# Teaching Social Dilemma through Simulating Cooperation: A Classroom Experiment

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## Abstract

Despite an increased number of case studies simulating social problems in the classroom, due attention has been rarely paid to social dilemma games in light of teaching the key concepts of sociology. We propose a paper-and-pencil experiment designed for sizeable students to simultaneously explore various conditions of sustainable cooperation in a Prisoner's Dilemma game, with five steps of in-class activities presented in details. We evaluate experimental results quantitatively and the usefulness of game-based learning on the basis of debriefing interviews. Beside positive effects of repeated dyadic interaction and direct communications on cooperation, it is shown that sharing a common goal with group members in the presence of intergroup competition tends to strengthen reputation-based indirect reciprocity. Students seem to learn more deeply and see wider relevance as a product of engaging in the experiment, generating findings from the simulated data, and associating them with real-world examples of reciprocity. Our case study on teaching social dilemma through a simple but novel classroom experiment may provide valuable information to educators and practitioners interested in the effective use of economic games as an interactive teaching method for undergraduates in the setting of higher education.

## Practitioner Notes

1. Introducing a classroom experiment on Prisoner's Dilemma provides engaging opportunities for students to study the key concepts of sociology linked to social problems in a learning by doing manner.
2. Five building blocks of teaching practice are recommendable from sharing learning objectives and the main ideas in the readings, building hypotheses with students, running experiment, and illustrating results and generating findings to in-class discussion and reflection.
3. Valid simulated data collected under multiple conditions could be employed to demonstrate students with existing theories on different types of reciprocity, communications, and intergroup competition.
4. Post-experiment interviews produce important information and insights into what students experience from the game and learn through in-class activities.
5. Group discussion carried out by employing a social dilemma experiment appears to contribute to developing students' civic values in a broader context of citizenship education.

## Keywords

# Introduction

A social dilemma is a situation wherein a decision immediately rewarding to each individual leads to a suboptimal outcome at the collective level. It has provided a research framework for investigating various examples of conflict between individual and collective interest in human societies (Van Lange et al., 2014; Chaudhuri, 2016) as people in such mixed-motive situations, albeit well aware of mutual benefits to performance, psychological well-being, and interpersonal relations from cooperative behavior (Comb, 1992), have a strong tendency not to cooperate. Among social dilemma games, the Prisoner's Dilemma (PD hereafter) and its n-person versions concerning public goods and common pool resources have been extensively studied to tackle the fundamental issues in different forms of human cooperation and their consequences (Chaudhuri, 2009).

Learning about the idea of social dilemma and its applications can encourage undergraduate students beyond a specific area of social sciences to develop insights into fictional or real-world problems where individual rationality is contradictory to the collective good and further to realize their connectedness to a larger community. Nonetheless, teaching social dilemma in the higher education setting seems to have obtained disproportionate attention across the disciplines. For instance, cooperation and collective action from the perspective of game theory have close affinity with the theoretical key concepts such as social order, social norm, institutions as behavioral regularities, unintended consequences of intentional actions and "precontractual solidarity" as trust (Collins, 1992), but sociology textbooks rarely engage "how people attune their efforts to one another and how people perform tasks together" (De Swaan, 2013) in the context of social dilemma. Appropriate credit has been rather received mainly in economics and political science, as often illustrated in connections with the examples of market failure, externality, public goods provision, and conflict resolution. Especially, economists have developed various models of social dilemma games for teaching (Bernard & Bernard, 2005; Bodo, 2002; Farolfi & Erdlenbruch, 2020; Holt, 2007; Holt & Capra, 2000; Kirts & Tumeo, 1991; Pickhardt, 2005; Powers, 1986).

With empirical studies regarding the effectiveness of classroom experiments on learning (Davis, 2019; Dickie, 2006; Emerson & English, 2016; Gremmen & Potters, 1997; Porter et al., 2004), using economic games in the classroom has been highlighted as an interactive teaching method in the setting of higher education (Cartwright & Stepanova, 2012; Egbert & Mertins, 2010; Picault, 2019). Beyond economic education, increased cases of simulating various social problems in the classroom (e.g., deviance, environmental degradation, gendered socialization, racial and ethnic relations, and stratification and inequality) have been reported more widely in the other social sciences disciplines (Ansoms & Geenon, 2012; Coghlan & Huggins, 2004; Dorn, 1989; Groves et al., 1996; Latshaw, 2015; Merlone & Romano, 2017; Obach, 2003; Paino & Chin, 2011; Waren, 2011). As practices in active learning induce students to engage in inquiring and solving problems, classroom experiments enable to create such learning experiences by providing a more

enthusiastic environment where students are identified themselves as game participants rather than as passive recipients of knowledge (Emerson & Hazlett, 2011; Feinstein et al., 2002; Hofstede & Pederson, 1999; Lantis et al., 2010; Lean et al., 2006; Ruben, 1999).

Our simulation is based on a simple pencil-and-paper game applicable to a sizable group if the classroom is sufficiently large. Despite some advantages of computerized experiment (say, using z-Tree software), it has been also documented that paper-based games can significantly promote student motivation and learning (Guest, 2015). The game in the present study is originally inspired by Harrod (1983). Embedded in a cyclic network, players randomly assigned to groups of varying size pass a card of one of two colors to forward adjacent players and receive another from neighboring players in the behind. As far as a PD payoff structure is common knowledge, self-interested actors are always better off not helping their co-players forward who cannot repay indebtedness to them. Given this type of interaction structure like a chain (Greiner & Levati, 2005), our unique experimental design is sufficiently suitable for generating the simulated data with which different conditions for the emergence of cooperation including generalized exchange (Bearman, 1997; Takahashi, 2000; Yamagishi & Cook, 1993) can be readily examined. To the best of our knowledge, the present in-class experiment is the first one to simultaneously explore various conditions in accordance with the main mechanisms of cooperation in the literature.

The current paper reports the results from a case of classroom experiment on Prisoner's Dilemma implemented in an undergraduate social psychology course offered by the department of sociology. In the local context of South Korea within which game-theoretical approaches to social problems and policies among sociologists are rarely adopted for research, not to mention teaching. We intend to assess the theoretical validity and empirical relevance of the proposed experiment and the usefulness of our game-based active learning by using a multi-method (Creswell & Creswell, 2017): statistical analysis of the simulated data and unstructured interviews at the end of experiment (Merriam, 1988). One part of results evidence that our classroom experiment provides reliable and informative simulated data to illustrate students with theories of social dilemma about different types of reciprocity, communications, and intergroup competition. The other part on the basis of students' comments on the experiment also shows what they experience, discover, and learn by doing as a product of active participation.

In the remainder, we first and briefly review literature on the primary mechanisms of cooperation in PD as introduced to students in the course. Instead of presenting a set of hypotheses acquired in a strictly theoretical manner for the sake of testing, we encouraged grouped students to develop those ones by themselves with critical thinking. Second, after fully describing the experimental design and procedures, we show the main results in the same manner as illustrated in the classroom. While students were watching the exchange patterns in figures and tables, they learned to generate findings from the simulated data. Different levels of cooperation across experimental conditions were then statistically evaluated. Third, we describe outlines of in-class discussion topics in connection to theoretical ideas and real-world examples of reciprocity with possible directions for further extensions. Finally, we provide anecdotal interview comments during debriefing, instead of statistically evaluating any quantitative learning outcomes between game participants and non-participants, in order to suggest pedagogical implications of teaching social dilemma through classroom experiment.

## Literature

**Introducing the main ideas (step 1)**

We introduced in the classroom three theoretical perspectives on human cooperation at the first step of teaching. Evolutionary approaches propose kin selection, direct reciprocity, indirect reciprocity, network reciprocity, and group selection as the mechanisms of cooperative behavior in light of evolved human nature (Nowak, 2006; Rand & Nowak, 2013). Psychological explanations underline the effects of motivation, cognition, emotion like fear and greed (Coombs, 1973), social value orientation (Liebrand, 1984), empathic concern and other-regarding preferences (Batson & Moran, 1999), and personality traits (Thielmann et al., 2020), whereas cultural approaches highlight social norms, generalized trust, and institutional arrangements (Fehr & Schurtenberger, 2018). Based on different criteria of whether egoistic players are assumed and the game rules are changeable, Kollock (1998) classifies solutions to social dilemma into three clusters: motivational (social value orientation, group identity, communications), strategic (reciprocal strategies, partner choice, group reciprocity), and structural (identifiability under repeated interactions, payoff structure, group size).

We particularly expanded on the type of reciprocity as a key aspect of social exchange that strengthens the glue that holds community together and presented several stylized examples of generalized exchange. Two forms of reciprocal exchange have been widely reviewed (Molm et al., 2007) since Ekeh (1974) who is one of the classical social exchange theorists: restricted exchange based on dyadic bilateral relationships and generalized exchange wherein values move in one direction across multiple actors. The well-known Tit-for-Tat strategy (Axelrod, 1984) accounts for the evolution of reciprocal cooperation in repeated interactions. This direct reciprocity is not scalable, and also it hardly produces social bonds among participants involved in large-sized exchange unless supportive cliques are formed. Nonetheless, different forms of generalized exchange are frequently observed in societies such as donation, peer-review, carpooling, p2p file sharing, peer production, rotating credit association, self-help group, community gift circle, and local exchange trading system(LETS). In all these examples of generalized reciprocity, those who cooperate do not receive benefits directly from the recipients of their help (Bearman, 1997; Takahashi, 2000; Yamagishi & Cook, 1993). Two types of generalized exchange are recognized (Nowak & Roch, 2007; Nowak & Sigmund, 2005; Whitham, 2021): downstream reciprocity through reputation (a player A, by cooperating with B, receives help from C) and upstream reciprocity motivated by gratitude (a player B receives help from A and then cooperates toward C).

**Sharing learning objectives (step 1)**

Before introducing students to the design of our classroom experiment, we shared learning objectives of understanding possible solutions to social dilemma across three domains in Kollock (1998). On one hand, the experiment focuses on an intergroup competition effect (Bornstein et al., 1990; Kramer & Brewer, 1984). When groups compete for limited resources or collective rewards to all members of higher-scoring groups, cooperation is more likely to emerge and sustain itself in spite of the second-order social dilemma. One plausible reason for valuing collective outcomes more than individual ones is that game participants with emerging group identities in a common boundary are less motivated in making sharp distinctions between their own and other's welfare (Kramer & Brewer, 1984; Titlestad et al., 2019). Otherwise, cooperative strategy can be chosen due to their expectation of in-group reciprocity if common knowledge about group membership is shared (Yamagishi et al., 1999): ingroup favoritism in this case is grounded on beliefs rather than on preferences (Everett et

al., 2015).

On the other hand, our experiment is engaged in the effects of different types of interaction and communication structure within groups. The Tit-for-Tat strategy begins by cooperation on the first move and then simply follows the co-player's previous action which serves as a heuristic clue to strategic intent and motivation. The downward TFT strategy (Boyd & Richerson, 1989) indicates that if a player A helps B (does not help B), and then a third party helps A (does not help A). This form of indirect reciprocity (Alexander, 1987) evolves not only in a connected cyclic chain like the Kula ring but also among randomly encountered people through indirect communications. As with the case of reputation-based cooperation in real-world situations, the presence of discriminators is a necessary condition who cooperate toward good players with high image scores but refuse to help bad ones as far as such punishment is seen as justifiable to others (Milinski et al., 2001; Nowak& Sigmund, 1998; Okada, 2020). Yet, direct communications among group members alone can induce sustainable cooperation through the building of trust and moral obligation (Balliet, 2010; Cardenas, 2004; Messick & Brewer, 2005; Wilson & Sell, 1997).

**Building hypotheses together with students (step 2)**

As the second step of teaching, we encouraged students to make predictions in accordance with the main theoretical ideas in the literature that they need to understand while facilitating the in-class discussion about real-life examples of social dilemma over a couple of weeks. Since the current experiment is designed for teaching rather than for research, we helped students set up the hypotheses together, with their answers in assignment to course materials: 1) individuals under intergroup competition are more likely to choose cooperative strategy due to the increased value of the collective outcome or anticipated in-group reciprocity; 2) individuals without any type of communications or a repeated interaction structure are least likely to cooperate toward their forward neighbors; 3) individuals under a direct message condition are more cooperative than those who are allowed to communicate indirectly by using simple reputation because game participants under the former situation can deliver more diverse contexts with a higher sense of control; and 4) individuals are highly likely to cooperate if embedded in symmetric interaction where benefits no longer unilaterally flow with mutual monitoring and sanctions more effective. Once again, all these hypotheses derived from grouped students in our teaching experiment should be meaningful for learning purposes (i.e., discovery-oriented learning) rather than for testing and refining existing or new theories.

# Methods

From a multi-method perspective, we intend to examine the overall validity of the proposed experiment quantitatively and the value of simulation game-based learning with post-experiment interviews qualitatively. Given the unique design of the present study as described below, we could generate the quantitative data from classroom simulation in order to evaluate the internal and theoretical validity of our experiment under varying scenarios. Besides, we obtained the qualitative data from debriefing interviews with game participants to draw pedagogical insights and implications. The institutional review board of Jeonbuk National University approved all the procedures and protocols of the present research (#2015-12-003). Informed consent was obtained from all participants in our classroom experiment.

**Running the experiment (step 3): Participants**

We conducted the experiment at the third step of teaching in the classroom of 60 students one

day in October, 2015. Among 51 volunteers, 22 participants major in sociology and the rest are in diverse other majors. Each student was randomly assigned to one of eight groups of varying size. The participants in each group sat on their chairs in a clock-wise circle, so that each player could pass a card forward and receive another card from behind. We double-checked that any friends should not sit adjacent to each other in every group. Each participant received a sheet of detailed instructions and another one for payoff calculation (Appendix).

## Experimental design

The experiment was implemented according to the matrix in Table 1. Given a 2x4 factorial within-subjects design, counterbalancing was applied to remove the order effect. First, we manipulated competition among groups by differential rewards based on the outcome of each session. During each of the first two sessions (1 and 2) in the absence of intergroup competition, an 8G USB (priced 5 dollars at the time of purchase in August of 2015) was awarded to the individual who scores highest in each group. For the last two sessions (3 and 4) in the presence of intergroup competition, an 8G USB was presented to the highest scorer in each group, but additionally all members in the highest-scoring group were entitled for customized beverage at the next class meeting. It should be acknowledged here that offering the prizes only to the players and the best-performed group is not a common practice in the lab experiments of behavioral economics. There were no considerable differences in the overall results from the same game with play money in a previous pilot study, but we were concerned about ethical issues with letting the actual payoff proportional to the scores of players.

Given the presence or absence of intergroup competition, we considered different forms of communications and interaction as in Table 1. Under Condition I, players are not allowed to communicate with one another. In Condition II, players can write a direct message immediately after each round and send it to the player behind before the next round begins. Under Condition III, players alternate between sending a card forward and receiving another from the same co-player. We note that this symmetric interaction termed here as "sender-receiver shift" is not the same as the social exchange structure in the other three conditions (asymmetric interaction). In Condition IV, players pass the correct information about their own move at the previous round, that is, reputation as indirect message, to the rear player. According to our experience, it is duly recommended that since the proposed experiment is not computerized, game participants should be ensured not to see the color of a card when their front co-players envelop it.

**Table 1**

*Experimental design and treatments*

| Intergroup competition | No | | Yes | |
|---|---|---|---|---|
| Session | 1st | 2nd | 3rd | 4th |
| #1(n=9), #5(n=5) | I | II | III | IV |
| #2(n=8), #6(n=5) | IV | I | II | III |
| #3(n=6), #7(n=4) | III | IV | I | II |

| #4(n=9), #8(n=5) | II | III | IV | I |
|---|---|---|---|---|

*Note*. Condition I (No communications); II (Direct message); III (Sender−Receiver shift); and IV (Reputation)

## Procedures

The experiment consists of four sessions, with four rounds in each session. It takes approximately 40 minutes in total. Before every first round of each session, we made sure that the goal of this game is for each participant to accumulate as many points as possible. At each round, everyone simultaneously sends a yellow or a blue card in an envelope to the player ahead and receives a card from the player behind, and then calculates her score using the payoff matrix in Table 2. The expected outcome in a single round is {Yellow, Yellow} equivalent to a Nash equilibrium under PD. A self-interested player has no incentive for sending a blue card since a yellow card is the best response leading to higher rewards, regardless of the color of a received card. As interactions are iterated four times in each session, players can learn from their past behavior. Expectedly, most players pass yellow cards while green cards hardly circulate even in the presence of cooperative strategies that sporadically appear at the local level. Post-experiment interviews with game participants are conducted during debriefing. The length of interviews varied from 10 to 30 minutes depending on each student's comment in a blank sheet of paper submitted at the end of experiment.

**Table 2**

*Payoff matrix*

| | | Card received from behind | |
|---|---|---|---|
| | | Yellow | Blue |
| Card sent ahead | Yellow | 0[a] | 25[b] |
| | Blue | −15[c] | 10[d] |

*Note*. Numbers indicate the focal player's payoffs.

[a] punishment for mutual defection.

[b] temptation to defect.

[c] sucker's payoff.

[d] reward for mutual cooperation.

# Results

## Illustrating results and generating findings (step 4)

At the fourth step of teaching, we asked leading questions and encouraged students to pay attention to interesting points from the simulated data in response to the hypotheses in the following ways. First, it was observed that the average payoff varies by experimental conditions, as illustrated in Figure 1. Notably, there is the main effect of group competition on cooperation across all conditions. Whether such competition is present or not, the highest cooperation is achieved when players are allowed to receive a direct message from the co-players ahead after every round. The second highest score is observed when the same two

players repeated interact in commitment relationship by exchanging the roles of sender and receiver. The third highest score is shown when the information is provided about the forward player's cooperativeness at the previous round as far as a common goal is shared among group members. Without intergroup competition, however, there seems to be no significant difference in the average score between this indirect message condition ("reputation") and the baseline condition ("no communications").

*Figure 1*

*Average payoff by treatments*
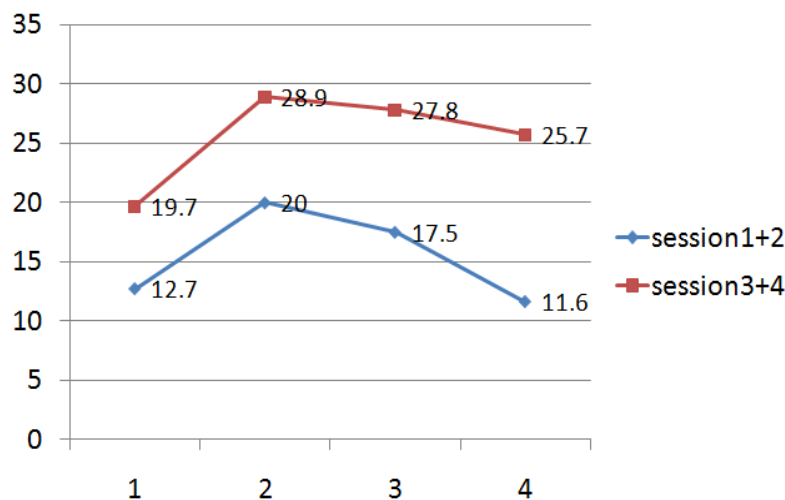


*Note*. 1 (No communications); 2 (Direct message); 3 (Sender−Receiver shift); 4 (Reputation)

**Table 3**

*Exchange patterns by treatments*

| Intergroup Competition | Communications and Interaction Structure | | | |
|---|---|---|---|---|
| No | I | II | III | IV |
| Defection, Defection | 45.4% | 28.6% | 31.3% | 52.2% |
| Defection, Cooperation | 23.1% | 21.4% | 26.0% | 19.6% |
| Cooperation, Defection | 23.1% | 20.5% | 25.0% | 19.6% |
| Cooperation, Cooperation | 8.3% | 29.5% | 17.7% | 8.7% |
| Yes | I | II | III | IV |
| Defection, Defection | 29.2% | 8.7% | 13.9% | 17.9% |
| Defection, Cooperation | 24.0% | 21.7% | 17.6% | 18.8% |
| Cooperation, Defection | 24.0% | 21.7% | 17.6% | 18.8% |
| Cooperation, Cooperation | 22.9% | 47.8% | 50.9% | 44.6% |

*Note.* The first column lists the strategy of the focal and backward players. I (No

communications); II (Direct message); III (Sender−Receiver shift); IV (Reputation).

Next, Table 3 summarizes the distribution of four possible sets of individual strategies at the dyadic level in the absence of intergroup competition (upper panel) and in its presence (lower). Considering the possibility of the learning effect from the participants' experience of the first session (given our within-subjects design), we intend to present the result of each session. When there is no group competition, patterns of paired strategies significantly vary according to different structures of social communications and interaction ($\chi^2$=30.95 at *df*=9, *p*=.000, *N*=408). Mutual defection is most popular, but it is noticeable that direct message and also direct reciprocity have a positive influence on cooperative behavior. Meanwhile, we find any significant difference between the indirect message condition and the no communications condition. Once intergroup competition is activated, local cooperation becomes more prominent and reinforced by direct message, direct reciprocity, and reputation. The overall patterns in the presence of intergroup competition also considerably differ across experimental conditions ($\chi^2$=26.24 at *df*=9, *p*=.002, *N*=408). Contingent on the presence and absence of group-level competition, the biggest difference in exchange patterns is observed when participants are fully aware of the strategy of their benefit recipients at the previous round. This interaction effect is indeed significant between intergroup competition and reputation-based indirect reciprocity (not shown here). As a study of teaching experiment, not research experiment, the aim of our statistical analysis from here is for students to better understand the results, not to challenge well-established knowledge in the field of game theory.

**Table 4**

*Regression coefficients for cooperative strategy*

| Variables | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Intergroup competition | 1.189(.176)*** | .879(.185)*** | .888(.186)*** |
| Sender-Receiver shift | .931(.242)*** | .644(.249)* | .654(.249)** |
| Direct communications | 1.173(.246)*** | .973(.250)*** | .982(.250)*** |
| Indirect communications | .371(.238) | .207(.243) | .210(.243) |
| Group size | | −.052(.085) | −.053(.085) |
| Cooperation $_{t-1}$ | | .588(.198)*** | .579(.198)** |
| Cooperation from behind $_{t-1}$ | | .765(.192)*** | .749(.192)*** |
| Male | | | .276(.374) |
| Sex homogeneity | | | −.045(.370) |
| Major homogeneity | | | −.803(.613) |
| Intercept | −1.155*** | −1.139* | −1.138* |
| *−2LL* | 915.353 | 888.320 | 885.380 |
| $\chi^2$ | 64.07*** | 86.09*** | 88.15*** |
| *McFadden's pseudo-R$^2$* | .076 | .103 | .106 |

*Note*. *** *p*<.001, ** *p*<.01, * *p*<.05. Numbers in parentheses are standard errors. *N*=765.

Our final task in the classroom seeks to identify the major determinants of individual cooperation from the simulated data using a mixed-effects model. Because the primary motivation of our simulation game and statistical analysis is not to strictly test new hypotheses with unbiased estimates as is the case with research experiment, we do not intend to measure individual-level confounders (e.g., generalized trust and social value orientations). One approach for checking robustness against this issue of unobserved heterogeneity at the individual level is to nest the repeated observations (rounds) within participants: within-individual model (level-1) and between-individual model (level-2). Since multi-level modeling is unfamiliar to undergraduate students, showing the regression coefficients from binary logit model at the individual level can be an alternative option for easier understanding of the dynamics of cooperation. Indeed, there were no substantial differences in the overall results.

In the mixed-effect logit model with random intercepts in Table 4, the dependent variable is the focal player's cooperation (valued as 1 when she or he cooperates and otherwise as 0; $Mean=.52$, $SD=.5$). As predictors, we consider four dummy variables representing intergroup competition, direct message, direct reciprocity, and indirect message (with the no communications condition as the omitted category). Six covariates in total are statistically controlled in the model: 1) whether the focal player cooperated toward the forward co-player at the previous round (cooperation $_{t-1}$); 2) whether the player benefited from cooperation of the backward co-player at the previous round (cooperation from behind $_{t-1}$); 3) group size ($Mean=6.92$, $SD=1.89$); 4) male (with female as the omitted category; $Mean=.29$, $SD=.46$); 5) a dummy variable of sex homogeneity (measured as 1 only if the focal player and two adjacent co-players all have the same sex; $Mean=.29$, $SD=.46$); and 6) a dummy variable of major homogeneity (coded as 1 only if these three players all have the identical major; $Mean=.08$, $SD=.27$). In this manner, at least two non-time-varying attributes of actors are directly controlled (i.e., sex and major homophily), with some aspects of auto-regressive effects. For the sake of simplicity, the interaction effect was not presented between indirect communications and intergroup competition.

We display the results from three models in Table 4. The intra-class correlation coefficient of the unconstrained model without independent variables is .232 while the standard deviation of random intercepts is .997, which suggests that between-subject heterogeneity accounts for a considerable amount of the total variability. Model 1 is significant, with a higher goodness of fit compared to the baseline model, according to the Likelihood Ratio test ($p=.000$ from $\chi^2=75.34$ at $df=4$). All treatments except indirect message are positively associated with the probability of cooperation. The predictability of Model 2 has considerably increased, as suggested by the LR test between the two models ($p=.000$ from $\chi^2=27.3$ at $df=3$). Group size, albeit not significant, has a negative effect on cooperative norm. Cooperation at the previous round, either by the focal player or by the co-player behind, promotes subsequent cooperative behavior. Model 3 is not significantly improved against Model 2 with the pseudo-$R^2$ of 0.103 ($p=.401$ from $\chi^2=2.94$ at $df=3$). The estimated effects of the covariates in Model 3 on cooperative behavior turn out insignificant. In Model 2, direct message has the largest effect among our experimental conditions, multiplying the odds of cooperation by approximately 160% compared to no communications. The strength of the intergroup competition effect comes in the second place. The odds of cooperative behavior once the sender-receiver shift is implemented are almost 90% higher than in the reference condition. The effect of cooperation at the previous round is also noticeable, with the odds of next cooperation greater approximately up to 80%. Additionally, the odds of cooperative strategy increase by 115% if a

player benefits from the co-player's cooperation behind at the previous round.

**Post-experiment discussion and reflection (step 5)**

As presented so far, a simple classroom experiment like ours would be sufficient for teaching social dilemma with all reproducible results for further reflection and extensions. We observed that while sporadic cooperation may occur either intentionally or accidentally by mistake, unless a critical mass is synchronically formed, defection at the status quo is robust against any local change by cooperators. The proposed experiment also showed that the dynamics of cooperation can be significantly affected by situational factors. Our key findings indicate that communications via direct messages and common goals under intergroup competition, let alone commitment relationships, seem to make downstream reciprocity in a chain less vulnerable to perturbations. As the last step of teaching, we reviewed the meanings of these main effects with students in order to promote their own reflection. Below we describe the outlines of in-class discussion, focusing on how they understand the implications of the main findings with interviews from debriefing as a form of reflection (Crookall, 2010).

First, our experiment confirms that cooperative behavior is enhanced in the presence of intergroup competition. Informed by realistic conflict theory, students expected that a superordinate goal would promote cooperation within group members. We observed large differences in the average individual propensities to cooperate possibly due to emergent group identity induced by such competition. This effect provides entry points for teaching students about intergroup conflict and cooperation in connection with other course readings: some students might revisit social identity theory (Tajfel & Turner, 1979) and self-categorization theory (Turner et al., 1987) in order to explain sustainable cooperation without a common interest; and others might bring up different mechanisms of within-group favoritism such as expectations of future reciprocity from in-group members, adherence to cooperative norms, and in-group love (Everett et al., 2015).

The sender-receiver shift condition seems to induce mutual expectation under repeated dyadic interactions. As predicted, it results in more clusters of local cooperation, making the effect of direct reciprocity stronger than the effect of either no communications or indirect reciprocity based on reputation. Some points deserve attention during in-class discussion since the TFT strategy vulnerable to mistakes is well known to incur the risk of a spiral of retaliation (Wu & Axelrod, 1995), as similar to the downstream indirect reciprocity using image score addressed below. While reviewing the experiment results together, one student indeed mentioned such punishment (e.g., "I revenged my partner who gave me a yellow card last time"). What was observed from our simulated data is that repeated exchange between the same players tends to enhance cooperation, but alternating retaliation without forgiveness (Molander, 1985) might appear if the number of dyadic interactions per session increased. Further reflection then is ready for critical thinking in connection with how to recover socially desirable outcomes once mutual trust and cooperation are disrupted (Ostrom, 2010).

The experiment also highlights the differential effect of direct and indirect communications on cooperative behavior. Passing a direct message backward to the co-player seems to positively affect sustainable cooperation. During in-class discussion, the messages exchanged between adjacent players particularly provide students important information about how their strategies are developed. In the classroom, we presented two word-clouds of real messages in the absence and presence of intergroup competition in Figure 2 (*N*=76 and *N*=71, respectively). The modal category turns out to be "blue, please" (*f*=26 in the left and *f*=12 in the right panel),

followed by "thanks" in the second place (*f*=10 and *f*=9, respectively): a plea for cooperation and a feeling of gratitude, respectively. Some messages indicate a possibility of the interaction effect between direct message and intergroup competition, although moderation is insignificant (not shown here), such as "better get beverages together" (*f*=5) and "send message that let's pass blue to get beverages" (*f*=4). More importantly, students made observations into a positive effect of direct communications on cooperation (e.g., "My messages seemed to make her feel happier," "It is like direct message could enhance group solidarity somehow"). The word-clouds surely stimulated further stories about the power of direct communications. As students excitedly told, some messages might induce a feeling of guilt about free-riding (e.g., "How can you do that?", "No more word left to you," "Do you really want to be a selfish winner?"), while others are more associated with a sense of obligation to help (e.g., "Don't say that you will send yellow," "I'm crying").

**Figure 2**

*Messages sent to the behind players*



*Note*. Left (Session 1 and 2); Right (Session 3 and 4). The size of message is proportional to its relative frequency in each picture.

We expect that the correct information about the forward player's behavior in the very past can serve as a heuristic cue for cooperation by the focal player. Theoretically, indirect reciprocity via reputation is feasible if players simply follow the rule of helping adjacent cooperators in a ring of social networks (Boyd & Richerson, 1989). However, indirect communications alone in our experiment did not successfully promote cooperative behavior even in a small chain. When interviewed after the game, some participants told us: "I could not be so sure that the player behind would value my cooperative behavior even if I told him I sent blue forward" and "what else could I choose other than sending yellow to such a guy who is selfish at the previous round?" Their comments aptly point out weaknesses incurred in downstream reciprocity, consistent with recent studies of indirect reciprocity by image-scoring (Okada, 2020). On one hand, doing act of kindness motivated by strategic investment in reputation may not be sufficient unless it is guaranteed that every cooperative behavior is rewarded by third parties reading good image score under a high risk of self-interested non-cooperation (Roberts et al., 2021). On the other hand, when someone loses reputation after

refusing to help free-riders, cooperative norm is more likely to be disrupted without additional information of whether such punishment is justifiable or not (Nowak & Sigmund, 2005). As presented in Table 3, however, our results suggest that sharing a common goal with group members in the presence of intergroup competition can lower such vulnerability of reputation-based indirect reciprocity.

Apart from the main experimental effects, we observed cooperative behavior at the current round significantly associated with that at the previous round, not only by themselves and also by their nearest co-players behind, indicating temporal correlation (i.e., reinforced behavioral tendency) and lagged spatial correlation, respectively. Interestingly enough, the latter result seems to support upstream indirect reciprocity because selfish players in our experiment would not send a blue card forward despite the benefits from the backward co-players at the previous round. Informed by recent studies on "pay-it-forward reciprocity" (Chang et al., 2012; Fowler & Christakis, 2010; Gray et al., 2014) originating from feelings of gratitude (Nowak & Roch, 2007), we proceeded with further in-class discussion about down-to-earth examples such as pay-it-forward in drive-thrus, social support exchange in online communities, and reciprocity in LETS and Timebank (Collom et al., 2016).

## Discussion

In our experiment, students play a Prisoner's dilemma game sitting in a cyclic network. Eight treatments in total are implemented in a 2x4 factorial design. In one dimension, the instructor can vary individual incentives only versus team incentives in addition to individual ones. In the other dimension, three different conditions besides the default condition (no communication) are considered according to whether players can communicate with their partners undirectionally (expected action of the co-players behind), bidirectionally (expected action and promise to the co-players ahead) or reputationally (by telling the co-players behind the strategy at the previous round).

We found the positive effects of repeated dyadic interaction ("If you scratch my back, I will scratch yours.") and direct messages (sending certain messages to the player behind to express gratitude, sadness, or a plea for help) on sustainable cooperation. Sharing a common goal with group members in the presence of intergroup competition seems to serve as a scope condition for downstream reciprocity (telling whether or not to cooperate at the previous round to the player in front). The main findings from statistical analysis of the data could be regarded as supportive of the overall validity of the proposed experiment in terms of verification. To be more accurate, our in-class simulation game can be readily used if discovery-oriented learning is concerned as in the current study.

We also observed that students deepened their understanding of theoretical and abstract concepts in sociology as a product of participating in the experiment, generating findings together, reflecting on observations in connection with real-world examples of reciprocity. As students reported what they experienced from the main experiment and learned about social dilemma, it seems that a more constructive dialogue emerged between their own ideas and evidence during post-experiment discussion, which may be otherwise unattainable in theory-based teaching only (e.g., "I was able to get a big picture of abstract sociological concepts thanks to classroom experiments," "It was fun to relate to experiment results with hypotheses we generated together," and "It was an exciting challenge to discover in practice what we are supposed to learn from dry theories").

According to our experience as sociologists, teaching social dilemma using economic games in the classroom may further contribute to fostering students' civic values by evoking the paradox that individual rationality leads to suboptimal collective outcomes. Although subject to quantitative evaluation in future studies, this additional merit seems also supported by anecdotal interviews with game participants ("Learning social dilemma offers the moment of reflection on my relationships with others," "I realized that reciprocity and social capital are so critical for social integration," "To me, joint discussion provided more thoughts about common issues facing our communities today," "This experiment made me more doubtful about status competition pervasive in our culture," and "I had an opportunity to think about what roles we can play together for saving our environment," to name a few). Given the limitation of instructional simulation as representing reality in a simplified manner, it is acknowledged that our study should have been combined with more concrete examples and activities linked to real social problems that help students cherish a sense of togetherness and community values in a broader context of citizenship education (Hachen, 2001; Ostrow et al., 1999; Singer, 1995).

## Conclusion

Although a growing body of case studies using simple games have simulated social problems (e.g., deviance, gendered socialization, racial relations, and stratification) in the introductory sociology course, employing in-class experiments on social dilemma is yet to be regarded as a pedagogic method for interactively teaching the key concepts of sociology and critically thinking about social issues related to cooperation and collective action. We devised a paper-based experiment especially designed for a sizeable class (up to 60 people) that implements different conditions of sustainable cooperation, with five building blocks of teaching practice described in details: sharing learning objectives and the main ideas in the readings; building hypotheses with students; conducting experiment; illustrating results and generating findings; and in-class discussion and reflection.

The main purpose of the current research was to comprehensively present the results of our classroom experiment to educators and practitioners concerned with the effective use of social dilemma games as interactive teaching strategy in the setting of higher education. The present study may deliver valuable information about practices and protocols for designing and implementing a paper-based Prisoner's Dilemma game. Beyond the realm of sociology, our experiment can be extended to develop students' thinking capabilities based on their hand-on experiences in the other social sciences. Nonetheless, it should be also admitted that the present study has little convincing qualitative evidence for the effect of interactive teaching employing our experiment on students' educational performance. Regarding future studies of simulating social problems through instructional experiment in general, our particular suggestion from a mixed-method point of view is to qualitatively examine how each activity of interactive learning in the classroom experiment is transferred to students' experiences via cognitive processes and to quantitatively test a theory-based causal model of learning outcomes conceptualized and measured in different dimensions.

## Conflict of Interest

# References

Alexander, R. D. (1987). *The biology of moral systems*. New York: Basic Books.

Ansoms, A., & Geenen, S. (2012). Building ties in a stratified society: A social networking simulation game. *Simulation & Gaming*, 43(5), 673-685. https://doi.org/10.1177/1046878112440163

Axelrod, R. (1984). *The evolution of cooperation*. New York: Basic Books.

Balliet, D. (2010). Communication and cooperation in social dilemmas: A meta-analytic review. *Journal of Conflict Resolution*, *54*(1), 39-57. https://doi.org/10.1177/0022002709352443

Batson, C. D., & Moran, T. (1999). Empathy-induced altruism in a Prisoner's Dilemma. *European Journal of Social Psychology*, 29(7), 909-924. https://doi.org/10.1002/(SICI)1099-0992(199911)29:7<909::AID-EJSP965>3.0.CO;2-L

Bearman, P. (1997). Generalized exchange. *American Journal of Sociology*, 102(5), 1383-1415. https://www.jstor.org/stable/10.1086/231087

Bernard, J. C., & Bernard, D. J. (2005). Using context in classroom experiments: A public goods example. *International Review of Economics Education*, 4(2), 9-22. https://doi.org/10.1016/S1477-3880(15)30134-1

Bodo, P. (2002). In-class simulations of the Iterated Prisoner's Dilemma Game. *The Journal of Economic Education*, 33(3), 207-216. https://doi.org/10.1080/00220480209595187

Bornstein, G., Erev, I., & Rosen, O. (1990). Intergroup competition as a structural solution to social dilemmas. *Social Behavior*, 5(4), 247-260.

Boyd, R., & Richerson, P. J. (1989). The evolution of indirect reciprocity, *Social Networks*, 11(3), 213-236. https://doi.org/10.1016/0378-8733(89)90003-8

Cardenas, J. C. (2004). Norms from outside and from inside: An experimental analysis on the governance of local ecosystems. *Forest Policy and Economics*, 6(3), 229-241. https://doi.org/10.1016/j.forpol.2004.03.006

Cartwright, E., & Stepanova, A. (2012). What do students learn from a classroom experiment: Not much, unless they write a report on it. *The Journal of Economic Education*, 43(1), 48-57. https://doi.org/10.1080/00220485.2012.636710

Chang, Y. P., Lin, Y. C., & Chen, L. H. (2012). Pay it forward: Gratitude in social networks. *Journal of Happiness Studies*, 13(5), 761-781. https://doi.org/10.1007/s10902-011-9289-z

Chaudhuri, A. (2009). *Experiments in Economics: Playing Fair with Money*. London: Routledge.

Chaudhuri, A. (2016). Recent advances in experimental studies of social dilemma games. *Games*, *7*(1), 7. https://doi.org/10.3390/g7010007

Coghlan, C. L., & Huggins, D. W. (2004). "That's not fair!": A simulation exercise in social stratification and structural inequality. *Teaching Sociology*, 32(2), 177-187. https://doi.org/10.1177/0092055X0403200203

Collins, R. (1992). *Sociological insight: An introduction to non-obvious sociology*. New York: Oxford University Press.

Collom, E., Lasker, J. N., & Kyriacou, C. (2016). *Equal time, equal value: Community currencies and time banking in the US*. London: Routledge.

Combs, A. (1992). *Cooperation: Beyond the age of competition*. Philadelphia: Gordon and Breach.

Coombs, C. H. (1973). A reparameterization of the Prisoner's Dilemma Game. *Systems Research and Behavioral Science*, 18(6), 424-428. https://doi.org/10.1002/bs.3830180605

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Thousand Oaks, CA: Sage.

Crookall, D. (2010). Serious games, debriefing, and simulation/gaming as a discipline. *Simulation & gaming*, *41*(6), 898-920. https://doi.org/10.1177/1046878110390784

Davis, J. S. (2019). IQA: Qualitative research to discover how and why students learn from economic games. *International Review of Economics Education*, *31*, 100160. https://doi.org/10.1016/j.iree.2019.100160

De Swaan, A. (2013). *Human societies: An introduction*. Cambridge: Polity Press.

Dickie, M. (2006). Do classroom experiments increase learning in introductory microeconomics?. *The Journal of Economic Education*, *37*(3), 267-288. https://doi.org/10.3200/JECE.37.3.267-288

Dorn, D. S. (1989). Simulation games: One more tool on the pedagogical shelf. *Teaching Sociology*, 17(1), 1-18. https://doi.org/10.2307/1317920

Egbert, H., & Mertins, V. (2010). Experiential learning with experiments. *International Review of Economics Education, 9*(2), 59-66. https://doi.org/10.1016/S1477-3880(15)30050-5

Ekeh, P. P. (1974). *Social exchange theory: The two traditions*. Cambridge, Mass.: Harvard University Press.

Emerson, T. L., & English, L. K. (2016). Classroom experiments: Teaching specific topics or promoting the economic way of thinking?. *The Journal of Economic Education*, *47*(4), 288-299. https://doi.org/10.1080/00220485.2016.1213684

Emerson, T., & Hazlett, D. (2011). Classroom experiments. In: G. Hoyt & K. McGoldrick (Eds.), *International handbook on teaching and learning economics*. (pp. 90-98). Cheltenham, UK and Northampton, MA: Edward Elgar. https://doi.org/10.4337/9781781002452.00018

Everett, J. A., Faber, N. S., & Crockett, M. (2015). Preferences and beliefs in ingroup favoritism. *Frontiers in Behavioral Neuroscience*, *9*(15), 1-21. https://doi.org/10.3389/fnbeh.2015.00015

Farolfi, S., & Erdlenbruch, K. (2020). A classroom experimental game to improve the understanding of asymmetric common-pool resource dilemmas in irrigation water management. *International Review of Economics Education*, *35*, 100199. https://doi.org/10.1016/j.iree.2020.100199

Fehr, E., & Schurtenberger, I. (2018). Normative foundations of human cooperation. *Nature Human Behaviour*, *2*(7), 458-468. https://doi.org/10.1038/s41562-018-0385-5

Feinstein, A. H., Mann, S., & Corsun, D. L. (2002). Charting the experiential territory: Clarifying definitions and uses of computer simulation, games, and role play. *Journal of Management Development 21*(10): 732-744. https://doi.org/10.1108/02621710210448011

Fowler, J. H., & Christakis, N. A. (2010). Cooperative behavior cascades in human social networks. *Proceedings of the National Academy of Sciences*, 107(12), 5334-5338. https://doi.org/10.1073/pnas.0913149107

Gray, K., Ward, A. F., & Norton, M. I. (2014). Paying it forward: Generalized reciprocity and the limits of generosity. *Journal of Experimental Psychology: General*, 143(1), 247-254. https://doi.org/10.1037/a0031047

Greiner, B., & Levati, M. V. (2005). Indirect reciprocity in cyclical networks: An experimental study. *Journal of Economic Psychology*, 26(5), 711-731. https://doi.org/10.1016/j.joep.2004.04.003

Gremmen, H., & Potters, J. (1997). Assessing the efficacy of gaming in economic education. *The Journal of Economic Education*, *28*(4), 291-303. https://doi.org/10.1080/00220489709597934

Groves, J. M., Warren, C., & Witschger, J. (1996). Reversal of fortune: A simulation game for teaching inequality in the classroom. *Teaching Sociology*, 24(4), 364-371. https://doi.org/10.2307/1318873

Guest, J. (2015). Reflections on ten years of using economics games and experiments in teaching. *Cogent Economics & Finance*, *3*(1), 1115619. https://doi.org/10.1080/23322039.2015.1115619

Hachen, D. S. (2001). *Sociology in action: Cases for critical and sociological thinking*. Boston: Pine Forge.

Harrod, W. J. (1983). Social dilemma: A teaching game. *Teaching Sociology*, 10(2), 266-274. https://doi.org/10.2307/1317117

Hofstede, G. J., & Pedersen, P. (1999). Synthetic cultures: Intercultural learning through simulation games*. Simulation & Gaming, 30*(4), 415-440. https://doi.org/10.1177/104687819903000402

Holt, C. A. (2007). *Markets, games, and strategic behavior: Recipes for interactive learning*. Boston: Pearson Addison Wesley.

Holt, C. A., & Capra, M. (2000). Classroom games: A Prisoner's Dilemma. *The Journal of Economic Education*, 31(3), 229-236. https://doi.org/10.1080/00220480009596781

Kirts, C. A., & Tumeo, M. A. (1991). Teaching the dilemmas of commons property management using the commons game. *The Journal of Environmental Education*, 22(3), 22-27. https://doi.org/10.1080/00958964.1991.10801964

Kollock, P. (1998). Social dilemmas: The anatomy of cooperation. *Annual Review of Sociology*, 24(1), 183-214. https://doi.org/10.1146/annurev.soc.24.1.183

Kramer, R. M., & Brewer, M. B. (1984). Effects of group identity on resource use in a simulated commons dilemma. *Journal of Personality and Social Psychology*, 46(5), 1044-1056. https://doi.org/10.1037/0022-3514.46.5.1044

Lantis, J. S., Kille, K. J., & Krain, M. (2010). The state of the active teaching and learning literature. In: R. A. Denemark (Ed.), *The international studies encyclopedia. Vol. 10 (pp.* 6574-6592). Malden, MA: Wiley-Blackwell.

Latshaw, B. A. (2015). Examining the impact of a domestic violence simulation on the development of empathy in sociology classes. *Teaching Sociology*, 43(4), 277-289. https://doi.org/10.1177/0092055X15601187

Lean, J., Moizer, J., Towler, M., & Abbey, C. (2006). Simulations and games: Use and barriers in higher education. *Active Learning in Higher Education*, 7(3), 227-242. https://doi.org/10.1177/1469787406069056

Liebrand, W. B. (1984). The effect of social motives, communication and group size on behavior in an n-person multi-stage mixed-motive game. *European journal of social psychology*, 14(3), 239-264. https://doi.org/10.1002/ejsp.2420140302

Merlone, U., & Romano, A. (2017). Commuter bridge: a Braess paradox simulation to teach social dilemmas. *Simulation & Gaming*, *48*(1), 153-169. https://doi.org/10.1177/1046878116671755

Merriam, S. B. (1988). *Case study research in education: A qualitative approach*. San Francisco: Jossey-Bass.

Messick, D. M., & Brewer, M. B. (2005). Solving social dilemmas: A review. In: M. H. Bazerman (Ed.), *Negotiation, decision making and conflict management*. Vol. 1–3 (pp. 98-131). Northampton, MA: Edward Elgar Publishing.

Milinski, M., Semmann, D., Bakker, T. C., & Krambeck, H. J. (2001). Cooperation through indirect reciprocity: Image scoring or standing strategy?. *Proceedings of the Royal Society of London B: Biological Sciences*, 268(1484), 2495-2501. https://doi.org/10.1098/rspb.2001.1809

Molander, P. (1985). The optimal level of generosity in a selfish, uncertain environment. *Journal of Conflict Resolution*, 29(4), 611-618. https://doi.org/10.1177/0022002785029004004

Molm, L. D., Collett, J. L., & Schaefer, D. R. (2007). Building solidarity through generalized exchange: A theory of reciprocity. *American Journal of Sociology*, *113*(1), 205-242. https://doi.org/10.1086/517900

Nowak, M. A. (2006). Five rules for the evolution of cooperation. *Science*, 314(5805), 1560-1563. https://doi.org/10.1126/science.1133755

Nowak, M. A., & Roch, S. (2007). Upstream reciprocity and the evolution of gratitude. *Proceedings of the Royal Society of London B: Biological Sciences*, 274(1610), 605-609. https://doi.org/10.1098/rspb.2006.0125

Nowak, M. A., & Sigmund, K. (1998). Evolution of indirect reciprocity by image scoring. *Nature*, 393(6685), 573-577. https://doi.org/10.1038/31225

Nowak, M. A., & Sigmund, K. (2005). Evolution of indirect reciprocity. *Nature*, 437(7063), 1291-1298. https://doi.org/10.1038/nature04131

Obach, B. (2003). Barriers to collective action: A classroom simulation. *Teaching Sociology*, 31(3), 312-318. https://doi.org/10.2307/3211328

Okada, I. (2020). Two ways to overcome the three social dilemmas of indirect reciprocity. *Scientific reports*, *10*(1), 1-9. https://doi.org/10.1038/s41598-020-73564-5

Ostrom, E. (2010). Analyzing collective action. *Agricultural economics*, *41*, 155-166. https://doi.org/10.1111/j.1574-0862.2010.00497.x

Ostrow, J., Hesser, G., & Enos, S. (1999). *Cultivating the sociological imagination: Concepts and models for service-learning in sociology. AAHE's Series on Service-Learning in the Disciplines*. Washington, DC: American Association for Higher Education.

Paino, M., & Chin, J. (2011). Monopoly and critical theory: Gaming in a class on the sociology of deviance. *Simulation & Gaming*, 42(5), 571-588. https://doi.org/10.1177/1046878110391022

Picault, J. (2019). The economics instructor's toolbox. *International Review of Economics Education*, *30*, 100154. https://doi.org/10.1016/j.iree.2019.01.001

Pickhardt, M. (2005). Teaching public goods theory with a classroom game. *The Journal of Economic Education*, 36(2), 145-159. https://doi.org/10.3200/JECE.36.2.145-159

Porter, T. S., Riley, T. M., & Ruffer, R. L. (2004). A review of the use of simulations in teaching economics. *Social science computer review*, *22*(4), 426-443. https://doi.org/10.1177/0894439304268464

Powers, R. B. (1986). The commons game: Teaching students about social dilemmas. *The Journal of Environmental Education*, 17(2), 4-10. https://doi.org/10.1080/00958964.1986.9941402

Rand, D. G., & Nowak, M. A. (2013). Human cooperation. *Trends in Cognitive Sciences*, 17(8), 413-425. https://doi.org/10.1016/j.tics.2013.06.003

Roberts, G., Raihani, N., Bshary, R., Manrique, H. M., Farina, A., Samu, F., & Barclay, P. (2021). The benefits of being seen to help others: indirect reciprocity and reputation-based partner choice. *Philosophical Transactions of the Royal Society B*, *376*(1838), 20200290. https://doi.org/10.1098/rstb.2020.0290

Ruben, B. D. (1999). Simulations, games, and experience-based learning: The quest for a new paradigm for teaching and learning. *Simulation & Gaming, 30*(4), 498-505. https://doi.org/10.1177/104687819903000409

Singer, P. (1995). *How are we to live?: Ethics in an age of self-interest*. Amherst, NY: Prometheus Books.

Tajfel, H., & Turner, J. C. (1979). The social identity theory of intergroup conflict. In: S. Worchel & W. G. Austin (Eds.), *Psychology of intergroup relations*. (pp. 7-24). Chicago, IL: Nelson Hall.

Takahashi, N. (2000). The emergence of generalized exchange. *American Journal of Sociology*, 105(4), 1105-1134. https://www.jstor.org/stable/3003889

Takata, S. R. (1997). The chairs game: Competition versus cooperation: The sociological uses of musical chairs. *Teaching Sociology*, 25(3), 200-206. https://doi.org/10.2307/1319395

Thielmann, I., Spadaro, G., & Balliet, D. (2020). Personality and prosocial behavior: A theoretical framework and meta-analysis. *Psychological Bulletin*, *146*(1), 30. https://doi.org/10.1037/bul0000217

Titlestad, K., Snijders, T. A. B., Durrheim, K., Quayle, M., & Postmes, T. (2019). The dynamic emergence of cooperative norms in a social dilemma. *Journal of Experimental Social Psychology*, *84*, 103799. https://doi.org/10.1016/j.jesp.2019.03.010

Turner, J.C., Hogg, M. A., Oakes, P. J., Reicher, S. D., & Wetherell, M. S. (1987). *Rediscovering the social group: A self-categorization theory.* New York: Blackwell.

Van Lange, P. A. M., Balliet, D., Parks, C. D., & Van Vugt, M. (2014). *Social dilemmas: The psychology of human cooperation*. New York, NY: Oxford University Press.

Waren, W. (2011). Using 'Monopoly' to introduce concepts of race and ethnic relations. *Journal of Effective Teaching*, 11(1), 28-35. https://eric.ed.gov/?id=EJ1092125

Whitham, M. M. (2021). Generalized generosity: How the norm of generalized reciprocity bridges collective forms of social exchange. *American Sociological Review*, *86*(3), 503-531. https://doi.org/10.1177/00031224211007450

Wilson, R. K., & Sell, J. (1997). "Liar, liar..." cheap talk and reputation in repeated public goods settings. *Journal of Conflict Resolution*, 41(5), 695-717. https://doi.org/10.1177/0022002797041005005

Wu, J., & Axelrod, R. (1995). Coping with noise: How to cope with noise in the Iterated Prisoner's Dilemma. *Journal of Conflict Resolution*, 39(1), 183–189. https://doi.org/10.1177/0022002795039001008

Yamagishi, T., & Cook, K. S. (1993). Generalized exchange and social dilemmas. *Social Psychology Quarterly*, 56(4), 235-248. https://doi.org/10.2307/2786661

Yamagishi, T., Jin, N., & Kiyonari, T. (1999). Bounded generalized reciprocity: Ingroup boasting and ingroup favoritism. In: S. Thye, M. Macy, H. Walker, & E. Lawler (Eds.), *Advances in Group Processes* (pp. 161-197). New York: Elsevier Science.

# Appendix

Payoff calculation sheet

**Group _____ Number _____ Sex _____ Major _____**

Your score would be _____

* \_\_\_\_\_0\_\_\_\_ if you sent YELLOW forward and received YELLOW from backward.
* \_\_\_\_25\_\_\_\_ if you sent YELLOW forward and received BLUE from backward.
* \_\_\_−15\_\_\_\_ if you sent BLUE forward and received YELLOW from backward.
* \_\_\_\_10\_\_\_\_ if you sent BLUE forward and received BLUE from backward.

**<Session 1> My total score = _____**

| Round | Which card to send | Which card to received | My score |
|-------|--------------------|------------------------|----------|
| 1 | Yellow, Blue | Yellow, Blue | |
| 2 | Yellow, Blue | Yellow, Blue | |
| 3 | Yellow, Blue | Yellow, Blue | |
| 4 | Yellow, Blue | Yellow, Blue | |

**<Session 2> My total score = _____**

| Round | Which card to send | Which card to received | My score |
|-------|--------------------|------------------------|----------|
| 1 | Yellow, Blue | Yellow, Blue | |
| 2 | Yellow, Blue | Yellow, Blue | |
| 3 | Yellow, Blue | Yellow, Blue | |
| 4 | Yellow, Blue | Yellow, Blue | |

**<Session 3> My total score = _____**

| Round | Which card to send | Which card to received | My score |
|-------|--------------------|------------------------|----------|
| 1 | Yellow, Blue | Yellow, Blue | |
| 2 | Yellow, Blue | Yellow, Blue | |
| 3 | Yellow, Blue | Yellow, Blue | |
| 4 | Yellow, Blue | Yellow, Blue | |

**<Session 4> My total score = _____**

| Round | Which card to send | Which card to received | My score |
|-------|--------------------|------------------------|----------|
| 1 | Yellow, Blue | Yellow, Blue | |
| 2 | Yellow, Blue | Yellow, Blue | |
| 3 | Yellow, Blue | Yellow, Blue | |
| 4 | Yellow, Blue | Yellow, Blue | |

**Thanks a lot for your participation!**