Laboratory experiments as a nudging to study game theory and behavioral economics

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Problem. The widespread use of laboratory experiments allows a deep study of people's behavior when making decisions in socio-economic situations.

However, it is equally important that society at least at a basic level adequately assimilates new theoretical approaches, since this can and should lead to a positive impact on the efficiency of the economic system as a whole.

To solve this problem, you can rely on the principle of “learning by doing”, which allows you to nudge the participants in the experiments to master the basic concepts of game theory and behavioral economics.

In the fifth year, students at the PhysTech School of Applied Mathematics and Computer Science traditionally take a course in game theory and decision-making.

Menshikov I.S. Lectures Notes on Game Theory and Economic Modeling, 2010 (in Russian)

Gibbons S. Game Theory for Applied Economists. 1992.

The theoretical foundations of the courses are not accompanied by practical exercises, which complicates the assimilation of the material.

So it was decided to add laboratory games based on the oTree system.

For this purpose, a wireless local area network was installed in the lecture room, and students only needed to have a telephone or other device for working with a browser to participate in the experiments.

Model. For each of the 14 lectures of the training course, one or two laboratory games were developed.

Some of these games were designed to master the concepts of game theory, and some were devoted to socio-economic models that can be built on the basis of these concepts.

Within the framework of the course, four main classes of games are successively studied: static and dynamic games of complete information, as well as static and dynamic games of incomplete information.

Four main types of equilibria correspond to these classes of games: Nash equilibrium, Subgame Perfect Nash equilibrium, Bayes-Nash equilibrium, Perfect Bayes equilibrium (or, alternatively, Sequential equilibrium).

Laboratory games

- **Static Games of Complete Information**
  - Normal form, dominated strategies, Nash equilibrium
    - Prisoners' Dilemma
    - Battle of Sexes
  - Economic models based on static games with complete information
    - Cournot Model of Duopoly
    - Common Good (Linear model)
  - Mixed Strategies and the Existence of Nash equilibria
    - Matching Pennies (asymmetric case)
    - 11-20 (Rubinstein)
- **Dynamic Games of Complete Information**
  - Perfect Information. Backwards Induction.
    - Add no more than 10 until 100.
    - The Trust Game
  - Economic models based on dynamic games with perfect information
    - Stackelberg Model of Duopoly
    - Firm and Union (wages and employment, Leontief)

    - Dynamic games of complete but imperfect information
        - Stackelberg – Cournot (leader and two followers)
    - Repeated games
        - Repeated Prisoners' Dilemma (random number of reputations)
    - Models based on repeated gamed
        - Sequential bargaining over inheritances
        - Efficiency wages: firm and worker
    - Extensive Form Presentation of Games
        - An example of an extensive form game of imperfect information
- **Static Games of Incomplete Information**
    - Static Bayesian Games, Bayesian Nash Equilibrium
        - Battle of Sexes (asymmetric information)
    - Auctions and the Revelation Principle
        - Double Auction. Seller and Buyer
- **Dynamic Games of Incomplete Information**
    - Perfect Bayesian Equilibrium, Sequential Equilibrium
        - Asymmetric information about moves of Nature
    - Signaling Games
        - Signal Advertising
    - Models based on signaling games
        - Lemons market

As part of the intermediate and final tests, students are offered tasks to understand which class of games the described economic situation belongs to and what type of equilibrium should be sought here.

Many years of experience in conducting tests on the course showed that if students at MIPT adequately understand the game-theoretic logic, then the mathematics associated with the problems does not cause difficulties.

The main problem for a large mass of students is the correlation of common sense, which, as it seems to them, follows from the rules of the game with formal constructions.

The introduction to the laboratory games course was aimed at helping them combine two views on the game: the participant in the game and the theorist as an outside observer.

10-15 minutes with a small number of repetitions were allocated for one game at a lecture.

The main goal was to interest students in the game and nudge them to analyze it.

Result 1. Introduction to the lecture course of laboratory games significantly increased attendance.

By tradition, MIPT students are not required to attend lectures.

Many, for various reasons, prefer to prepare for the test work on their own.

Laboratory games and a brief discussion of their results aroused obvious interest and allowed students to be involved in a discussion of what the game theory can and cannot explain in people's behavior in socio-economic situations.

Even students who did not have to officially pass the game theory attended lectures and participated in games.

Result 2. The students' academic performance at the course increased.

A comparison of performance was carried out on the basis of a database of student ratings for past years.

For each student, each item of each task was evaluated separately, so each student received about 15 grades.

This made it possible to compare academic performance both by year as a whole and separately by game class.

Result 3. The involvement of students in the assimilation of material increased.

Compared with last year, when a certain bonus in the final grade was given simply by the number of lectures attended, the relationship between attendance at lectures and academic performance based on the results of the test work changed radically.

In 2018, only one student who regularly attended lectures got into the top 10 according to the results of the test.

In 2019, 9 out of 10 students with the best test results regularly attended classes and successfully participated in laboratory games.

Of the 20 students who scored the highest scores for games, only one was in the 10 worst according to the results of the test.

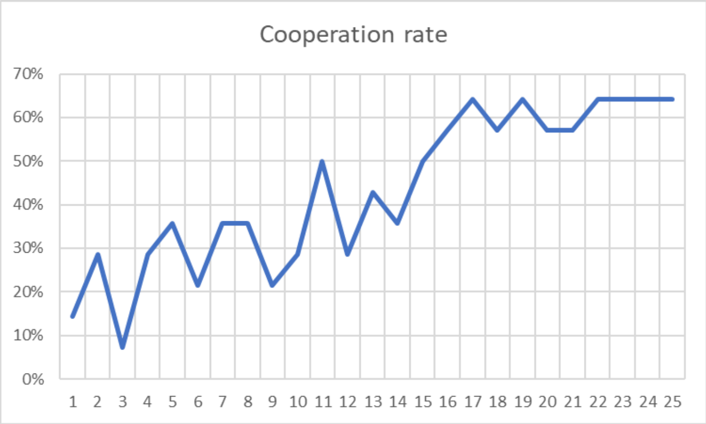
The long-term use of laboratory games in experimental economics classes for a small group (up to 20) of MIPT students made it possible to say earlier that the principle of “learning by doing” is applicable to game theory and, especially, to behavioral economics.

Modern technologies make it possible to successfully apply this method of interactive learning in lecture halls (up to 100 people) with relatively little time, but nevertheless with a significant effect.

How to solve the Prisoners' Dilemma using behavioral economics?

	C	D
C	20,20	0,30
D	30,0	10,10

The original game. 10 participants, 20 reps, **random partners in pairs**.
Share of cooperative moves**: 5%.**
Cooperative moves are mostly at the beginning of the game.
Modified game.
Ranking by the number of cooperative moves in past repetitions.
Couples are neighbors in the ranking. 43% of cooperative moves.



How to solve the Battle of the Sexes using behavioral economics?

	A	B
A	20,10	0,0
B	0,0	10,20

Original game. 12 participants, 20 repetitions, random partners in pairs.

Coordination level: **53%**

Modified game.

Common signal to each pair: A or B with equal probability.

It is not necessary to follow the signal.

Coordination level: **79%**

Focal point effect

References

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