**Appendix 1**

Here we find a symmetrical quantal response equilibrium (QRE) for PD in Markov strategies.

Consider $\left\{α\_{1},γ\_{1}\right\}$ – Markov strategies for player 1, and $\left\{α\_{2},γ\_{2}\right\}$ – Markov strategies for player 2, $\left\{λ\_{1},λ\_{2}\right\}$ – parameters of rationalities for players 1 and 2 (rationalities are assumed to be constants).

We find QRE for this game using the following approach: fix both parameters of one player (for example, $α\_{2}$ and $γ\_{2}$) and only one parameter for another player (for example, $γ\_{1}$). After, we switch to the symmetrical case by assuming $α\_{1}= α\_{2}, γ\_{1}=γ\_{2},λ\_{1}=λ\_{2}$. The combination of pure strategies for another parameter then gives us the required equation of QRE. We must determine the equations of payoff function for different cases of strategy fixation.

Using system (2), we have:

$$p\_{1}^{c}=\frac{α\_{1}-α\_{2}(α\_{1}-γ\_{1})}{1-(α\_{1}-γ\_{1})(α\_{2}-γ\_{2})}, p\_{2}^{c}=\frac{α\_{2}-α\_{1}(α\_{2}-γ\_{2})}{1-(α\_{1}-γ\_{1})(α\_{2}-γ\_{2})}$$

First, we fix the profile of strategies $α\_{2},γ\_{2}, γ\_{1}$ and calculate the probabilities of cooperative choice for pure strategies $α\_{1}=0 $and $α\_{1}=1$.

For $α\_{1}=0$ we have:

$$p\_{1}^{c}=\frac{α\_{2}γ\_{1}}{1+γ\_{1}(α\_{2}-γ\_{2})},$$

$$p\_{2}^{c}=\frac{α\_{2}}{1+γ\_{1}(α\_{2}-γ\_{2})}.$$

For $α\_{1}=1$ we have:

$$p\_{1}^{c}=\frac{1-α\_{2}+α\_{2}γ\_{1}}{1+(1-γ\_{1})(α\_{2}-γ\_{2})},$$

$$p\_{2}^{c}=\frac{γ\_{2}}{1-(α\_{2}-γ\_{2})(1-γ\_{1})}.$$

Then, we fix the profile of strategies $α\_{2},γ\_{2}, α\_{1}$ and obtain the probabilities of cooperative choice for pure strategies $γ\_{1}=0 $and $γ\_{1}=1$.

For $γ\_{1}=0$:

$$p\_{1}^{c}=\frac{α\_{1}-α\_{2}α\_{1}}{1-α\_{1}(α\_{2}-γ\_{2})},$$

$$p\_{2}^{c}=\frac{α\_{2}-α\_{2}α\_{1}+α\_{1}γ\_{2}}{1-α\_{1}(α\_{2}-γ\_{2})}.$$

When $γ\_{1}=1$:

$$p\_{1}^{c}=\frac{α\_{1}+α\_{2}-α\_{2}α\_{1}}{1-(α\_{2}-γ\_{2})(α\_{1}-1)},$$

$$p\_{2}^{c}=\frac{α\_{2}-α\_{2}α\_{1}+α\_{1}γ\_{2}}{1-(α\_{2}-γ\_{2})(α\_{1}-1)}.$$

In the symmetrical case, we have $α\_{1}= α\_{2},γ\_{1}= γ\_{2}, λ\_{1}= λ\_{2}$. Then, the probabilities of cooperative choice transform to the following equations:

$$p\_{1}^{c}\left.​\right|\_{α\_{1}=0}=\frac{αγ}{1+γ(α-γ)}, p\_{2}^{c }\left.​\right|\_{α\_{1}=0}=\frac{α}{1+γ(α-γ)},$$

$$p\_{1}^{c}\left.​\right|\_{α\_{1}=1}=\frac{1-α+αγ}{1-(1-γ)(α-γ)}, p\_{2}^{c}\left.​\right|\_{α\_{1}=1}=\frac{γ}{1-(1-γ)(α-γ)},$$

$$p\_{1}^{c}\left.​\right|\_{γ\_{1}=0} =\frac{α-α^{2}}{1-α(α-γ)}, p\_{2}^{c }\left.​\right|\_{γ\_{1}=0}=\frac{α-α^{2}+αγ}{1-α(α-γ)},$$

$$p\_{1}^{c }\left.​\right|\_{γ\_{1}=1}=\frac{2α-α^{2}}{1-(α-1)(α-γ)}, p\_{2}^{c }\left.​\right|\_{γ\_{1}=1}=\frac{α-α^{2}+αγ}{1-(α-1)(α-γ)}.$$

Note that if we first made the symmetrical assumption before substituting pure strategies into resulted expressions, we would only obtain extreme cases.

Next, we find the payoff functions using (3) for particular strategies (note that, e.g., $α=0$ is rather a formal notation, than traditional substitution in formulas below):

$$U\left.​\right|\_{α=0}=\frac{-4α^{2}γ}{(γ\left(α-γ\right)+1)^{2}}-\frac{αγ}{\left(γ\left(α-γ\right)+1\right)}+\frac{9α}{\left(γ\left(α-γ\right)+1\right)}+1,$$

$$U\left.​\right|\_{α=1}=\frac{-4γ(-α\left(1-γ\right)+1)}{(-\left(α-γ\right)(1-γ)+1)^{2}}+\frac{9γ}{\left(-\left(α-γ\right)(1-γ)+1\right)}-\frac{\left(-α\left(1-γ\right)+1\right)}{\left(-\left(α-γ\right)\left(1-γ\right)+1\right)}+1,$$

$$U\left.​\right|\_{γ=0}=\frac{-\left(α^{2}+α\right)}{\left(-α\left(α-γ\right)+1\right)}-\frac{4\left(-α^{2}+α\right)\left(-α\left(α-γ\right)+α\right)}{\left(-α\left(α-γ\right)+1\right)^{2}}+\frac{9\left(-α\left(α-γ\right)+α\right)}{\left(-α\left(α-γ\right)+1\right)}+1,$$

$$U\left.​\right|\_{γ=1}=\frac{-(α(α-1)+α)}{(-(α-1)\left(α-γ\right)+1)}-\frac{4\left(-α\left(α-1\right)+α\right)\left(-α\left(α-γ\right)+α\right)}{\left(-\left(α-1\right)\left(α-γ\right)+1\right)^{2}}+\frac{9\left(-α\left(α-γ\right)+α\right)}{\left(-\left(α-1\right)\left(α-γ\right)+1\right)}+1.$$

Finally, we find QRE for PD in Markov strategies solving system of equations:

|  |  |
| --- | --- |
| $$\left\{\begin{array}{c}α= \frac{e^{λU\left.​\right|\_{α=1}}}{e^{λU\left.​\right|\_{α=0}}+e^{λU\left.​\right|\_{α=1}}},\\γ= \frac{e^{λU\left.​\right|\_{γ=1}}}{e^{λU\left.​\right|\_{γ=0}}+e^{λU\left.​\right|\_{γ=1}}},\end{array}\right.$$ |  |

where $α\in \left[0;1\right]$ and $γ\in \left[0;1\right]$ are unknowns, and $λ\in [0;+\infty )$ is fixed. Note that different values of the rationality may lead to different profiles of strategies.

**Appendix 2**

Participants were recruited from the Moscow Institute of Physics and Technology in Moscow. A total of 168 individuals (72 females) participated in 14 experiments. We recruited participants through posting advertisements on the social networking site VKontakte. For every experiment, we only selected participants who were unacquainted with each other. Because our participants were students, we collected demographic information, such as academic major, group, and year of study. All participants were provided with written and verbal instructions related to the experiment. Experimenters notified participants that all points won in the games would be converted to real money (the average win rate was approximately equal to the cost of a full lunch in a cafe). The study procedures involving human participants were approved by the Skolkovo Institute of Science and Technology (Skoltech) Human Subjects Committee. Written informed consents were obtained from participants. All methods were performed in accordance with the relevant guidelines and regulations. Experimental data are available from the authors. The experimental design and the results are also presented in the following papers9,26,38.

**Game*.*** The study employed the Prisoner’s Dilemma Game (PD).

**Iterated Prisoner’s Dilemma Game.** Two individuals anonymously participated in each round of the game. They both had two strategies: cooperation or defection (Table 1). Participants were divided into pairs randomly each period of the game.

**Experimental design.** The experimental procedure consisted of three stages. To execute the game, z-Tree, a specialized tool developed at the University of Zurich for designing and performing experiments in a group of experimental economics, was used39.

**Stage 1: Anonymous playing phase.** Participants played the Prisoner’s Dilemma Game for eleven to twenty-two game rounds. Participants did not know how many rounds they would play. In each round, participants were randomly divided into pairs and made choices simultaneously and independently of each other. In each round, participants were re-paired randomly, and participants were unaware of who they were playing against. After each of the periods, each participant observed their own and their opponent’s results on a screen.

Points earned at this stage were added to the total win and converted into real money at the end of the game.

**Stage 2: Socialization phase.** In this phase, participants engaged in social interaction, which consisted of familiarization, communication, and division into groups. The participants memorized each other’s names by playing "snowball"9. According to the game, players were seated in a circle, and the first person said his/her name and a personal quality that started with the same letter as the name. Second, the next participant repeated the name along with the quality of the first participant and gave his/her name and quality. This process was repeated with each participant until the last person, who was due to repeat all the names and personal qualities. Then, in a different order, the participants shared personal information, such as their hometown, academic major, hobbies, and interests. Following that, two captains were volunteer selected themselves from among the participants. The captains remained indoors while the other participants left the room. Then, in random order, they entered the room one by one. Every participant who entered the room chose a captain whose group he/she wanted to join. Consequently, two groups of 6 people were formed. In the end, each group of 6 people was tasked to find 5 common characteristics (i.e., 5 characteristics that united them) and choose a name for their group.

**Stage 3. Socialized phase.** The participants played the Prisoner's Dilemma Game. However, unlike the first stage, the participants interacted only in the groups of 6 previously composed during the socialization phase of the experiment. For each round, the participants were randomly divided into pairs. They were informed that they were interacting with a member of their "own" group, but they did not know who exactly that person was. After each of the periods, each participant observed their own and their opponent’s results on a screen. Both the games consisted of 15-20 rounds. The group names, chosen by participants at the socialization stage, appeared on monitors in the Prisoner's Dilemma Game.

Points were added to those obtained at the first stage. As a result, the final prize was generated and could be converted into a cash reward to compensate participants.

The schematic representation of the experiment design included the following components:

1. 12 participants are recruited (12 strangers).

2. Participants play PD in a mixed-gender group of 12 people for 11-22 rounds.

3. Socialization of unacquainted members of groups occurs. Participants are divided into two groups of 6 people.

4. Participants play PD in the newly formed groups for 15-20 rounds.

5. Participants are compensated for the experiment.

**Appendix 3**

Table 1. Experimental results aggregated by experiments.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Number of the experiment | % of cooperation before socialization | alpha before socialization | gamma before socialization | % of cooperation after socialization | alpha after socialization | gamma after socialization |
| Exp\_1 | 18.89% | 0.19 | 0.22 | 36.67% | 0.34 | 0.43 |
| Exp\_2 | 13.89% | 0.16 | 0.04 | 3875% | 0.34 | 0.45 |
| Exp\_3 | 17.22% | 0.13 | 0.32 | 59.58% | 0.38 | 0.72 |
| Exp\_4 | 29.17% | 0.25 | 0.36 | 88.33% | 0.69 | 0.91 |
| Exp\_5 | 25.38% | 0.20 | 0.36 | 47.50% | 0.36 | 0.58 |
| Exp\_6 | 14.02% | 0.12 | 0.14 | 53.75% | 0.23 | 0.80 |
| Exp\_7 | 26.52% | 0.21 | 0.38 | 85.00% | 0.71 | 0.89 |
| Exp\_8 | 9.47% | 0.07 | 0.17 | 32.92% | 0.26 | 0.43 |
| Exp\_9 | 20.56% | 0.17 | 0.25 | 42.92% | 0.30 | 0.57 |
| Exp\_10 | 28.33% | 0.31 | 0.19 | 35.42% | 0.27 | 0.49 |
| Exp\_11 | 25.56% | 0.21 | 0.33 | 81.67% | 0.50 | 0.88 |
| Exp\_12 | 20.45% | 0.18 | 0.29 | 67.50% | 0.37 | 0.81 |
| Exp\_13 | 33.33% | 0.27 | 0.43 | 57.50% | 0.58 | 0.57 |
| Exp\_14 | 28.79% | 0.27 | 0.25 | 84.44% | 0.73 | 0.86 |
| Mean: | **22.25%** | **0.20** | **0.27** | **58.00%** | **0.43** | **0.67** |