, i.e. for different combinations of outcomes and probabilities while keeping the expected value constant. Analogously, one can describe a stochastic social dilemma by the expected payoffs of cooperation. In a one-shot prisoner's dilemma, people not only cooperate but also respond to different outcomes (Guyer & Rapoport, 1972). Extending this finding to a stochastic setting, the second goal of this study is to establish whether and how different levels of risk affect behavior in one-shot social dilemmas with the same expected payoffs.

Like other types of choices, cooperation is a function of the match between decision processes and the decision-making environment, or what has been labeled ecological rationality. Besides social uncertainty, which has been studied extensively, the levels of environmental risk and uncertainty are critical components of real-world environments that researchers are only recently beginning to appreciate. For instance, cooperation unravels slower in a stochastic social dilemma than in a deterministic one (Bereby-Meyer & Roth, 2006), and groups cooperate more than individuals (Gong et al., 2009). None of the studies, however, addresses how differences in risky environments and the way risk is presented affects cooperation.

## Experiment

The goal of the study is to investigate how risk presentation and different levels of environmental risk affect cooperation in a social dilemma. Even if the outcomes of cooperation also depend on the action of others, the environmental risk affects all who cooperate equally. We thus expect both aspects to influence cooperation in risky environments in the same way as lottery choices with environmental risk alone. To facilitate understanding, we present the detailed hypotheses (see below) after the implementation.

We used a 2 x 2 between-subjects design in which we manipulated risk presentation (description vs. experience) and choice situation (social dilemma vs. lottery). In the *description* condition, subjects received information about how environmental risk influenced outcomes in a *social dilemma* as a probability statement, whereas in the *experience* condition participants sampled to infer the probabilities. To control whether the values and probabilities chosen to implement environmental risk replicated the DE gap, two further groups made decisions in *lotteries*, again either from description or experience. The environmental risk was identical between lotteries and games. To investigate how different levels of risk affect behavior in one-shot social dilemmas, we varied probabilities and outcomes within-subjects while keeping the expected outcomes constant.

### Methods

**Environmental Risk in Social Dilemmas and Lotteries**
For the *social dilemma* conditions, we used a stochastic 2-person public goods game (PG) with binary choices. For each choice, participants receive an endowment *e* (10€) which they could contribute to a joint project with a randomly matched partner or keep for themselves. Contributions were multiplied by a value (*msr*) and shared equally between both pair members. Denoting *i*'s contribution by $c_i$, where $c_i \in \{0, e\}$ and $i = 1, 2$, *i*'s payoff is given by

$$\pi_i = e - c_i + \frac{msr}{2}(c_1 + c_2). \qquad (1)$$

We impose $msr \in \{1, 2\}$. An $msr > 1$ made it socially optimal to contribute, whereas an $msr < 2$ rendered free-riding the dominant strategy for a selfish person, thus creating a social dilemma.

We manipulated environmental risk by assigning the *msr* to one of two possible values, representing either a good or a bad event, with a certain probability. In case the bad event occured (with probability *p*), contributions were multiplied by an $msr < 1$, decreasing the value of the public good. When the good event occured, contributions were multiplied by an $msr > 1$, increasing the value of the contributions. The environmental risk only affected what was invested. Cooperation thus represents the risky and non-cooperation the sure option. We chose the two potential *msr*-values and corresponding probabilities such that the expected *msr*, *E[msr]*, across good and bad event always yielded a social dilemma with $1 < E[msr] < 2$.

Table 1 illustrates the eight decision situations employed. Situations 1 to 4 contained *rare* ($p < 0.25$) bad events, analogous to the DE gap studies with lotteries (e.g., Hertwig et al., 2004). Situations 5 and 6 contained more *common* ($p > 0.25$) bad events to test whether the DE gap extends beyond rare events as found by Ludvig and Spetch (2011). We use two different expected *msr*, 1.2 and 1.4, to check the robustness of the results. Situations 1 – 6 were designed to extend the findings from the DE gap studies in risky choice to social dilemmas. At the same time, keeping the expected *msr* constant across different combinations of probabilities and potential returns allows us to test whether different levels of environmental risk affect choices in the PG in the same way in which they affect choices in lotteries.

Decision situation 7 and 8 explored boundary conditions of a social dilemma and provided a further control of participants' understanding of the incentives. In situation 7, the *E[msr]* equaled 1.1, which made it less attractive to cooperate compared to situations 1 – 6. In contrast to the other situations, here the rare event was the good state of the world. Different from situations 1 to 7, the expected *msr* of 2.1 in situation 8 did not generate a social dilemma and made it individually and socially optimal to cooperate.

In most studies on the DE gap, the risky option has an expected value that is only marginally higher than the sure option. To avoid floor effects in the social dilemma, we used relatively large expected *msr.* This should provide strong incentives to cooperate in the PG but results in a larger difference between the expected *msr*-value of the sure option and risky option. To control whether the parameters we chose for implementing environmental risk replicated the DE gap in more standard settings, we ran the same choices as lotteries with identical environmental risks. In the lottery conditions, participants also received an endowment *e* and had to decide whether to invest into a risky option. The risky option in each lottery used the same two possible *msr* with the same probabilities as the corresponding PG. Yet, while the payoffs in the games also depended on the action of another person, the payoffs in the lotteries only depended on the realized state of the world. The lotteries strip the strategic component away but retain the stochastic component that stems from the environment. We randomized the order of decision situations in games as well as lotteries, and participants received no feedback about the realized *msr* (or decision of the other group member) after each decision.

**Decisions from Description vs. Decision from Experience** In the *description* conditions, participants received information about environmental risk as a summary statement about probabilities and associated *mrs*-values before they made their decision. In the *experience* conditions, participants sampled the distribution of *mrs*-values by drawing 25 cards from a deck. We used a matched-sampling design based on Ungemach et al. (2010), where people were forced to view a representative sample of the underlying distributions of outcomes. Each card contained a number corresponding to one of the two possible *msr*. For example, in situation 1 the deck had 2 cards with the *msr* 0 and 23 cards with the *msr* 1.30. The sequence of cards was randomized for each participant, yet the two possible *msr* and their frequencies matched exactly the objective probabilities given in the *description* condition. Thus, sampling error could not cause any differences observed between the two conditions.

In the *experience* conditions, we additionally collected time stamps that allowed us to evaluate how long participants viewed a certain card and whether this influenced their decision. To check the accuracy of risk estimates, we also asked participants after the last round how often they saw the two sampled *msr*-values. In the *description* conditions, participants translated the probability statement of the last round into a frequency statement to control whether participants accurately understood the risk.

**Further Tasks** In the *social dilemma* conditions, participants also faced two deterministic PGs with an *msr* of 1.2 and 1.4 (randomized order) after the stochastic situations. This allowed us to investigate how cooperation varies if the stochastic component is removed, since the deterministic games matched the expected *msr* of the stochastic PGs in situations 1, 2, and 5 (*E[mrs]* = 1.2) as well as 3, 4, and 6 (*E[mrs]* = 1.4).

At the end of the experimental session, participants indicated in a questionnaire which of six reasons best explains their decision to invest/not invest into the stochastic PGs: the probability of the *mrs* were (not) sufficiently high, the values of the *mrs* were (not) sufficiently high, conditional cooperation, social uncertainty, greed/opportunism, moral values, or none of these. A section on demographics concluded the experiment.

**Participants and Procedure** We randomly assigned 128 students in Jena, Germany, to one of four sessions. In the social dilemma conditions, participants had to pass control questions to ensure that they understood the impact of environmental risk and of the other person's choice on their payoffs. All tasks were completed anonymously employing a perfect stranger design. At the end, one decision situation was randomly chosen to determine the payoff. Participants earned on average 14€.

## Hypotheses

**Risk sensitivity in social dilemmas and lotteries** Do different levels of environmental risk affect stochastic PGs in a similar way as they affect lotteries? To test this presupposition, we focus on decisions from description and employ the predictions of Prospect Theory (Kahneman & Tversky, 1992). Using a separate value and weighting function, Prospect Theory transforms the expected outcomes of a lottery into Prospect Theory Values (PTVs), analogous to expected values. When comparing the PTV of a lottery's risky option with a sure option (always 1 in our case), the conventional prediction is that the risky (sure) option is picked if the PTV is larger (smaller). Investment rates into the PG are expected to be lower than in lotteries due to a second source of uncertainty that stems from the other person. Thus, the PTVs based on environmental risk alone are unlikely to be useful. However, the PTVs also produce a ranking of the 8 decision situations in terms of proportion of risky choices. Such a ranking can be applied to both lotteries and stochastic PGs in the description condition. Table 1 lists the PTVs for the eight decision situations of this experiment based on the parameters used by Tversky and Kahneman (1992). From the PTVs, two predictions follow for PGs and lotteries with the same expected *msr*:

(1a) Situations 1 and 3 (bad event occurs with 8%) will lead to a higher number of risky choices than situations 2 and 4 (where the bad event occurs with 20%).

(1b) Situation 5 (6), where the bad event is more common, will lead to more risky choices than situations 1 and 2 (3 and 4).

**Decisions from Description and from Experience** Using lotteries, studies found that experienced small probabilities appear to be underweighted in choices compared to described ones (Hertwig et al., 2004). Extending this choice pattern to social dilemmas leads to the following hypothesis for stochastic PGs and lotteries:

(2) The risky option will be chosen more frequently in the experience condition than in the description condition if the bad event is less likely (situations 1 – 6 and 8), whereas this pattern should reverse for situation 7, in which the good event is less likely.

# Results

## Risk Sensitivity in Social Dilemmas and Lotteries

We would not expect risk presentation to matter unless people are sensitive to different levels of risk in games as they are in lotteries. For the results of hypothesis 1a and 1b,

Table 1: Percentage of subjects investing in PGs / lotteries and differences between description and experience conditions

| **Decision Situations** | | | | **Stochastic PG** | | | **Lotteries** | | |
|---|---|---|---|---|---|---|---|---|---|
| # | Risky Option | *E[msr]* | PTV | Desc | Exp | Difference between description and experience conditions | Desc | Exp | Difference between description and experience conditions |
| **One rare event** | | | | | | | | | |
| 1 | 1.30, 0.92<br>0, 0.08 | 1.2 | 0.93 | 47 | 44 | -3 ($\chi^2(1) = 0.06$, p = 0.80) | 78 | 81 | +3 ($\chi^2(1) = 0.10$, p = 0.76) |
| 2 | 1.45, 0.8<br>0, 0.2 | 1.2 | 0.84 | 28 | 28 | 0 ($\chi^2(1) = 0.00$, p = 1.00) | 44 | 69 | +25 ($\chi^2(1) = 4.06$, p = 0.04) |
| 3 | 1.55, 0.92<br>0, 0.08 | 1.4 | 1.09 | 66 | 56 | -9 ($\chi^2(1) = 0.59$, p = 0.44) | 81 | 88 | +6 ($\chi^2(1) = 0.47$, p = 0.49) |
| 4 | 1.80, 0.8<br>0, 0.2 | 1.4 | 1.02 | 38 | 38 | 0 ($\chi^2(1) = 0.00$, p = 1.00) | 63 | 78 | +16 ($\chi^2(1) = 1.87$, p = 0.17) |
| *Mean 1 – 4* | | | | *45* | *41* | *-3 ($\chi^2(1) = 0.26$, p = 0.61)* | *66* | *79* | *+13 ($\chi^2(1) = 5.03$, p = 0.03)* |
| **Two common events** | | | | | | | | | |
| 5 | 1.80, 0.64<br>0.20, 0.36 | 1.2 | 0.96 | 25 | 28 | 3 ($\chi^2(1) = 0.08$, p = 0.77) | 34 | 44 | +9 ($\chi^2(1) = 0.59$, p = 0.44) |
| 6 | 1.95, 0.56<br>0.70, 0.44 | 1.4 | 1.21 | 41 | 28 | -13 ($\chi^2(1) = 1.11$, p = 0.29) | 44 | 59 | +16 ($\chi^2(1) = 1.56$, p = 0.21) |
| *Mean 5 & 6* | | | | *33* | *28* | *-5 ($\chi^2(1) = 0.33$, p = 0.57)* | *39* | *52* | *+13 ($\chi^2(1) = 2.02$, p = 0.16)* |
| **Extreme *msr*** | | | | | | | | | |
| 7 | 0.75, 0.88<br>3.50, 0.12 | 1.1 | 1.23 | 19 | 16 | -3 ($\chi^2(1) = 0.11$, p = 0.74) | 38 | 16 | -22 ($\chi^2(1) = 3.92$, p = 0.05) |
| 8 | 2.20, 0.96<br>0.30, 0.04 | 2.1 | 1.70 | 91 | 88 | -3 ($\chi^2(1) = 0.16$, p = 0.69) | 100 | 97 | -3 (p = 0.50, Fisher's exact test) |

we focus on data from the *description* conditions for decision situations 1 to 6.

When comparing decision situations with an *E[msr]* = 1.2 and *E[msr]* = 1.4, cooperation increases with the expected *msr*. The deterministic PGs yield a similar pattern: the rate of cooperation is 53% when *msr* = 1.2 and, 81% when *msr* = 1.4 ($\chi^2(1) = 5.74$, p = 0.02). In the stochastic PGs, the average rate of cooperation is 33% when *E[msr]* = 1.2 and 48% when *E[msr]* = 1.4 ($\chi^2(1) = 4.23$, p = 0.04). Thus, differences in expected *msr* affect behavior even though the social dilemma is maintained and the dominant strategy for a person is not to cooperate. This replicates Guyer & Rapoport (1972) findings and extends it to a stochastic setting. But, besides being sensitive to different expected outcomes, do people react to different levels of risk for constant expected outcomes*?*

To address this question, we pool our data across situations with expected *msr*-values of 1.2 and 1.4 to obtain more reliable results. The mean cooperation rate is 1.7 times higher in situations where the bad event occurs with 8% than in situations where the bad event is common ($\chi^2(1) = 7.12$, p = 0.01). Thus, changes in the stochastic environment have a large impact on cooperation. The difference in cooperation between deterministic and stochastic PG with an 8% chance of a bad event is only 10.5% and not significant ($\chi^2(1) = 1.62$, p = 0.20).

To investigate hypotheses 1a and 1b – that situations with 8% receive more investment than situations with 20% –, one can also rely on the pooled data across the *E[msr]* of 1.2 and 1.4 because the rankings of PTVs are identical for both. The rate of investment in situations with a probability of 8% compared to 20% sharply drops both for stochastic PGs (from 56% to 33%, $\chi^2(1) = 7.17$, p = 0.01) and lotteries (from 80% to 53%, $\chi^2(1) = 10.12$, p < 0.001). Paralleling each other, stochastic PGs and lotteries thus are in line with prediction 1a based on Prospect Theory.

For prediction 1b, the data also suggests a decline in cooperation between situations with a probability of 20% and those with two common events. Statistically, however, there is no difference between these two situations, neither for the stochastic PGs (the investment rate is constant at 33%, $\chi^2(1) = 0.00$, p = 1.00), nor for lotteries (the investment rate declines from 53% to 39%, $\chi^2(1) = 2.55$, p = 0.11). Hypothesis 1b based on Prospect Theory – that the rate of investment is highest with a common event – is neither met in stochastic PGs nor in lotteries.

In summary, we find that different levels of environmental risk both influence choice in the PGs for decisions from description and result in similar behavior in stochastic PGs and lotteries. Though the data confirm the predictions of Prospect Theory for hypothesis 1a, we did not obtain support for hypothesis 1b for either PGs or lotteries.

## Decisions from Description and from Experience

**Is there a DE gap in lotteries and games?** We initially focus on pooled data from the eight decision situations to start with more reliable results. Hypothesis 2 is directional and states that, except for situation 7, participants should choose the risky option more often in the experience condition. To test this hypothesis, we subtracted the percentage of people contributing in the experience condition from those in the description condition, except for situation 7 where we do the opposite. The results show a positive gap for lotteries ($\chi^2$ (1) = 8.24, p = 0.003), with a mean difference between experience and description of 12% (SD = 10%).

Table 1 lists percentage of people investing in experience and description separately for all eight decisions situations in lotteries and stochastic PGs. For lotteries, the predicted difference between the experience and description condition is observed in all situations (including the reversal for situation 7) – except for lottery 8. This lottery shows a ceiling effect because the expected outcome is twice as high as the sure option, so that in both conditions all participants but one invested.

Averaging across lotteries 1-4, which contain a rare event, shows a DE gap of 13% (Table 1). The same DE gap (13%) occurs with lotteries containing a more common bad event (5 and 6, Table 1). The results replicate Ludvig and Spetch (2011), who find the DE gap also for situations with common events. Overall, responses to decisions from description and experience differed in lotteries as predicted based on previous findings. Thus, the parameters we chose for environmental risk replicate the DE gap found in the risky choice literature.

Given that the parameters replicate the DE gap in lotteries and the previous result that people's decisions in games were similarly sensitive to differences in risk as in lotteries, we expected the risk presentation format to influence cooperation as well. The behavior in the stochastic PGs, however, does in this respect not match the behavior in lotteries: the DE gap completely disappears in games ($\chi^2$(1) = 0.38, p = 0.30). The mean difference between experience and description in the stochastic PG is -3% (SD = 6%).

The stochastic PGs stand in stark contrast to the results in the lotteries. In games, 6 out of 8 decision situations show no or only minimal gaps. Experience and description conditions do not differ for any of the decision situations. In fact, situation 7, which is closest in spirit to the situations used in by Hertwig et al., (2004) and Ungemach et al., (2009), shows a strong DE gap in lotteries, but the gap disappears completely in the games.

**Why is there a DE gap in lotteries but not in games?** In the following, we explore reasoning processes in PGs and lotteries that provide hints to why risk presentation affects lotteries but not stochastic PGs.

One possible explanation underlying this pattern is that participants spend different amounts of time sampling in lotteries and games, which may indicate different search processes. In lotteries, participants spent more time viewing the rare event (M = 0.91 seconds, SD = 0.99) compared to the frequent event (M = 0.67 seconds, SD = 0.65, t(6400) = 10.01, p < 0.001). Similarly, for the games, participants viewed the rare event (M = 0.51 seconds, SD = 0.51) longer than the frequent event (M = 0.43 seconds, SD = 0.33, t(6400) = 6.38, p < 0.001). In lotteries, however, participants spent more time sampling than in games for both rare events (t(2432) = 12.45, p < 0.001) and frequent events (t(10368) = 24.02, p < 0.001). These differences in sampling times thus provide evidence for potentially different search processes in games which appear to pay less attention to the actually observed probabilities compared to lotteries.

To control for the accuracy of risk perception, participants in the experience conditions stated the frequency of the two outcomes in the last situation after they had decided. The actual distribution of outcomes participants saw correlates with the stated frequencies for lotteries ($r_S$ = 0.72, p < 0.001) yet to a lesser extent for stochastic PGs ($r_S$ = 0.43, p < 0.01). In both conditions participants were calibrated to the actual probabilities and did not underestimate but rather, if anything, overestimated the probability of rare events.

Some researchers suggest that the larger influence of recent events in decisions from experience may drive the DE gap. Hertwig et al. (2004) and Rakow, Demes, & Newell (2008) found a recency effect in decisions from experience but Ungemach et al., (2010) and Hau, Pleskac, Kiefer, & Hertwig (2008) did not. To test for a recency effect, we divided the 25 samples participants draw before each decision into two sets: from 1 to 12 (initial) and from 13 to 25 (latter). Then we computed the expected *msr* from the initial samples, $E[msr]_{1\text{-}12}$, and from the latter samples, $E[msr]_{13\text{-}25}$. Finally, we compare the number of risky choices made when $E[msr]_{13\text{-}25} > E[msr]_{1\text{-}12}$ to the number of risky choices made when $E[msr]_{13\text{-}25} < E[msr]_{1\text{-}12}$. When the *E[msr]* of the latter, more recent sample was larger, we find a higher number of risky choices in lotteries ($\chi^2$(1) = 3.77, p = 0.04) but not in games ($\chi^2$(1) = 0.30, p = 0.34). This also suggests that the actual observed probabilities may play a less important role in games than in lotteries.

Finally, for the stochastic PG in description and experience, participants indicated their most important reasons for cooperating as well as not cooperating. This resulted in two statements per participants. Aggregating across both statements, probabilities influenced cooperation decisions in the description condition for 59% of the participants, compared to 39% in the experience condition. In this condition, participants rather emphasized both the value of the *msr* they could obtain (20% in experience, and 3% in description) and their expectation whether the other will (not) cooperate, i.e. conditional cooperation (20% in experience and 11% in description). This indicates that the importance of the probabilities for decisions is further reduced in the stochastic PG in experience.

In summary, participants sampled more quickly in the stochastic PG in the experience condition than in lotteries, as if they were paying less attention to the observed probabilities. In line with this, subjects' risk perception was less accurate in games than in lotteries, and recency – a potential cause of the DE gap – did not play a role in games, whereas we did find a recency effect in lotteries. The questionnaire also highlighted that probabilities were less important in the PG in experience than the size of the values and beliefs about others' behavior. This provides converging evidence that as the probabilities of the risky option lose importance in the games, the DE gap washes out.

## General Discussion

People often cooperate in social dilemmas. We examined how critical aspects of the stochastic environment shape cooperation. First, different levels of environmental risk influence cooperation. Investments in the stochastic PGs match those observed in lotteries, with people preferring an 8% chance of a bad event to a 20% chance for constant expected payoffs. Second, the *msr*-values and probabilities chosen to implement environmental risk replicate the DE gap within individual risky choices in lotteries. That is, people choose the risky option more often when experiencing the risky outcomes compared to when receiving summary descriptions. Our key finding is that, nevertheless, risk presentation matters in lotteries but not in games: no DE gap existed for the social dilemmas. Process data and subjects self-reported reasons for cooperation suggest that the disappearance of the DE gap in games may result from a decision process that emphasizes the size of the outcomes and expectations about others' behavior over outcome probabilities.

In our view, to include environmental risk and decisions from experience into the study of cooperation invites more realism into the laboratory. This study is only a small step to build on insights from research on risky choice for decision situations which combine environmental risk and social uncertainty. In particular, models that focus more on actual decision processes instead of choices alone may provide promising alternative starting points to Prospect Theory, which in our study could not account for the data in the description condition for either lotteries or games. In complex interactive environments, it seems rather likely that non-compensatory decision making emerges. For instance, a lexicographic strategy like the Priority Heuristic (Brandstatter et al. 2006), outlines a sequential decision process which considers outcomes in the first and probabilities only as a second step if no decisions has been made. In a similar fashion, other strategies that do not trade-off reasons may be valuable to model search and decisions processes in situations that combine environmental risk and social uncertainty – and thus also include expectations about others and further social reasons besides mere outcomes and probabilities.

## Acknowledgments

This research was funded by a research grant of the Arete Initiative at the University of Chicago, with additional support from the Max Planck Society.

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