Preferences for efficiency, rather than preferences for morality, drive cooperation in the one-shot Stag-Hunt Game

Valerio Capraro[1] • Ismael Rodriguez-Lara[2, 3] • Maria J. Ruiz-Martos[2]

[1] Department of Economics, Middlesex University London

[2] Economic Science Institute (ESI), Chapman University

[2] Department of Economics, Universidad de Granada

Journal of Behavioral and Experimental Economics, forthcoming

Abstract

Recent work highlights that cooperation in the one-shot Prisoner's dilemma (PD) is primarily driven by moral preferences for doing the right thing, rather than social preferences for equity or efficiency. To our knowledge, nothing is known on whether moral preferences affect cooperation in the Stag-Hunt Game (SHG). Cooperation in the SHG fundamentally differs from cooperation in the PD in that it is not *costly*, but *risky*: players have no temptation to deviate from the cooperative outcome, but cooperation only pays off if the other player cooperates. Here we provide data from two experiments (total N = 523) to investigate SHG cooperation. Contrary to what has been observed for the PD, we find that SHG cooperation is primarily driven by preferences for efficiency, rather than moral preferences for doing the right thing.

Keywords: morality, cooperation, efficiency, risky choices, stag-hunt game.

1. Introduction

There is wide consensus among scholars that people's capacity to cooperate is what has made human societies extremely successful, compared to other animal societies (Trivers, 1971; Ostrom, 2000; Skyrms, 2004; Rand & Nowak, 2013). Psychologists even argue that the psychological basis of cooperation, *shared intentionality*, is what makes humans uniquely humans, as it is possessed by children, but not by great apes (Tomasello et al., 2005). Not surprisingly, a great deal of research has sought to understand what makes people cooperate.

Behavioral economists usually address this question by gathering experimental data on cooperative behavior. Cooperation between two players is typically modeled using either the Prisoner's dilemma (PD) or the Stag-Hunt game (SHG). In the PD, players can either defect (A) or cooperate (B). In the SHG, the choice of players is between a safe action (A), and a cooperative/risky action (B). The payoff consequences of each action in each of the games are shown in Table 1.

Table 1. Payoff table in the PD (left-hand side) and SHG (right-hand side).

	A	B
A	P, P	T, S
B	S, T	R, R

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A	P, P	P, S
B	S, P	R, R

The payoffs are assumed to satisfy the inequalities T > R > P > S. Thus, mutual defection (A, A) is the unique Nash equilibrium of the one-shot, anonymous, PD. Yet, this gives a smaller payoff than mutual cooperation (B, B), which requires that players override the *temptation* to free-ride by giving up their maximal individual payoff (T > R). Hence, PD cooperation is *efficient* but *costly*.

The SHG fundamentally differs from the PD in that people have no temptation to defect, when the other cooperates. Yet, cooperation is *risky*, in that it is beneficial only if both players cooperate. Thus, players in the SHG receive a small but certain payoff if they choose the safe option A. Cooperation (i.e., playing B) is "risky" because it offers a greater payoff (R > P), but only if the other cooperates. The consequence of this payoff structure (R > P > S) is that the SHG has two pure Nash equilibria: a risk-dominant equilibrium (A, A) where agents play safe, and a cooperative (payoff-dominant) equilibrium (B, B), which is efficient (Harsanyi & Selten, 1988; Schmidt et al. 2003).

Previous work on what motivates people to cooperate in these games has mainly focused on the effect of payoff parameters. In the PD, several papers have found that one-shot cooperation depends on the

cost associated to (unilateral) cooperation (R > S) and the *temptation* to free-ride (T > R) (Rapoport et al. 1965; Capraro et al. 2014; Engel & Zhurakhovska, 2016. See Mengel, 2017, for a review). There is also evidence that the payoff parameters influence the selection of the risk or the payoff-dominant equilibria in the SHG (Battalio et al. 2001; Schmidt et al. 2003; Rydval & Ortmann 2005; Devetag & Ortmann 2007).[1] These findings have yielded researchers to consider that one-shot cooperation might be driven by distributional, social preferences for equity and/or efficiency (Fehr & Schmidt, 1999; Bolton & Ockenfels, 2000; Charness & Rabin, 2002; Engelmann & Strobel, 2004).[2] However, this conclusion has been recently challenged by Capraro & Rand (2018), who found that cooperation in the one-shot, anonymous PD is not primarily driven by distributional motives, but rather by moral preferences for doing the right thing.

By contrast, nothing is known on whether moral preferences motivate people to cooperate in the SHG. This is an important gap in the literature as the SHG has served to model cooperative behavior in several settings, including depletion of natural resources (Hardin, 1968) or mobilizations (Kiss et al. 2017). The SHG is also prototype of the social contract (Rousseau, 1754/1999; Skyrms 2004). Is SHG cooperation, like PD cooperation, driven by non-distributional, moral preferences for doing the right thing? Or, alternatively, is it primarily driven by distributional, social preferences for equity or efficiency? Does the cooperative/efficient action indeed have a moral component in the SHG, as it does in the PD? These questions are non-trivial from a theoretical perspective. On the one hand, one might argue that SHG cooperation, compared to the PD cooperation, should have a smaller moral component, because it does not involve any cost for the decision maker. On the other hand, one might argue that, from a utilitarian perspective, SHG cooperation should still be considered as the morally right thing to do, because it maximizes the social welfare (Mill, 1863).

Our paper is an attempt to study the role of moral preferences in the SHG by means of two different studies. In the first one, we follow Capraro & Rand's (2018) methodology to investigate whether preferences for efficiency or moral preferences drive cooperation in the SHG. More precisely, we ask subjects to play the SHG and then we elicit their moral preferences using the Trade-Off Game (TOG) (Capraro & Rand, 2018; Tappin & Capraro, 2018). This game is a variant of the dictator game in which participants have to choose between an equitable and an efficient allocation that are morally framed. Our aim is to test whether moral choices in the TOG can predict behavior in the SHG, as it occurs in the PD (Capraro & Rand 2018). Our results show that they do not: SHG cooperation turns out to be correlated to the TOG efficient option,

[1] Other factors that can affect cooperation in these games include the matching protocol, the number of repetitions or the risk attitudes of the participants (e.g., Ellison, 1994; Rydval & Ortmann, 2005; Büyükboyacı 2014; Embrey et al., 2017; Dal Bó & Fréchette, 2018).

[2] Note that mutual cooperation is more equitable and efficient (under the additional assumption that 2R>T+S) than unilateral defection, thus people might prefer cooperation over unilateral defection if they have social preferences.

rather than the TOG moral option. At this point, one might argue that this happens because SHG cooperation does not have a moral component. To address this question, in our second study, we elicit moral judgments in the SHG in the same way as it was done in Capraro & Rand (2018), Study 4, that is, by asking participants what they think is the morally right thing to do. We do find that the majority of participants (61%) tend to think that cooperation is the morally right thing to do in the SHG. However, our results are in stark contrast with Capraro & Rand (2018), who found that 80% of the participants report that cooperating in the PD is the morally right thing to do. We believe that this difference in moral judgments can explain why preferences for efficiency, rather than moral preferences, are the primary motivation for cooperation in the SHG.

The rest of the paper proceeds as follows. In Section 2, we present the methodology for our first (pre-registered) study where we look at the predictive power of moral preferences and efficiency in the SHG. The results of this study are presented in Section 3. The design and results of our second study, where we elicit moral judgments in the SHG are shown in Section 4. Section 5 concludes.

2. Study I

2.1. Experimental design and procedures

We conduct our experiment on Amazon's Mechanical Turk (AMT) (Paolacci et al. 2010; Arechar et al. 2018). Only participants located in the US with HIT Approval Rate greater than 90% in AMT were allowed to take part in the study. The hypotheses, design, sampling and analysis plan were preregistered at http://aspredicted.org/blind.php?x=cv5ja2.[3]

First, participants were randomly matched in pairs to play the SHG. As there is evidence that the payoffs parameters affect choices in the SHG, we adapt Game 2 in Rydval & Ortmann (2005) after dividing the payoffs by 2. This is to produce roughly 50% of efficient choices in the one-shot SHG. Table 2 presents the payoff table we used in our experiment.[4]

Table 2. Payoff table in the SHG

	A	B
A	25, 25	25, 5
B	5, 25	40, 40

[3] See the Appendix for further details, including verbatim instructions.
[4] A payoff of 25 in our game corresponds to $0.25.

After making their choices in the SHG, participants were matched in trios to play the Trade-Off Game (TOG) (Capraro & Rand, 2018; Tappin & Capraro, 2018). In this game, participants had to choose (as dictators) between an "equitable" allocation (13,13,13) that paid the same amount to all members of the trio, and an "efficient" allocation (13, 23,13) that paid more to one of the members, different from the dictator. The TOG choices were framed differently depending on the treatment condition (between-subjects, random assignment):

- ***TOG efficient frame.*** The efficient allocation was labeled as "be generous"; the equitable allocation, as "be ungenerous". [5]
- ***TOG equitable frame.*** The equitable allocation was labeled as "be fair"; the efficient allocation, as "be unfair".

By this design choice, the efficient (equitable) allocation was framed as morally appropriate in the TOG efficient (equitable) frame, respectively. Thus, we *purposely* created an experimenter demand effect by providing "cues about what constitutes appropriate behavior" (Zizzo, 2010). This is usually considered to be troublesome in experiments. When researchers try to understand how participants react to different treatments, introducing cues about which choice is appropriate generates an alternative cause of variation. This is problematic when the option suggested by the experimenter coincides with the one that the experimenter hypothesizes it is driven by the experimental manipulation because the experiment cannot tell if the result is due to the manipulation or the demand effect. This criticism does not apply to our setting. We aim to study precisely the effect of giving information about the appropriateness of the actions. The demand effect *is* therefore our manipulation, and not a confound. In line with this view, Capraro & Rand (2018), Study 4, show that these frames successfully change the perception of what people think is the morally right thing to do.

Our experiment concludes with standard demographic questions, where we collected data on the participants' age, gender and level of education. Participants received a bonus for their choices in the SHG and the TOG in addition to their participation fee ($0.50).

2.2. Hypotheses

As mentioned above, Capraro & Rand (2018), Study 4, show that participants in the TOG efficient (equitable) frame consider to "be generous" ("be fair") as the morally right thing to do. They also find (Study

[5] The instructions read "If you choose to be generous, then you earn 13 cents, Person B earns 23 cents, and Person C earns 13 cents as a bonus. If you choose to be ungenerous, then you earn 13 cents, Person B earns 13 cents, and Person C earns 13 cents as a bonus."

2) that PD cooperation is correlated with the TOG positively framed option (whichever that is), thus they conclude that moral preferences drive PD cooperation. We define SHG cooperation as the choice that results in the efficient outcome (i.e., option B in the SHG). We use the methodology in Capraro & Rand (2018) to contrast the following pre-registered hypotheses:

Efficiency preferences hypothesis. SHG cooperation is primarily driven by social preferences for efficiency: there is a positive correlation between the TOG efficient choice and SHG cooperation.

Moral preferences hypothesis. SHG cooperation is primarily driven by moral preferences for doing the right thing: there is a positive correlation between the TOG positively framed choice and SHG cooperation.

3. Results

Following our preregistered protocol, we exclude from the analysis those participants who answered one or more of the comprehension questions incorrectly, or did not answer these questions. We also eliminate duplicate responses according to participants' IP address/unique Mechanical Turk ID. In doing so, we have a total of N=436 participants. Their behavior is summarized in Table 3. In line with Capraro & Rand (2018) and Tappin & Capraro (2018), we find a strong framing effect: participants are more likely to choose the TOG efficient allocation in the efficient frame, using a test of proportions (82.73% vs 37.50%, $p < 0.001$). [6]

Table 3. Likelihood of choosing the efficient choice in the SHG and the TOG

	N	SHG cooperation	TOG efficient	SHG cooperation | TOG efficient allocation	SHG cooperation | TOG equitable allocation
TOG efficient frame	220	61.36 %	82.73%	60.99 %	63.16 %
TOG equitable frame	216	64.35 %	37.50%	72.84 %	59.26 %

As pre-registered, we contrast our hypotheses using logistic regressions to predict cooperation in the SHG.[7] Our dependent variable is then a dummy variable that takes the value 1 if the participant chooses the cooperative action (B) and 0 if she chooses the safe choice (A). The independent variables include dummy variables for the TOG efficient choice, the TOG efficient frame, and their interaction. Table 4 presents the results (see Appendix C for the marginal effects).

[6] See Appendix C for details on the statistical (non-parametric) analysis.
[7] All the *p*-values below refer to our econometric analysis.

In line with the "*efficiency preferences hypothesis*", column (1) reports a positive correlation between the TOG efficient allocation and SHG cooperation. This finding is robust when controlling for gender, age and the level of education, as pre-registered (see column (2)). Interestingly, our econometric analysis suggests that the results may be driven by the behavior of participants in the TOG equitable frame ($p < 0.046$); by contrast, those choosing the efficient allocation in the TOG efficient frame do not cooperate more than those choosing the equitable allocation ($p > 0.80$). Along these lines, SHG cooperation appears to be (weakly) more frequent among those choosing the TOG efficient allocation in the TOG equitable frame, compared to those choosing the same allocation in the efficient frame ($p < 0.068$).

Table 4. Logit regressions predicting SHG cooperation.

	(1)	(2)
Constant (b_0)	0.375**	0.154
	(0.175)	(0.567)
TOG Efficient Frame (b_1)	0.164	0.171
	(0.380)	(0.394)
TOG Efficient Choice (b_2)	0.612**	0.642**
	(0.305)	(0.309)
TOG Efficient Frame x TOG Efficient Choice (b_3)	-0.704	-0.801
	(0.479)	(0.492)
Controls (Gender, Age, Education)	No	Yes
χ_1^2-test (H_0: $b_1 + b_3 = 0$)	3.40*	4.54**
χ_1^2-test (H_0: $b_2 + b_3 = 0$)	0.06	0.17
LR-chi2	4.63	10.45
Observations	436	426

Note: Significant at *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors are reported in parenthesis.

Overall, these findings suggest that *i*) choices in the SHG are mainly driven by efficiency motives, and *ii*) (if anything) participants are more likely to choose the efficient choice in the SHG if they chose the efficient choice in the TOG in the Equitable frame, when this was negatively framed.

4. Study II

We elicit moral judgments in the SHG in our second study, where we adapt the methodology of Capraro & Rand (2018), to our SHG. Specifically, participants first read the instructions of the SHG in Study I, then

completed the comprehension questions, and finally were asked to report what they think is the morally right thing to do in this game. Their answers were not incentivized following the approach in the moral psychology literature to elicit personal norms (e.g., Everett, Pizarro & Crockett, 2016; Eriksson et al. 2017; Capraro & Rand, 2018; Capraro & Vanzo, 2019).

Our results indicate that 61% of the participants (53 out of 87) reported that cooperation is the morally right thing to do in the SHG. The test of proportion indicates that this proportion is significantly different from 50% ($p = 0.042$), which is consistent with the utilitarian perspective (Mill, 1863) and our interpretation that choosing the cooperative/risky action would be considered as the moral thing to do in the SHG. However, our data is in stark contrast with the results regarding cooperation in the PD, reported in Capraro & Rand (2018), Study 4, where 81% of the participants (129 out of 160) reported that cooperation is the morally right thing to do. The test of proportion suggests that participants are more likely to value cooperation in the PD as the moral thing to do, compared with cooperation in the SHG ($p < 0.001$). This provides an additional piece of evidence that moral preferences do not play a primary role in determining SHG cooperation.

5. Conclusion

Recent work highlights that (one-shot, anonymous) PD cooperation is primarily driven by moral preferences for doing the right thing, rather than by distributional preferences for equity or efficiency (Capraro & Rand, 2018). The current paper adapts the research methodology of Capraro & Rand (2018) to investigate behavior in the SHG, where cooperation is not *costly* (there is no temptation to deviate from the cooperative outcome if the other player cooperates) but it is *risky* (cooperation pays off *iff* the other player cooperates). Is SHG cooperation driven by distributional preferences or by moral preferences? This is an important question because SHG cooperation is thought to represent the prototypical form of social contract (Rousseau, 1754/1999; Skyrms 2004).

Our first, well-powered, preregistered experiment demonstrates that SHG cooperation tend to be correlated with the efficient choice in the TOG, rather than with its moral choice. This suggests that SHG cooperation is primarily driven by efficiency motives, rather than by moral preferences. Interestingly, this effect seems to be driven by the behavior in the TOG equitable frame, where the efficient allocation is negatively framed. We argue that participants choosing the efficient allocation in this frame are likely to have strong preferences for efficiency, strong enough to overcome the moral framing. In fact, people choosing the efficient allocation in the TOG equitable frame might have a stronger preference for efficiency than those in the TOG efficient frame, where the efficient allocation is "nudged".

From a theoretical perspective, our findings shed lights on the basic ingredients of moral behavior. Why is PD cooperation driven by moral preferences, whereas SHG cooperation is not? Both kinds of cooperation benefit the group; their key difference is that PD cooperation is costly for the cooperator, while SHG cooperation is not. Therefore, our results suggest that one primary ingredient that determines whether a behavior has an element of morality is not whether that behavior benefits the group, but whether it is costly for the individual performing that behavior. In line with this view, there is evidence that preferences for efficiency may be important in games that require coordination; e.g., to determine the willingness to vote in a threshold coordination game (Dawes et al., 2011). Further, our second study finds that 61% of participants rate SHG cooperation to be the morally right thing to do. This is in stark contrast with the results in Capraro & Rand (2018) where 81% of participants reported that cooperation is the morally right to do in the PD. Clearly, whether an action is costly for the decision maker is not the only ingredient determining whether that action has a moral value. For example, in the trade-off game, neither option is costly for the individual; yet, this game still has an element of morality: cues about what constitutes the appropriate choice affect people's behavior as well as their judgments about which choice they think is moral (Capraro & Rand, 2018). Classifying and identifying the basic ingredients of moral behavior is certainly an important direction for future research.

We believe that our findings relate to the literature in various fronts. Capraro & Rand (2018), Tappin & Capraro (2018), and Huang et al. (2019) found that framings affect choices and moral judgments in the trade-off game. Our results include a direct replication of their findings, which is particularly important in light of the current replicability crisis (Open Science Collaboration, 2015). Our paper dovetails also with other experimental studies that investigate the effects of personal and social norms on behavior. In particular, there is evidence that individuals might have preferences for following a norm (e.g., Brekke et al., 2003; Brañas-Garza, 2007; Levitt & List, 2007; Alger & Weibull, 2013; Krupka & Weber, 2009, 2013; Kimbrough & Vostroknutov, 2016; Eriksson et al. 2017; Capraro & Rand, 2018; Capraro & Vanzo, 2019). For example, dictator games in which dictators are given the possibility to take money from recipients (List, 2007; Bardsley, 2008; Krupka & Webwe, 2013; Korenok et al., 2014) suggest that enlarging the choice set by adding a "take option" might affect generosity and the perception on what constitutes a generous behavior; e.g., when taking money is an option, "the right thing to do" may not necessarily invoke giving. In a similar vein, Krupka and Weber (2013) argue that framing effects in the dictator game, which clearly cannot be explained by outcome-based preferences for equity or efficiency, can be explained by a preference for doing what people think is the socially appropriate thing to do. Our results contribute to this literature by showing that these preferences do not play a major role in determining cooperation in a strategic situation like the SHG. While we do find that individuals perceive that cooperation has a moral component in the SHG, this role turns out to be quite small in comparison to other games such as the PD.

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