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Anti-social motives explain increased risk aversion for others in decisions from experience

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Abstract

When deciding for others based on explicitly described odds and outcomes, people often have different risk preferences for others than for themselves. In two pre-registered experiments, we examine risk preference for others where people learn about the odds and outcomes by experiencing them through sampling. In both experiments, on average, people were more risk averse for others than for themselves, but only when the risky option had a higher expected value. Furthermore, based on a separate set of choices, we classified people as pro- or anti-social. Only those people classified as anti-social were more risk averse for others, whereas those classified as prosocial chose similarly for themselves and others. When the uncertainty was removed, however, all participants exhibited less anti-social behavior. Together, these results suggest that anti-social motives contribute to the observed limited risk taking for others and that outcome uncertainty facilitates the expression of these motives.

Keywords: decisions from experience, uncertainty, decision making for others, social interaction, anti-social behavior

1 Introduction

Many risky decisions that people make affect other people, which can effectively spread, share, or even offload the risk. Some situations are more obviously social, such as when a financial advisor invests a portfolio for a client, but others are less so, such as when people make career decisions that affect themselves, their families, and their friends. Though most studies of risky choice are devoid of an explicit social context (e.g., Gneezy & Potters, 1997; Holt & Laury, 2002), several studies have examined risk taking for others. Findings in this literature are mixed: Some studies have found that people tend to be more risk averse for others than themselves (e.g., Bolton & Ockenfels, 2010; Reynold, Joseph & Sherwood, 2009), a result often attributed to a sense of responsibility (Charness & Jackson, 2009). In contrast, other studies have found that people tend to be more risk seeking for others than themselves (e.g., Chakravarty, Harrison, Haruvy & Rutström 2011; Pollmann, Potters & Trautmann, 2014; Stone & Allgaier, 2008), a result sometimes attributed to a social norm of risk taking that is heeded more in choices for others than for oneself.

Irrespective of the direction of change in risk taking, the differences in choices for self and others are usually attributed to prosocial attitudes, assuming that people choose what they think would be best for the other person. This supposed ubiquitous prosociality conforms with the hyper-altruism observed when people are faced with causing harm to others (Crockett et al., 2014; Perera et al., 2016), but conflicts with findings that people also have a competitive streak, such as when people are happier when their income exceeds that of those around them (e.g., Clark & Oswald, 1996) or even an anti-social streak, such as when they do not contribute to a public good even though it is in their self-interest to do so (Brandts, Saijo & Schram, 2004; Saijo, 2008). This occasional anti-social behavior in social comparison suggests that differences in risk taking for self and other could also be due to anti-social motives. For example, people might choose the better of two lotteries (in terms of their expected utility) for themselves and the worse for another person. This pattern could then lead to more or less risk taking for others, depending on the exact characteristics of those lotteries. Here, in two pre-registered experiments, we examine how decision making for others differs in an experience-based learning environment and test whether pro- or anti-social motives are connected to any observed differences.

People have strong social preferences about how to equitably distribute outcomes to others (Fehr & Schmidt, 1999), which might also affect their risk taking for others. These social preferences, however, have mostly been tested under certainty. For example, in the dictator game, where participants decide how to distribute money between themselves and a second person, non-zero outcomes for others are typically selected (Engel, 2011; Kahneman, Knetsch & Thaler, 1986). To disentangle the different potential motives in these social

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games, a collection of dictator games with a fixed choice set has been developed into the social-value-orientation (SVO) scale (e.g., Liebrand, 1984; Murphy, Ackerman & Handgraaf, 2011). Based on the choices made, this scale provides both a quantitative estimate of prosociality (the SVO angle, described later) as well as a discrete classification of people into competitive, selfish, prosocial, or altruistic groups based on this quantitative score. According to this measure, around 12% of people express competitive behavior, which can be considered as anti-social, whereas 46% behave in accordance with prosocial motives (Au & Kwong, 2004). These behavioral results have led to models of social preference which assume that people value equity in outcomes (e.g., Bolton & Ockenfels, 2000; Fehr & Schmidt, 1999; but see Charness & Rabin, 2002).

Whereas laboratory studies often find prosocial tendencies and inequity aversion, field studies find that happiness increases with an increase in relative income rank compared to others in one's respective peer group (e.g., Brown, Gardner, Oswald & Qian, 2008; Clark & Oswald, 1996; Tideman, Frijters & Shields, 2008). One potential interpretation of this finding is that people gain utility from having more than someone else, which resembles competitive behavior in the SVO classification. Consequently, there might be an inherent tension between people's pro- and anti-social tendencies, and the expression of these tendencies might at least depend partly on the environment. One apparent difference between the laboratory experiments and real-world surveys is the degree of ambiguity in the link between choice and outcome: Ambiguity is typically absent in the former setting, but present in the latter. Simply introducing risk with pre-defined probabilities of rewards into the dictator game affects social preferences: People do still share chance outcomes with others, but to a lesser extent (Brock, Lange & Ozbay, 2013; Krawczyk & Le Lec, 2010). Moreover, across individuals, there is no correlation between social preferences under certainty and risk (Bolton, Ockenfels & Stauf, 2015; Bradler, 2009). Given this anti-social streak, especially under uncertainty, it is potentially problematic that predominantly prosocial tendencies have been invoked to explain differences in risky decisions for self and others.

Almost all previous studies examining risky choice for others have used decisions from description, where the odds and outcomes are explicitly presented (e.g., Bolton & Ockenfels, 2010; Charness & Jackson, 2009; Raynold, Joseph & Sherwood, 2009). In contrast, in real life, the odds and outcomes are often not known when people make decisions for themselves or for other people. In this study, we developed a decisions-from-experience (DfE) design where people have no prior knowledge of the odds or outcomes, but can only learn them by sampling from the different options. This procedure makes the odds and outcomes more ambiguous compared to decisions with explicitly described risks and thus might affect the expression of social preferences. In decision making without a social context, the same odds and outcomes can lead to different behavior when presented either in a described or experience-based format (Hertwig, Weber, Barron & Erev, 2004). For example, rare events are weighted differently in experience compared to description (Wulff, Mergenthaler-Canseco & Hertwig, 2018; Glöckner, Hilbig, Henninger & Fiedler, 2016; Kellen, Pachur & Hertwig, 2016) and extreme outcomes gain more importance in experience (Ludvig & Spetch, 2011; Ludvig, Madan & Spetch, 2014, Madan, Ludvig & Spetch, 2017). Given these dissimilarities in individual risky choice, how social preferences under certainty and risk will generalize to an experience-based protocol is not clear.

In this paper, we present two experiments that examine how social preferences interact with outcome uncertainty, using a DfE design. The first experiment focuses on the following pre-registered question: How do risk preferences change in choices for others compared to oneself? Post-hoc, we classified people according to their social preferences and examined which motives correspond with risk taking for others. Furthermore, we compared social preferences in the DfE task with those under certainty. Then, in a second pre-registered experiment, using different rewarding outcomes, we replicate the core results and confirm the post-hoc findings from the first experiment.

2 Experiment 1

2.1 Method

2.1.1 Participants

Sixty-two participants were recruited in 4 sessions of 10–20 participants from the University of Warwick paid participant pool via the Sona system — an online system for managing experimental participants (https://www.sona-systems.com/). The Warwick participant pool is run jointly by Psychology, Economics, and the Business School, and consists of both students (mostly) and staff from all disciplines as well as former students and members of the local community. The number of participants was determined prior to the experiment through a power analysis with 80% power to find a medium effect size (d = 0.5) at the 5% significance level with a two-sided, two-sample t test. Four participants were excluded, who could either not be matched to another participant in an individual session or failed at the catch trials, leaving 58 participants ($M_{\text{age}} = 21.4$, $SD_{\text{age}} = 3.1$; 42 female, 16 male). We did not collect other demographic details from the participants. Participants were paid a show-up fee of £4 plus a variable bonus depending on their own choices or the choices of a matched partner (ranging from £0.50 to £8.00, M = £4.82). All procedural details, including hypotheses, recruited participant numbers, exclusion criteria, and planned analyses were preregistered at the Open Science

Framework: https://osf.io/2bts4. Code for experiments and analysis as well as the raw data are available at the same link.

2.1.2 Procedure and Materials

Upon arrival to the laboratory, participants received an information sheet and then provided written informed consent to participate in the experiment. The experiment was performed at a computer and consisted of six blocks of trials. There were 3 *sampling* and 3 *choice* blocks, with each sampling block followed by a choice block. The experiment was programmed with PsychoPy 1.84 (Peirce, 2007). Instructions were provided on the computer screen and could be read at the participant's own pace; questions could also be asked of the experimenter. The instructions described the task and framed it as a group decision-making experiment in which participants could choose between monetary lotteries for themselves and for another randomly selected participant in the room. The instructions stressed that the choices for oneself and the other person were separate from each other.

In the sampling blocks, participants distributed 40 samples among 8 decks of cards in whatever order or quantity they wished. Each deck had a unique symbol that was the same for a given distribution throughout the experiment (see Figure 1). The connections between the symbols and the underlying distributions were randomized for each participant. All distributions were continuous and uniform. There were 2 low-value decks (mean = £2.5), 4 medium-value decks (mean = £4.5), and 2 high-value decks (mean = £6.5). Draws from the decks were randomly distributed around these means. Half the decks for each mean value had a small range (i.e., lower variance, range of ±0.5), and the other half had a medium range (i.e., medium variance, range of ±2); decks with an even larger range of ±3.5 were used only in Study 2. In the choice blocks (see below), all the high-value and low-value decks appeared in the choices for both self and other. The 4 medium decks, however, were split such that 2 decks (one small and one medium range) appeared only in self choices, and the other 2 decks only appeared in choices for the other. This split aimed to examine whether people sample differently once they find out that some decks are relevant only in choices for themselves and some only in choices for other participants (see the Supplement for an analysis of sampling behavior, which did not provide evidence for this conjecture). Participants could learn about the range of possible outcomes only from experience and were told neither the means nor the ranges of the different decks.

Figure 1A shows a schematic of how, during the sampling blocks, the screen displayed all 8 decks as well as a decreasing count of the number of samples remaining. The 8 decks always appeared in the same locations during sampling, providing an additional memory cue for the symbol. Participants sampled from a given deck by left-clicking on it with the mouse. The symbol for the selected deck then

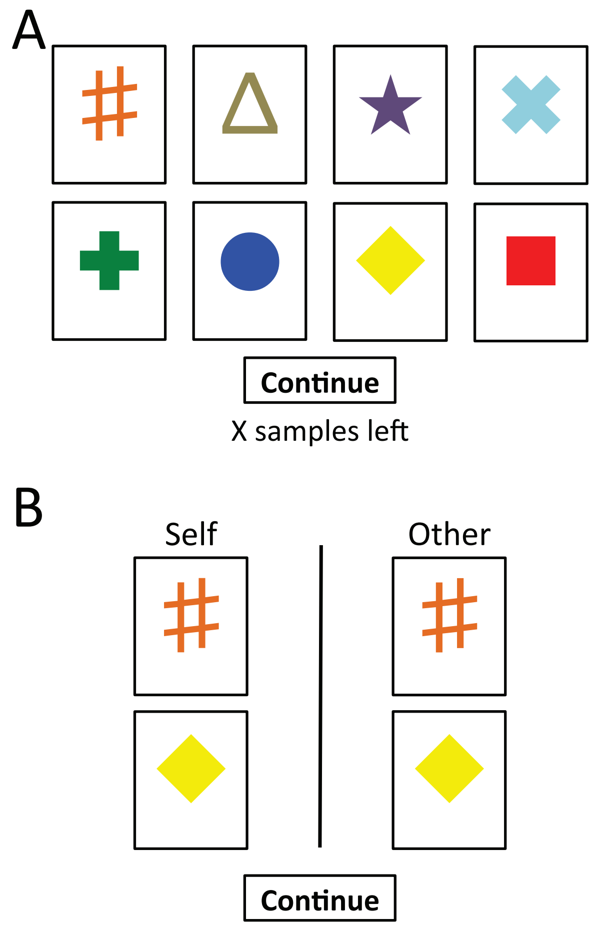

Figure 1: Screenshot from (A) the sampling block and (B) the choice block. Each square represents a deck of cards, and the symbols indicated the underlying distribution for a draw from that deck. The distributions could only be learned by sampling from each of the decks.

disappeared and, at its former position, a random draw from the corresponding distribution (see above) rounded to two digits (e.g., £2.36) appeared for 0.5 s. After that, the symbol for the given deck reappeared. While the outcome was displayed, no sampling was possible. Once participants had no samples left, they clicked on continue, and a choice block followed.

In the *choice* blocks, participants made 21 pairs of binary choices between the decks. On each of the 21 trials, participants made two choices: They chose between two of the decks for themselves and between two (possibly different) decks for a second participant. Figure 1B shows how the screen was divided down the middle by a line, with two decks of cards vertically positioned on each side (for a total of 4 decks). One side, indicated by the word "self", displayed the two decks to choose between for oneself, and the other side, indicated by the word "other", displayed the two decks to choose between for the other participant. The self/other location was counterbalanced across participants, but constant across trials for each participant.

Participants made choices by clicking on their preferred deck with the mouse. After a mouse-click on a deck, the deck's borders switched to green, indicating the deck had been clicked. Once a selection had been made both for self and other, the participant confirmed these choices by clicking on a continue button or by pressing "enter" on the keyboard. Selections could be changed until they were confirmed. No additional feedback was provided during the choice blocks, so participants had to rely on what they had learned during the sampling blocks to guide their choices.

Table 1 shows the 21 choice situations, each consisting of a choice between 2 decks for the decision maker and a choice between 2 decks for the other participant. Choices were presented in an order randomized for each participant and presented once in each block. Each of the situations was selected to test a particular hypothesis about how risk and inequity influence decision making in this social situation. The first 5 choices in the table examined risk attitude for self and other, comparing risk preference for identical choices, with a risk-return trade-off in choices 4 and 5. The next 6 choices examined whether the rewards potentially available to the other participant (higher or lower) influence risky choice (and vice versa). The next 6 choices examined inequity aversion (both advantageous and disadvantageous) by offering different potential reward levels for self and other. The next 2 choices were used as comparison to the inequity-aversion choices without differences in the choice menu between self and other. The final two choices served as catch trials, with an obvious dominant alternative, and, post-hoc, as a means of classifying participants as pro- or anti-social based on how they chose for the other participant.

In anticipation of Experiment 2, we define dominant choice situations as ones where one option has a higher EV and the same or smaller range than the other option and where the choice sets were the same for self and other. Choices 18 and 19 also have this characteristic; however, because they were used as comparisons for the inequity-aversion analysis (see the Supplement), they were not included in the primary classification. We revisit these trials in later robustness checks.

As the task was self-paced, at the end of the experiment, some participants had to wait for the other participants to finish. Once all participants finished, participants were matched in groups of two, and one participant from each pair was randomly determined to be the decision maker for that pair. One trial was randomly selected, and the distributions selected by the decision maker were played out for the decision maker and the other group member separately. The outcomes of these draws determined the variable payoffs for the two group members, respectively. Participants saw their own outcome on the computer screen and learned whether their own decision has been implemented or whether their outcome was determined by the other participant. Nobody, however, knew with whom they had been paired. Payment was given individually at the end of the experiment.

While participants waited for the payment and before they saw their experimental gains, they filled out the paper-and-pencil 6-item version of the SVO-Slider (Murphy, Ackerman & Handgraaf, 2011). This task consists of 6 mini-dictator games. In each game, participants chose how to distribute

Table 1: Choice situations in Experiment 1. % Self-B is the percentage of trials where option B was chosen for oneself. % Oth.-B is the percentage of trials where option B was chosen for the other person.

	Self-A	Self-B	Other-A	Other-B	% Self-B	% Oth.-B
Risk Attitude						
1	4.5L	4.5M	4.5L	4.5M	51	50
2	2.5L	2.5M	2.5L	2.5M	47	52
3	6.5L	6.5M	6.5L	6.5M	52	52
4	2.5L	4.5M	2.5L	4.5M	80	49
5	4.5L	6.5M	4.5L	6.5M	90	49
Social Aspiration level						
6	4.5L	4.5M	6.5L	6.5M	53	52
7	2.5L	2.5M	4.5L	4.5M	41	48
8	2.5L	2.5M	6.5L	6.5M	43	55
9	4.5L	4.5M	2.5L	2.5M	54	45
10	6.5L	6.5M	4.5L	4.5M	51	44
11	6.5L	6.5M	2.5L	2.5M	53	44
Inequity Aversion						
12	4.5L	4.5M	4.5L	6.5L	55	48
13	4.5L	4.5M	4.5M	6.5M	51	50
14	2.5M	4.5L	4.5L	6.5M	80	45
15	4.5L	6.5L	4.5L	4.5M	88	45
16	4.5M	6.5M	4.5L	4.5M	83	47
17	4.5L	6.5M	2.5M	4.5L	87	43
Comparison – No Inequity Aversion						
18	4.5L	6.5L	4.5L	6.5L	91	51
19	4.5M	6.5M	4.5M	6.5M	91	56
Catch Trials & Classification						
20	2.5L	6.5L	2.5L	6.5L	96	49
21	2.5M	6.5M	2.5M	6.5M	94	51

Note. The first number of each option is the expected value, and the letter symbolizes outcome ranges: L = ± 0.5, M = ± 2.0. H for high is reserved for stimuli in Experiment 2.

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money for themselves and someone else from 9 different distributions; these distributions varied across the 6 games. The different available distributions systematically varied the possible choice sets, thus allowing us to distinguish different motives, such as maximizing own outcome or maximizing social outcome. These choices were not incentivized. For each participant, an SVO angle was computed based on the choices made (see Murphy et al., 2011, for a graphical depiction of the logic behind these calculations). This angle is calculated as the inverse tangent of the ratio between the mean allocation for the other person and for oneself (subtracted by 50 monetary units each). Larger angles mean a higher degree of prosocial attitudes. Zero degrees signifies a perfectly selfish individual who maximizes their own allocation and otherwise chooses a random allocation for the other person. The computed angles are divided into a discrete classification system that bunches people into four groups from low to high prosociality: *Competitive* (SVO angle below −12.04°) means people gain utility from having a high difference in outcomes between oneself and someone else. *Selfish* (SVO angle between −12.04° and 22.45°) means that people gain utility only from their own outcomes and do not care about the outcome of others. *Prosocial* (SVO angle between 22.45° and 57.17°) means that people gain utility from their own and from someone else's outcome or by minimizing the distance between their own and someone else's outcome. Finally, *altruistic* (SVO angle above 57.17°) means that people only gain utility from outcomes for others.

All data analyses were conducted in RStudio 0.99 (R studio team, 2015) based on R 3.3.0 (R core team, 2016). Regressions were performed with the packages lme4 (Bates, Maechler, Bolker & Walker, 2015) and lmerTest (Kuznetsova, Brockhoff & Christensen, 2017). Regressions had subject random intercepts and used the logit link function with interaction and main effects as reported in the text. Effect sizes were calculated as Cohen's d from the choice proportion differences, and mean differences are presented with 95% confidence intervals. In general, the data analyses followed the pre-registered plan. Any deviations from this pre-registered analysis plan are clearly marked in the Results section.

2.2 Results

2.2.1 Risky Choices

First, we examined how risky choices differed when participants chose for themselves or another participant from the same choice set. Figure 2A shows the percentage of risky choices aggregated over all trials and all participants for choice situations 1–5 (left), 1–3 (middle), and 4–5 (right). For choices 1–5 (see Table 1), there was one smaller and one larger range option. Participants chose the larger range option 13.3 ± 6.5 percentage points (Mean ± 95% confidence interval) more often for themselves than for someone else. A Wilcoxon test confirmed a significant difference between choices for self and other ($W(n = 58) = 1178.5$, $d = 0.52$, $p < .001$).[1] Follow-up exploratory analyses showed that this effect, however, was entirely due to choices 4–5, which differed from choices 1–3 in that there was a risk-return trade-off between a small-range, low-expected-value (EV) option and a large-range, high-EV option. Here, people chose the safer option 35.3 ± 9.3% more often for others than themselves ($W(n = 58) = 836$, $d = 0.94$, $p < .001$). There was little difference, however, between choices for self and other in choices 1–3 (−1.3 ± 6.9%), where the expected value was the same for both options ($W(n = 58) = 579$, $d = 0.05$, $p > .250$). These results were confirmed by a logistic regression with random subject effects showing that there was a significant interaction between the choice type (1–3 vs. 4–5) and choices for self and other ($b = 1.83$, $SE = 0.22$, $p < .001$).

Further exploratory analyses revealed that there was a strongly bimodal distribution of choice proportions when deciding for others in choices 20 and 21. These situations consist of options with one low-EV and one high-EV option with equal range for both self and other. Thus, one option dominated the other. In choices for oneself, these situations were used as catch trials. In choices for others, these situations were used to classify participants. People used two clearly distinct strategies in choices for others: Figure 2C shows how 25 participants chose the higher-EV option for the other participants 5 or 6 out of 6 times they encountered the choice situation (green in figure), whereas 26 participants chose the higher-EV option 0 or 1 out of 6 times (yellow). In line with the literature about distributional choices, we term these two choice patterns as prosocial, where people either try to maximize the outcome for the other participant or minimize the difference between outcomes (as they chose the higher-EV option for themselves most of the time), and anti-social, where people try to minimize the outcome for the other participant or maximize the difference between outcomes.

Figure 2B shows that participants classified as anti-social chose the risky option 60.9 ± 13.3% more often for themselves than for others in choice situations (Choices 4–5) involving a risk-return trade-off ($W(n = 26) = 323.5$, $d = 1.76$, $p < .001$), as compared to prosocials, who only did so 6.7 ± 7.5% more often ($W(n = 25) = 42.5$, $d = 0.35$, $p = .134$). Anti-social participants consistently chose the lower-EV option for the other participant. This pattern was corroborated by a mixed-effects logistic regression where the interaction between choosing for oneself or other and being classified as either anti-social or prosocial was significant in the risk-return trade-off choices 4–5 ($b = 2.49$, $SE = 0.45$,

[1] The pre-registration indicated that paired t tests would be used, but the choice proportions were not normally distributed, so Wilcoxon tests were used instead. Sticking with the t tests yields the same qualitative conclusions.

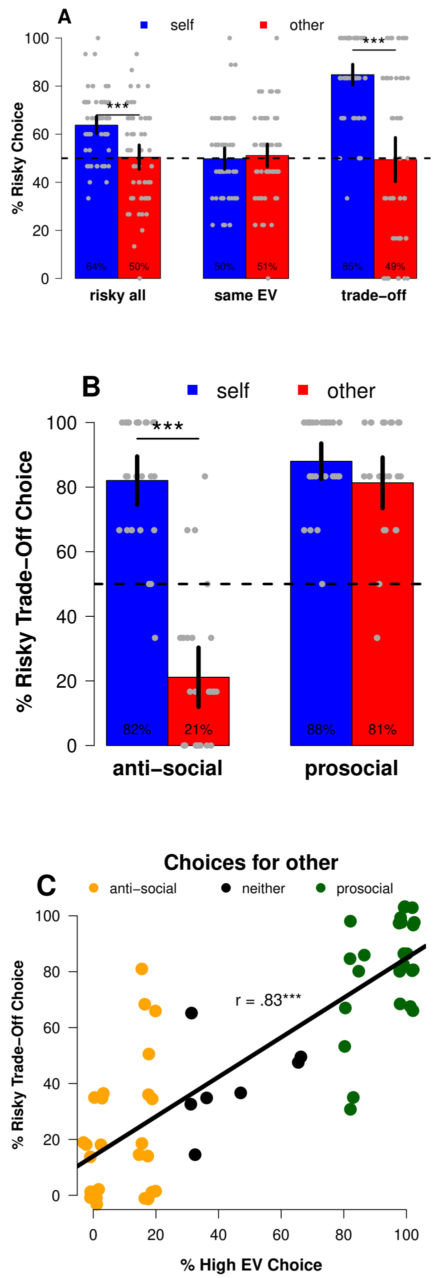

FIGURE 2: (A) Mean percentage (± 95% CI) of risky choices for all risk-attitude choice situations and then separately for those with the same expected value (1–3) and those with a risk-return trade-off (4–5). Grey dots are choice percentages for individual participants using horizontal jitter. (B) Mean percentage (± 95% CI) of risky choices for choice with a risk-return trade-off (4–5), split by participant classification as prosocial or anti-social. (C) Percentage of risky choices for others in the risk-return trade-off choices (4–5) correlated with the percentage of dominant choice for other in classification trials (20–21), where colors illustrate the classification scheme applied and vertical and horizontal jitter was applied to make all points visible. *** = p < .001.

$p < .001$). Moreover, Figure 2C plots risky choice in risk-return trade-off choices 4–5 against the choices in situations 20–21: There was a strong correlation between the number of higher-EV choices for others in the classification trials and the number of risky choices for others in the risk-return trade-off choices ($r(56) = 0.83$, $p < .001$).

2.2.2 Classification Results Compared to the SVO Questionnaire

Using the standard classification borders, the SVO slider questionnaire classified 25 people as prosocial, 33 as selfish, and 0 as competitive or altruistic. For the choice task, SVO prosocials would be expected to choose the higher-EV option for others consistently, because they benefit from minimizing the difference between themselves and another participant or because they want to maximize joint welfare. Those classified as selfish by the SVO should be indifferent with respect to the other participant's outcome. Thus, they should respond at a chance level with respect to choices for others with different expected values. In contrast, in the classification trials 20–21, 26 participants consistently chose the lower-EV option for the other participant — a strongly anti-social pattern, which may arise out of competitive motives. Yet, none of these 26 participants were classified as competitive by the SVO. To see whether the classifications of the experience-based task and the SVO are homogenous, we conducted a Stuart-Maxwell test on the joint frequency table. This test rejects homogeneity of the two classifications ($\chi^2(2) = 17$, $p < .001$). We thus conclude that the classification based on the SVO differs from the classification according to the main experience-based task. In particular, as is apparent in Figure 3A, the SVO did not classify the same number of people as anti-social or competitive compared to the main classification task.

Using the continuous scale of the SVO slider (Figure 3), where higher values indicate more prosocial behavior, there was a slight, but not statistically significant, positive correlation between angle and percentage of high-EV choices for the other participant in the choice task ($r(56) = .23$, $p = .077$). The correlation of the SVO angle with choosing the risky (and high-EV) option for other was numerically somewhat smaller in the risk-return trade-off choices ($r(56) = .15$, $p > .250$).

2.2.3 Robustness

As a robustness check, we assessed a different classification criterion, using choices 18 and 19 (instead of 20 and 21; see Table 1), where there was also a dominant option. With this alternate classification, 19 participants were classified as anti-social (of whom one was not classified as anti-social originally and 8 previously classified as anti-social are absent) and 24 as prosocial (of whom one was not classified as

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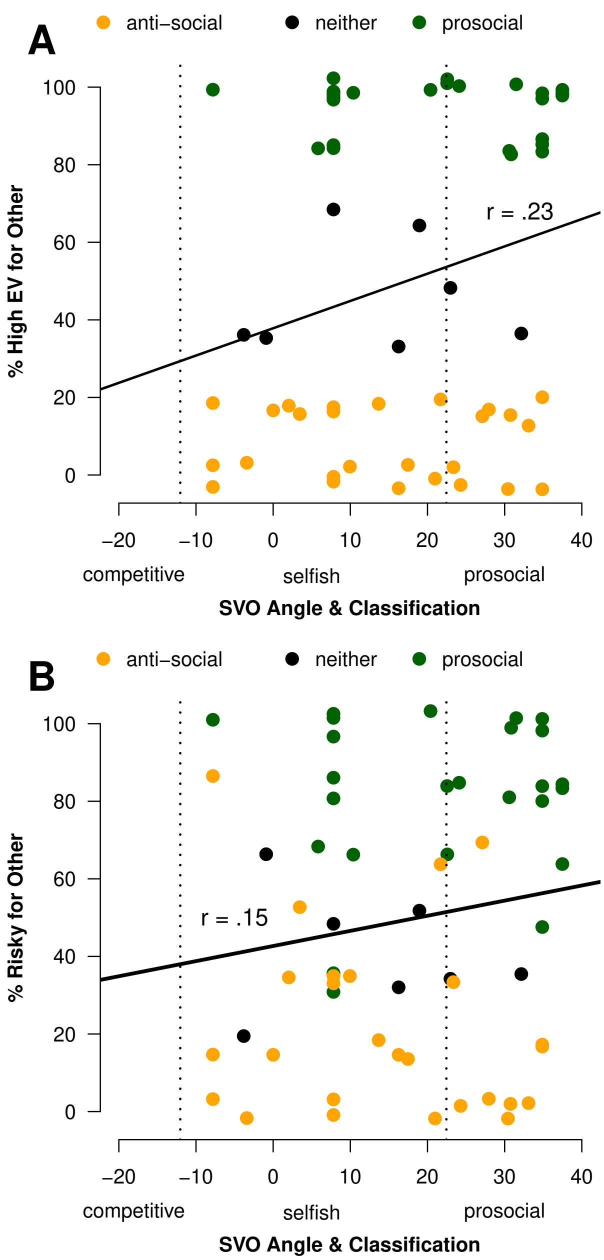

FIGURE 3: (A) Comparison of classification of prosocial behavior in the decision-from-experience task (choices 20 & 21) and the SVO Questionnaire (mini-dictator games). (B) Correlation between risky choice for others in the risk-return trade-off choices (4 & 5) and the SVO Questionnaire. In both figures the colors signify classification based on the decision-from-experience task, and vertical jitter was used to ensure visibility of all datapoints.

prosocial originally and two previously classified as prosocial are absent). As before, the anti-social participants chose the risky option 68.4 ±14.3% more often for themselves than others when there was a risk return trade-off in choices 4–5 ($W(n = 19) = 171$, d=2.15, p <.001), whereas prosocials only did so 4.9 ±7.0% of the time ($W(n = 24) = 32.5$, $d = 0.28$, $p >$ .250). A logistic regression confirmed a significant interaction between choosing for self and other and being classified anti-social or prosocial according to choices 18 and 19 in risk-return trade-off choices: $b = 3.08$, $SE = 0.51$, $p < .001$.

Furthermore, we checked for robustness of our analyses with respect to sampling errors. To do so, we compared the sampled mean and range with the theoretical mean and range of the respective choice options. After the first round of sampling, in none of the 348 relevant comparisons (risk-return trade-off choices 4 & 5 and classification choices 20 & 21) did the lower-EV option have a higher experienced EV, and in only 5 comparisons, was the higher-EV option better by less than £0.5 (compared to a £2 difference in the generative distributions). In only 7 out of 464 relevant comparisons (risky choices 1–5), the smaller-range option had the higher experienced range, and in only 18 comparisons, the difference between experienced ranges was less than ¼ of the theoretical range difference after the first round of sampling. The number of deviations between experienced and planned distributions was even lower after the second and third round of sampling.

To see whether these few trials affected our results, we excluded choices in all rounds where the previously experienced means or ranges were much closer to each other than planned (given the criteria above) after the first round of sampling. This exclusion removed 63 out of 1218, or roughly 5% of the relevant choices (risky choices 1–5 and classification 20 & 21). All the Wilcoxon tests performed above yielded qualitatively similar results after these exclusions.

In the pre-registration, we also asked questions about how the rewards of others influence risk preference (Choices 6–11), inequity aversion (Choices 12–19), and the sampling process. These analyses are included in the Supplement for completeness.

3 Experiment 2

In Experiment 1, people were more risk averse when deciding for others than for themselves in an experience-based task. Exploratory analyses showed that this effect was related to anti-social motives: Some of the participants consistently chose lower-EV options for others in risk-return trade-off situations. In addition, classification of participants based on the experience-based task was a much better predictor of anti-social behavior in risk-return trade-off choices than was classification based on the SVO slider task.

We pre-registered a second study to confirm the exploratory result by increasing the number of gambles used to examine risky choice and classify participants (see Table 2). In addition, we wanted to address two further open questions: First, participants were risk neutral in choices that differed

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TABLE 2: Choice situations in Experiment 2. % Self-B is the percentage of trials where option B was chosen for oneself. % Oth.-B is the percentage of trials where option B was chosen for the other person.

	Self-A	Self-B	Other-A	Other-B	% Self-B	% Oth.-B
Risk Attitude						
1	4L	4M	4L	4M	40	42
2	4M	4H	4M	4H	47	45
3	4L	4H	4L	4H	37	39
4	6L	6M	6L	6M	44	50
5	6M	6H	6M	6H	54	52
6	6L	6H	6L	6H	54	49
7	4L	6M	4L	6M	84	62
8	4M	6H	4M	6H	89	62
9	4L	6H	4L	6H	87	65
Inequity Aversion						
10	4L	6L	4L	4M	79	35
11	4M	6M	4M	4H	78	44
12	4H	6H	4M	4H	81	49
13	4L	4M	4L	6L	38	64
14	4M	4H	4M	6M	44	52
15	4M	4H	4H	6H	51	56
Comparison – No Inequity Aversion						
16	4L	6L	4L	6L	82	65
17	4M	6M	4M	6M	88	68
18	4H	6H	4H	6H	85	67
Catch Trials & Classification						
19	4H	6L	4H	6L	85	66
20	4M	6L	4M	6L	86	66
21	4H	6M	4H	6M	88	69

Note. The first number of each option is the mean value, and the letter symbolizes the range: L = ±0.5, M = ±2, H = ±3.5.

only in range. This pattern could reflect a genuine preference, but could also reflect a lack of learning about range differences between the decks. Therefore, we increased the range differences, reduced the number of decks, and explicitly asked participants about the ranges of outcomes. Second, we aimed to confirm the result that high levels of anti-social behavior were specific to choices under uncertainty. Therefore, we used a computerized version of the SVO and an extra one-shot choice under certainty, both fully incentivized, so as to be more comparable to the main task.

3.1 Method

3.1.1 Participants

Sixty-nine participants were recruited in 7 sessions of 4–12 participants from the same participant pool as Experiment 1. The number of participants was estimated prior to the experiment with a power analysis, as in the first experiment. Two participants were excluded who either could not be matched to a partner or failed the exclusion criterion (i.e., sampled one option fewer then 5 times), which left 67 participants (M_{age} = 23.6, SD_{age} = 3.1; 40 female, 27 male). Participants were paid a show-up fee of £4 plus a variable bonus depending on their own choices or the choices of a matched partner (ranging from £1.50 to £8.59, M = £4.71). Again, all methods and analyses were pre-registered and can be found together with all other material at https://osf.io/2bts4.

3.1.2 Procedure

The procedure was largely the same as in Experiment 1, with some changes in the reward distributions and the choice situations (see Table 2). In particular, the number of distributions (decks) was reduced from 8 to 6, a third range level was introduced, and only 2 mean values were used. The uniform distributions had a mean value of either 4 or 6 and a range of either ±0.5 (low), ±2 (medium), or ±3.5 (high). Table 2 shows the revised choice situations, which were selected to best follow up the results from the first study. There were 9 choice situations assessing risk attitude, of which 3 contained a risk-return trade-off. Furthermore, as in the first experiment, 9 choice situations assessed inequity aversion and 3 additional situations were used for classifying participants and as a manipulation check. The number of samples in each sampling block was changed slightly to boost learning about the 6 decks during the first block. Specifically, people sampled 80 times in the first block and only 30 times in each of the second and third sampling blocks. Again, participants could distribute these samples in any order they wanted among the 6 available decks.

After the final choice block, there was an additional choice between two certain options (a certain £4 vs. a certain £6) both for oneself and for another participant. After that question, the computerized version of the SVO slider (6 items) was presented. Finally, 4 additional questions assessing participants' knowledge about the ranges of the decks were presented. For each EV level, two questions were asked: First, all three decks with the same EV were presented, and participants were asked which deck was the riskiest. Second, all three decks were again presented, and participants were asked which deck was the safest. The same two questions were then repeated with the other three decks with the other EV. The payment mechanism was the same as in the first experiment, with the difference that a payoff-relevant trial could also be chosen from the SVO choices or from the choice under certainty. Thus, all choices were incentivized, but the questions about the decks' ranges were not.

3.2 Results

3.2.1 Risky Choices

With more risky-choice situations (1–9 in Table 2), the pattern from Experiment 1 was confirmed. Figure 4A shows how, overall, people chose the risky option 8.0 ± 4.0% more often for themselves than for others ($W(n{=}67) = 709$, $d = 0.48$, $p < .001$). This difference was again driven by choices with a risk-return trade-off (7–9), where people chose the risky option 23.7 ± 7.9% more often for themselves ($W(n{=}67) = 780.5$, $d = 0.72$, $p < .001$), as opposed to those with equal expected value (1–6), where people only chose the risky option 0.2 ± 4.2% more often for themselves ($W(n{=}67) = 2202$, $d = 0.01$, $p > .250$). This interaction in the percentage of risky choices for oneself and others in trade-off choices (7–9) as compared to choices with the same EV (1–6) was confirmed through a mixed-effects logistic regression ($b = 1.37$, $SE = 0.17$, $p < .001$).

As pre-registered, situations where one option dominated the other in terms of EV and range (19–21 in Table 2) were used as a measure of other-regarding preferences to classify the participants. Participants were classified as anti-social if they chose the dominating option for the other participant up to 2 out of 9 trials (13 participants) and as prosocial if they chose it at least 7 times (35 participants). These criteria left 19 participants unclassified (see Figure 4C). Figure 4B shows that those classified as anti-social chose the safe option 70.1 ± 12.9% more often for others than for themselves in the risk-return trade-off choice situations ($W(n{=}13) = 169$, $d = 2.95$, $p < .001$), whereas those classified as prosocial did so only 5.1 ± 5.7% more often ($W(n{=}35) = 685$, $d = 0.30$, $p = .108$), yielding a significant interaction in a mixed-effects logistic regression ($b = 3.35$, $SE = 0.48$, $p < .001$). Thus, the main results of the first study were confirmed in this replication with different choice situations. In addition, in choices with the same EV where only the range differed, people trended toward expressing slight risk aversion; that is, they chose the larger range option slightly less than 50% of the time for themselves and others (Self: $W(n{=}67) = 670.5$, $d = 0.23$, $p = .048$; Other: $W(n{=}67) = 745.5$, $d = 0.25$, $p = .071$)

3.2.2 Classification Results

Because the SVO questionnaire in the first study did not capture the observed anti-social behavior in risk-return trade-off trials, we implemented a computerized and incentivized version of the SVO in Experiment 2. Nonetheless, classification results in the SVO were comparable to Experiment 1: 22 prosocial, 44 selfish, and 1 competitive. The classifications

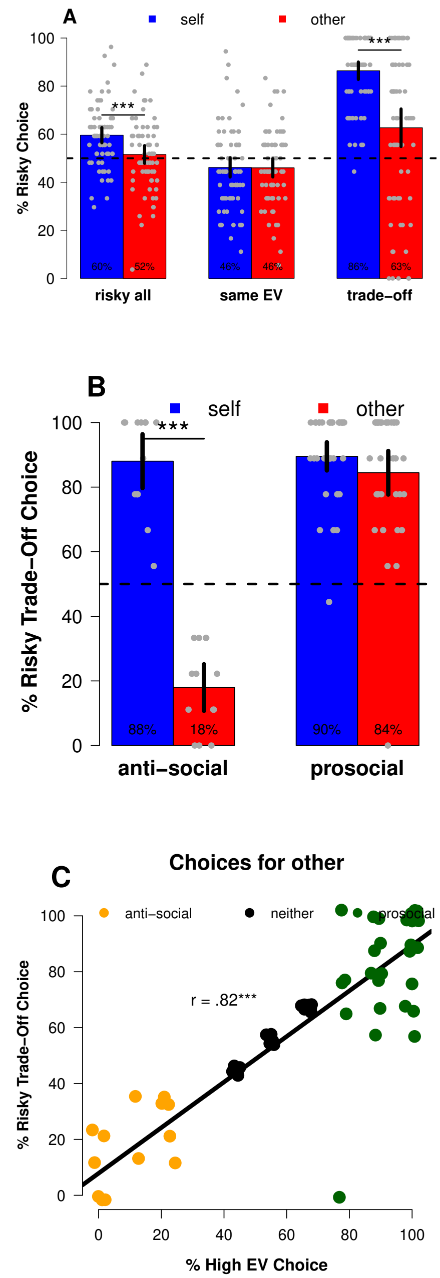

FIGURE 4: (A) Mean percentage (± 95% CI) of risky choices for self and other in all choice situations with different ranges (choice situations 1–9, left) and separately for those with the same expected value (1–6, middle) and those with a risk-return trade-off (7–9, right). Grey points represent individual participants with horizontal jitter. (B) Mean percentage (± 95% CI) of risky choices for self and other with a risk-return trade-off (7–9), split by participant classification. (C) Percentage of risky choices for others in the risk-return trade-off choices (7–9) correlated with the percentage of dominant choice for other in classification trials (19–21), where colors illustrate the classification scheme applied and both vertical and horizontal jitter were used. *** = p < .001.

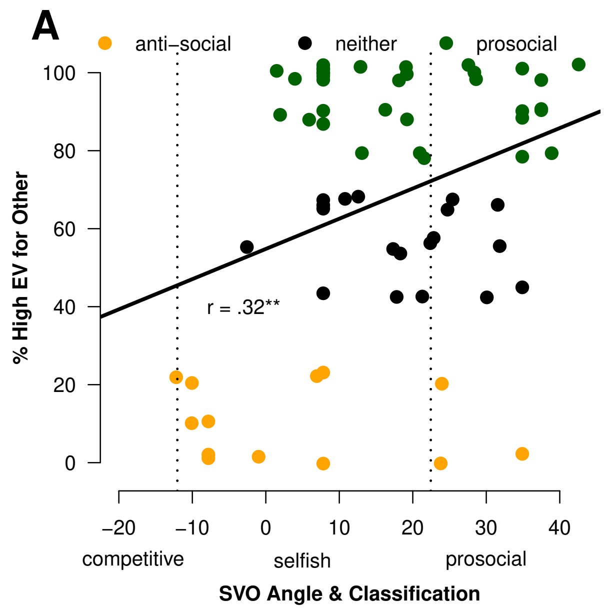

FIGURE 5: (A) Comparison of the two methods for classification of prosocial individuals in Exp 2 — choices with a dominant option for others in the main DfE task (i.e., choices 19–21) and the SVO Questionnaire (dictator games). (B) Correlation between choosing riskily for others in the risk-return trade-off choices (Choices 7–9 in the DfE task) and classification from the SVO Questionnaire. In both figures the colors signify classification based on the decision-from-experience task and vertical jitter was used. ** p < .01.

from the SVO and the experience-based task differed significantly from one another, as confirmed by a Stuart-Maxwell test ($\chi^2(2) = 19.94$, $p < .001$). Using the continuous scale of the SVO slider (Figure 5), however, where higher values signify more prosocial behavior, there was a significant positive correlation between the SVO angle and percentage of high-EV choices for the other participant (r (65) = .32, p = .008). Furthermore, there was a significant correlation between the SVO angle and the choice of risky (and high-EV) options for others in the risk-return trade-off choices (r(65) = .32, p = .007). This pattern indicates that the SVO does not predict the amount of anti-social behavior present in the decisions-from-experience task, but does capture part of the individual differences in this task.

In the two-choice distribution task under certainty, where people decided between taking either a certain £4 or £6 for themselves and then again for the other person, 17 of 67 participants chose the lower outcome for the other person. Thus, anti-social behavior was more pronounced here than in the SVO, where there were trade-offs between one's own and another person's outcome.

3.2.3 Robustness

Above, as pre-registered, we classified individuals on the basis of a subset of trials where there were dominant (higher mean; equal or smaller range) options for others (Choices 19–21 in Table 2). As in Experiment 1, by this definition, there were additional choices with a dominant option, which served as a comparison for any potential inequity aversion (see supplemental material). As a robustness check, we re-did our analyses with these trials to classify participants. With these trials, 10 participants were classified as anti-social (of whom 2 were not classified as anti-social according to the original classification trials and 5 previously classified as anti-social are absent) and 36 as prosocial (of whom 5 were not classified as prosocial according to the original classification trials and 4 previously classified as prosocial are absent). On the risk-return trade-off choices (7–9), the anti-social individuals chose the risky (higher EV) option 72.2 ±17.9% more often for themselves than others ($W(n = 10) = 100$, $d = 2.51$, $p < .001$), whereas prosocials did so only 4.6 ±4.1% more often ($W(n = 36) = 743$, $d = 0.37$, $p > .250$. A logistic regression confirmed this significant interaction between risk preference for self and other and being classified as antisocial or prosocial according to Choices 16–18: b = 3.53, SE = 0.53, $p < .001$.

As in Experiment 1, we also checked for robustness of the analyses with respect to sampling errors. To do so, we examined how the experienced outcomes matched the generative distributions. After the first round of sampling, the lower EV option had the higher experienced EV in only 3 of 402 relevant comparisons (risk-return trade-off choices 7–9 and classification choices 19–21). In addition, this difference was smaller than £0.50 in only 5 additional comparisons (compared to the planned £2). In terms of the range, in the 804 relevant comparisons (risky choices 1–9 and classifica-

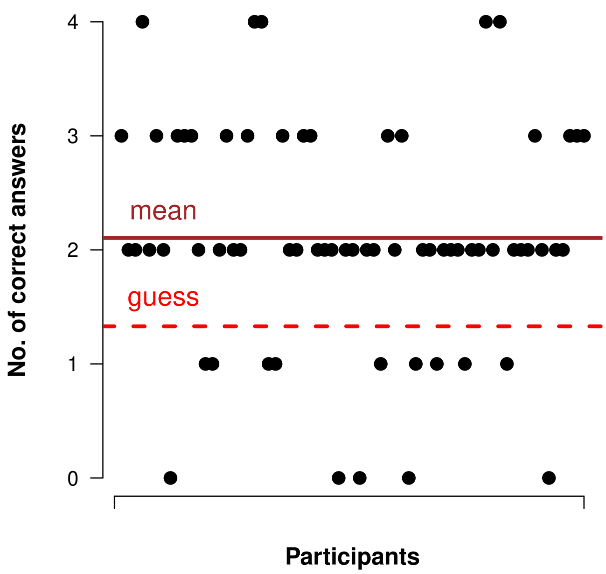

Figure 6: Scatterplot of people based on the number of correct answers given for the range questions (4 total questions with three answer options for each).

tion choices 19–21), the smaller-range option had the higher experienced range 10 times and the difference in ranges was smaller than ¼ of the planned difference 28 additional times after the first round of sampling. The numbers of such sampling errors were even lower after the second and third round of sampling. Excluding all these trials led to the exclusion of 90 out of 2412 choices, or 4% of the relevant choices, and the qualitative results for all statistical tests remained identical.

To check whether participants learned about the different levels of outcome ranges associated with the decks, we asked people to name the safest or riskiest out of each set of three decks with the same EV. There were 4 questions with 3 potential answers, thus the guessing rate was 1.33 correct answers. Figure 6 plots the frequencies of correct answers for all participants: 53 participants were above the guessing rate, and the average score was significantly better than this guessing rate ($M = 2.1 \pm 0.2$). There was no reliable correlation between the number of correct range answers and the likelihood of choosing the high-EV option for others in the classification trials, $r(65) = -0.11$, $p > .250$. In addition, anti-social and prosocial participants did not reliably differ in the number of correct answers to the range questions ($M_{\text{Antisocial}} = 2.31$ and $M_{\text{Prosocial}} = 2.03$, $t(18.99) = 0.80$, $p > .25$, corrected for heterogeneity of variance).

To see whether the key effects were driven by participants who could not distinguish between the different levels of range, we excluded participants who were below the guessing rate of 1.33 (14 participants with 0 or 1 correct answers excluded). There was still a significant difference between self and other for all risky choices 1–9 of 7.6 ± 4.3% ($W(n = 53) = 454$, $d = 0.49$ $p < .001$). Furthermore, there was also a significant difference in the risk-return trade-off choices 7–9: 24.5 ±8.8% ($W(n = 53) = 514$, $d = 0.75$, $p < .001$).

The pre-registered analyses concerning inequity aversion (choices 10–18) and the analyses of the sampling process are again included in the Supplement for completeness.

4 General Discussion

Across two experiments, people were more risk averse for others, largely due to a subset of participants who showed reward-maximizing behavior for themselves, but not for others. This anti-social behavior emerged only when there was uncertainty around the actual outcomes, but not in the social-value-orientation (SVO) questionnaire where decisions were made between certain outcomes. This study represents one of the first examinations of risky choice for others in a task that uses decisions from experience (Hertwig et al., 2004), building on prior work that used explicit descriptions of the risky outcomes (Bolton & Ockenfels, 2010; Chakravarty et al. 2011; Pollmann et al., 2014; Raynold et al., 2009). The results suggest that prior interpretations of differences in risky choices for self and other as an expression of prosocial motives (e.g., Charness & Jackson, 2009) may need to be reconsidered.

The anti-social behavior amongst a significant subset of the participants seems to be enabled by the outcome uncertainty in the experience-based task, which is not present with the SVO slider, where outcomes are certain. With uncertain outcomes, EV-minimizing choices for others might feel less severe because the consequences have not yet materialized. Similarly, people are known to give less in dictator games if the relation between one's own choice and the outcome for the other person is uncertain or not transparent (Dana, Weber and Kuang, 2007; Haisley & Weber, 2010). This lack of transparency creates some mental wiggle room, which allows for maintenance of a positive self-image despite seemingly anti-social actions (e.g., Mazar, On & Ariely, 2008; Rabin, 1995). Thus, in the DfE task, people could potentially justify their selecting the not-yet-materialized bad outcomes for the other person by engaging in wishful thinking and assuming that, despite the non-maximizing choice, a relatively high outcome might still occur.

The experience-based task used here introduces empirical uncertainty about the possible outcomes into a social-choice task. Similarly, greater uncertainty about another person's motives is associated with less cooperative behavior; for example, introducing uncertainty about another person's previous choices into a repeated prisoner's dilemma leads to less cooperation (Fudenberg, Rand & Dreber, 2012; Güth, Mugera, Musau & Ploner, 2014). This study builds on these findings, demonstrating that uncertainty not only increases selfish behavior, but can even lead to anti-social behavior.

The design of our studies allows elimination of several alternative explanations for the results. First, participants classified as anti-social were not indifferent with respect to the other person's outcomes — choices for others systematically differed from random choice both for choice situations with a risk-return trade-off and for the classification choices (Figures 2 and 4). In addition, participants learned the values of the different sets, as they consistently selected for themselves the same high-EV decks that they denied to others. Moreover, excluding those who performed poorly in a task where participants had to distinguish decks by their variability in Experiment 2 did not change the results. Our conclusions, however, must be tempered by the observation that participants also exhibited increased levels of anti-social behavior in a single question under certainty, when asked directly to give a large or small amount to oneself and another participant. This task differed from the SVO tasks in that participants chose one outcome for themselves and one for the other person, whereas they chose distributions for both players at once in the SVO. The answers to this single choice suggest that, in addition to shifting to experience-based questions, other changes to the answer format might also trigger more anti-social behavior.

The observed increase in risk aversion for others in these experience-based decisions resembles behavior in some studies when decisions are based on summary descriptions (e.g., Raynold et al., 2009), though other description-based studies have instead found more risk seeking for others (e.g., Chakravarty et al., 2011). Anti-social motives, as found here, might help provide an explanation as to why people sometimes choose more riskily and sometimes less so for others with described choices: When choosing between two options with different variances, if the higher variance option is more attractive to the decision maker, people may act more risk averse for others because they, anti-socially, choose this attractive high-variance option less often for others (as was the case with the risk-return trade-off trials in our experiments). If, however, the low-variance option is more attractive to the decision maker, people may, anti-socially, select the low-variance less often for others, producing more risk-seeking (as was the case in the classification trials in Exp. 2). Whether this line of reasoning about anti-social motives applies to description-based choices is an open question. At first glance, the explicit descriptions of probabilistic outcomes would seem to provide less mental wiggle room to justify a bad choice for another person (Haisely & Weber, 2010). Nonetheless, wishful thinking about the unrealized outcomes is still possible, even when the odds and outcomes are fully described.

Our results have implications for other, related situations where people make decisions for others. For example, one design variation in the literature examines choices for a team including the decider, so that choices for self and other are not separate (e.g., Bolton & Ockenfels, 2010; Rohde & Rohde, 2011). It would be interesting to see in future studies whether a similar share of anti-social people would also be present when those who choose a bad option for the team would also suffer themselves. There is also some related research on how people predict the risk attitudes of others. People can be very inaccurate when predicting other people's risk preferences (Faro & Rottenstreich, 2006; Hsee & Weber, 1997); this inaccuracy could be a further reason why they choose differently for others. It would be interesting to examine whether predictions about other people's preferences are more or less accurate after the decision maker experiences the outcomes rather than reading descriptions of them. Finally, choices for others can occur not only in the monetary realm, but also in the social domain, as in, for example, romantic relationships (e.g., Beisswanger, Stone, Hupp, Allgaier, 2003). In these instances, experience-based learning might have an even more pronounced effect on choices than in the monetary domain because non-monetary outcomes might be more memorable once experienced.

Social preferences differ significantly under risk or uncertainty relative to certainty (Bolton, et al., 2015; Bradler, 2009). Given the uncertainty in our daily interactions and in the economy more generally, measuring social preferences only under certainty (e.g., in a dictator game) may underestimate the role that anti-social behavior plays in daily life. Our experiments suggest that categorizations based on the SVO Questionnaire may underestimate the role of competitive behavior under uncertainty, though the continuous SVO measure does capture some of the individual differences (Exp. 2). Prosocial preferences thus do seem to generalize across certainty and uncertainty, but there are also considerable individual differences in how people deal with uncertainty that are not captured by social preferences under certainty (Roch & Samuelson, 1997). People may, for example, differ in the degree they create and use the mental wiggle room that provides for plausible deniability in highly uncertain situations.

The high level of anti-social behavior in the current DfE task is more congruent with the competitive motives observed in real-world studies of the links between happiness and income rank (Clark & Oswald, 1996) than with behavior typically observed in laboratory studies of prosociality (Engel, 2011). Our results suggest that, in the real world, a key difference that enables the expression of such anti-social behavior is the level of uncertainty. In line with this idea, people use the risk in the outcome of a donation to a charity as an excuse not to give (Exley, 2015). Similarly, returning to the example from the introduction, making decisions that affect one's own career path or the career paths of peers is only indirectly connected to income levels, which are known only with uncertainty. Reducing the uncertainty of potential future outcomes would thus seem to be one way to increase prosociality.

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