Visualizing cooperation theory in the non-majors evolution classroom:

free tools for teaching the evolutionary dynamics of the *Prisoner's Dilemma*

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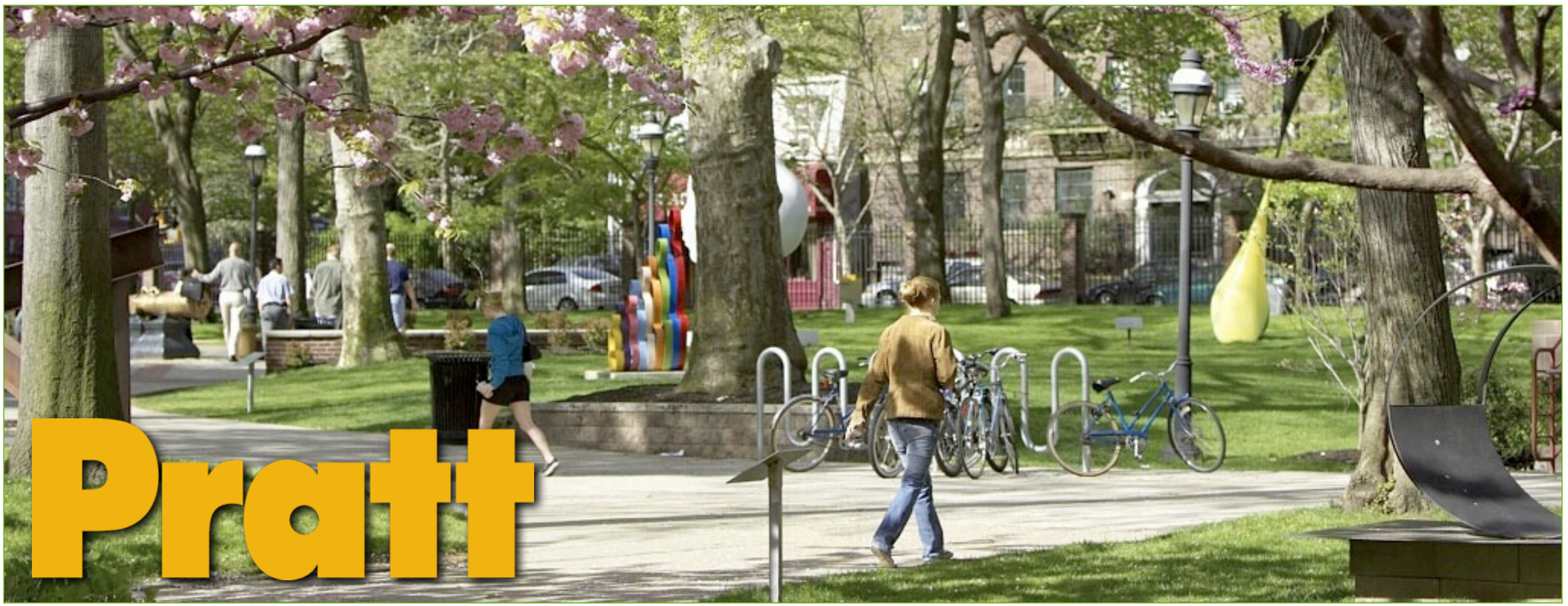
Pratt Institute?



- ★ Located in the Fort Greene/Clinton Hill neighborhood of Brooklyn, NY, USA
- ★ Offers graduate and undergraduate degrees in art, design, architecture, creative writing, critical studies, and library science

Source: Pratt.edu

The only EvCoop course for non-majors?

THE EVOLUTION OF COOPERATION

MSCI-463, The Evolution of Cooperation
Department of Mathematics and Science, School of Liberal Arts and Sciences, Pratt Institute

Course Description:

When we describe what propels evolution, "competition" and "exploitation" are the processes that first come to mind. However, cooperation within and between organisms has also played a prominent role in the evolution of the earth's species. In this course, we will consider the various levels at which cooperation has emerged as the result of natural selection, starting with single-celled organisms and building up to human cultural systems. While the course has no prerequisites, the readings and assignments will be aimed at highly-motivated students; students will be expected to conduct significant independent inquiry.

Upon completion, this course is worth three (3) credits.

Meeting Time: *Section 01:* Tuesdays, 9:30 am to 12:20 pm, Engineering 111
Section 02: Wednesdays, 9:30 am to 12:20 pm, Engineering 111

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The *Prisoner's Dilemma* (PD) and evolutionary theory explaining cooperation

Source: Google Scholar

The Prisoner's Dilemma *is often the default interaction module in evolutionary models explaining cooperation*

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Free Teaching Tools

★ **Evolutionary Games Infographic Project:**
Free images available via the web
(Wikimedia Commons + my site)
http://egip.christopherxjjensen.com

★ **Easy Iterated Prisoner's Dilemma:**
Free flash-based classroom activity
http://easy-ipd.christopherxjjensen.com/

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evolutionary games infographics project

*Created in collaboration with **Greg Riestenberg** (Graphic Designer & Lecturer at Kean University)*

★ Create a library of graphic images that can be used to teach game theory related to cooperation

★ Highlight critical conceptual components of these games using visual design

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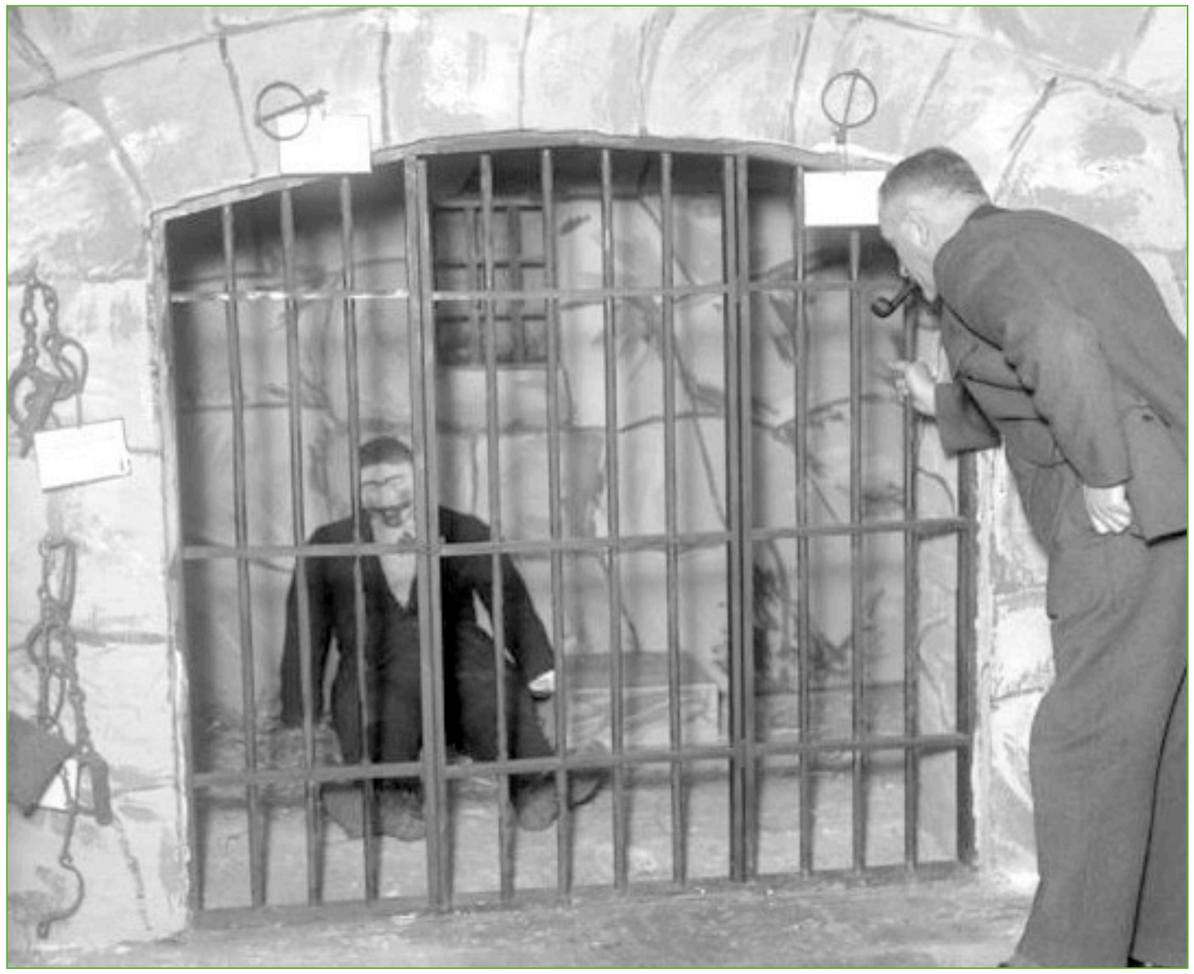
Is the archetypal PD story an asset or a liability?

Illustrative

Elements of the PD story emphasize key aspects of the game theory construct (e.g. symmetrical, simultaneous non-negotiated decision-making)

Motivating

Students find a story more interesting and easier to understand/remember.



Source: Wikimedia Commons

Inconsistent

The *Prisoner's Dilemma* story is told in a variety of ways, many of which are not particularly clear

Counter-Intuitive

Earning "payoffs" translates to avoiding jail time, so the "payoff" in the matrix does not map to the outcome "amount of time spent in jail"

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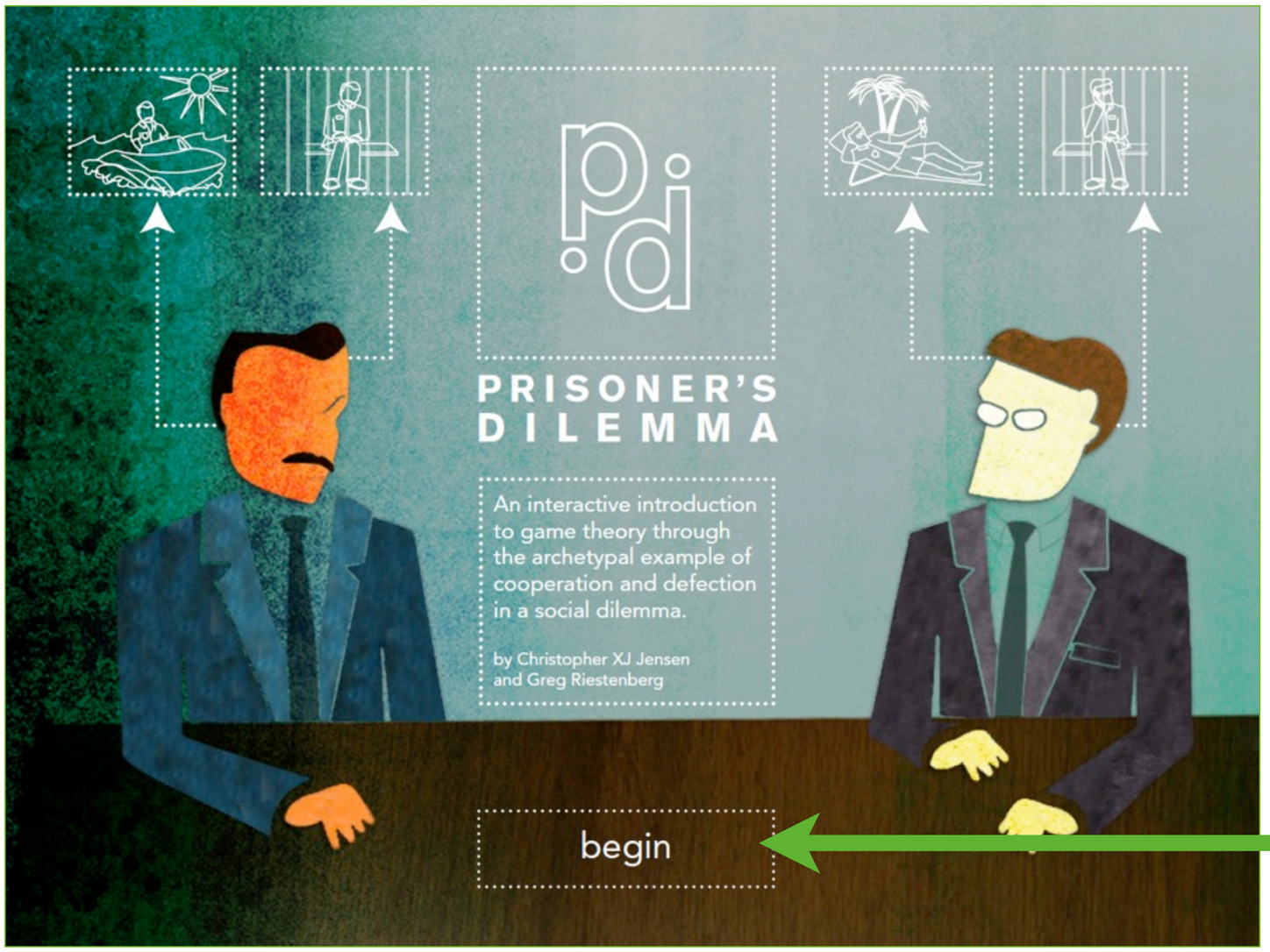
Interactive Storybook

Emphasizing the value of the PD story



Source: http://egip.christopherxjjensen.com

Interactive PDF

Allows students to navigate through the different scenarios of the *Prisoner's Dilemma* at their own pace and along a path of their own choosing

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Interactive Storybook

Emphasizing the value of the PD story

Source: http://egip.christopherxjjensen.com

First person

Students imagine themselves in the role of one of the embezzlers, choosing how to behave and seeing the consequences of their choice and the choice of their “partner”

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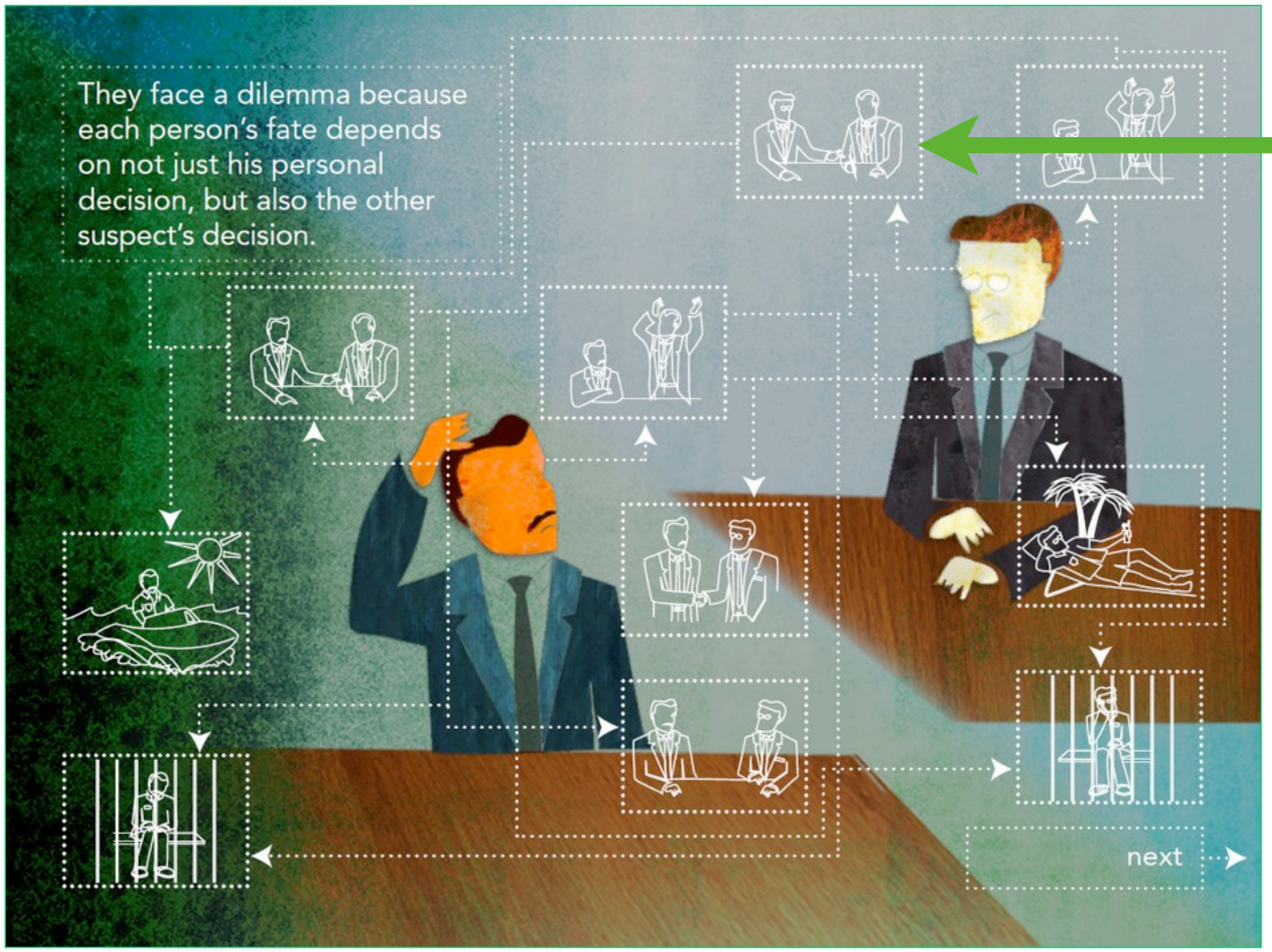
Interactive Storybook

Emphasizing the value of the PD story



Source: http://egip.christopherxjjensen.com

Iconographic

Different images are used to represent both different strategies and different outcomes

They face a dilemma because each person's fate depends on not just his personal decision, but also the other suspect's decision.

next

The way we usually represent the PD

punishment payoff *P*.

This can be expressed in normal form:

Canonical PD payoff matrix

	Cooperate	**Defect**
Cooperate	*R*, *R*	*S*, *T*
Defect	*T*, *S*	*P*, *P*

and to be a prisoner's dilemma game in
the payoffs:

$T > R > P > S$

The payoff relationship $R > P$ implies th

Source: Wikipedia

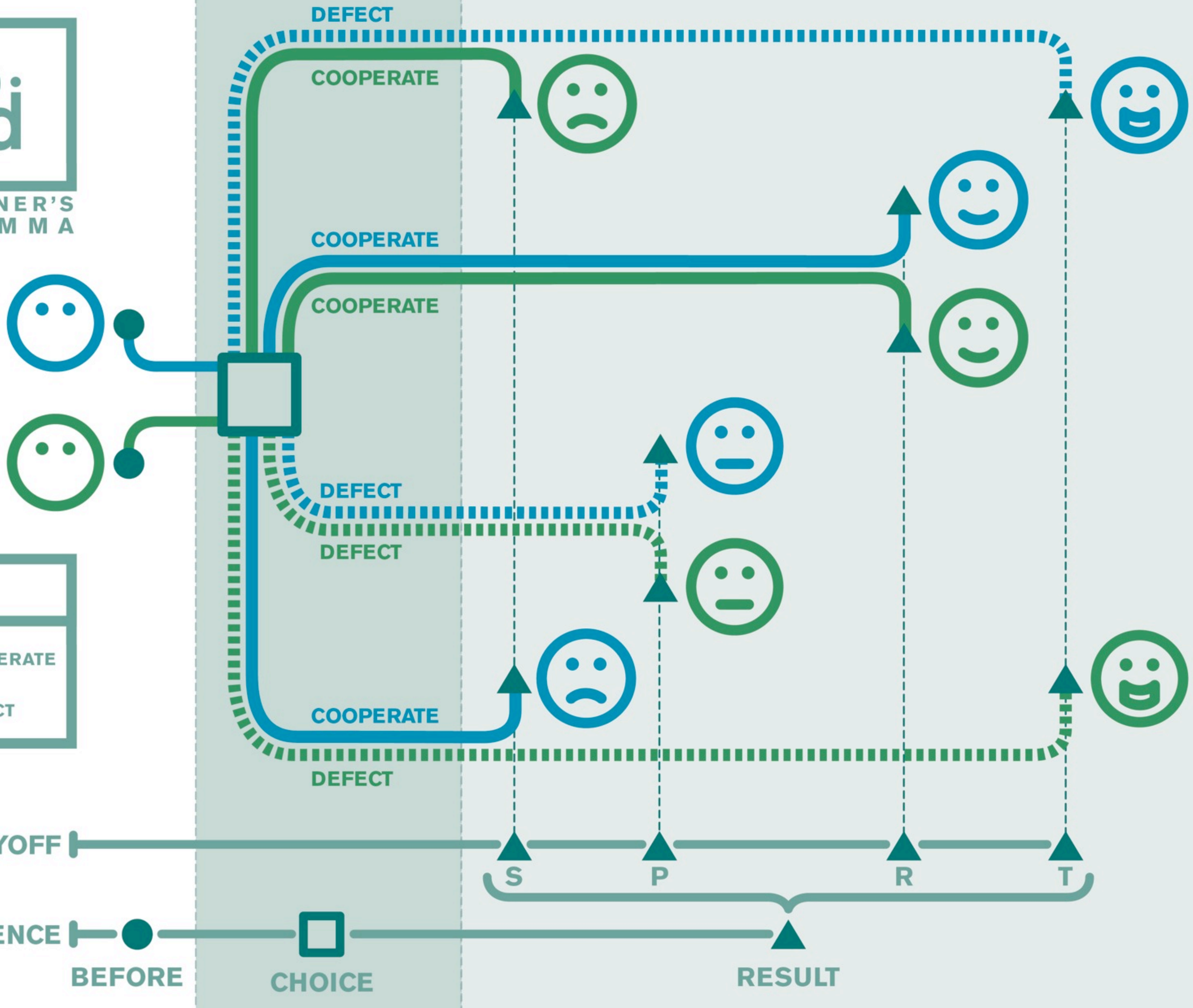
Abstract

Non-intuitive

(at least this version is color-coded)

Separated from definition of terms

PRISONER'S DILEMMA



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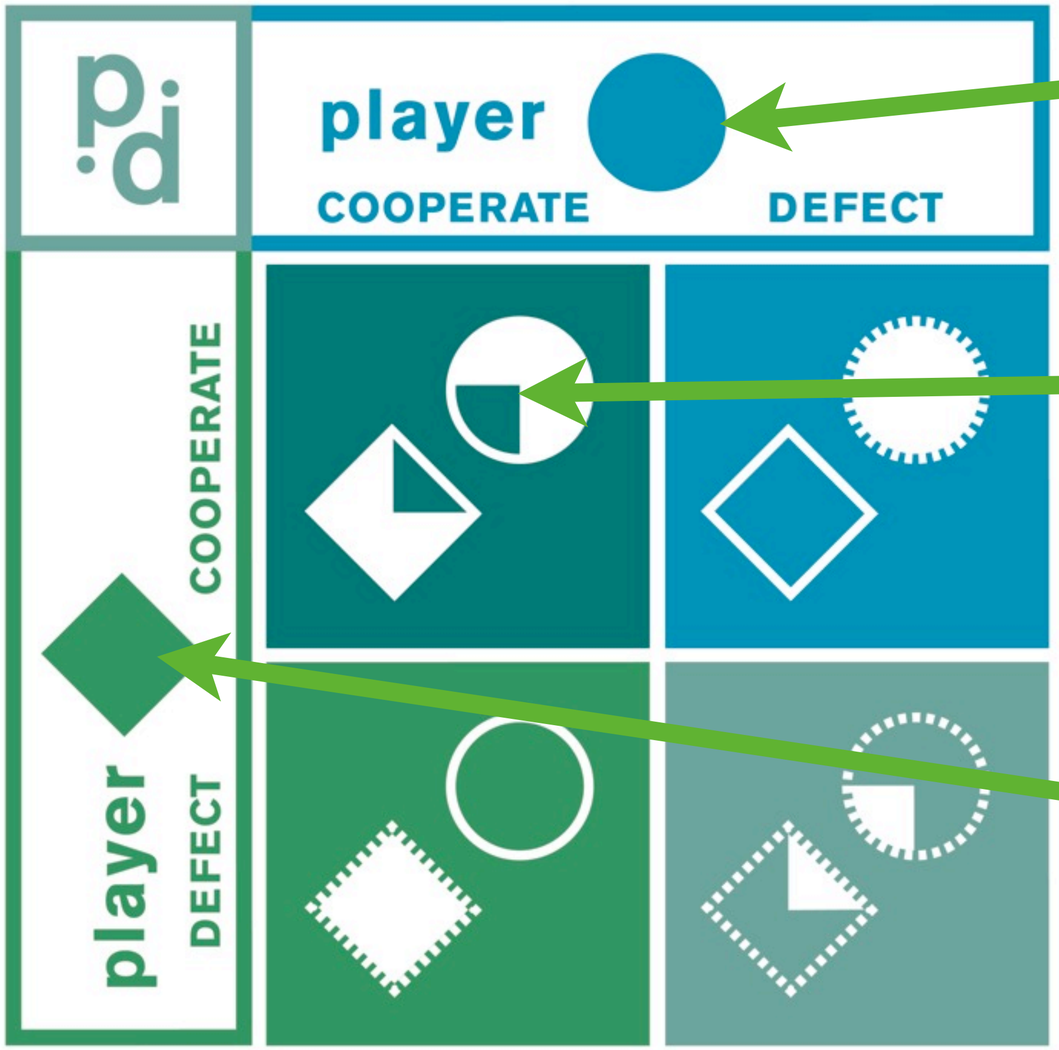
Non-mathematical matrices

Using color and shape to show outcomes



Color-coded

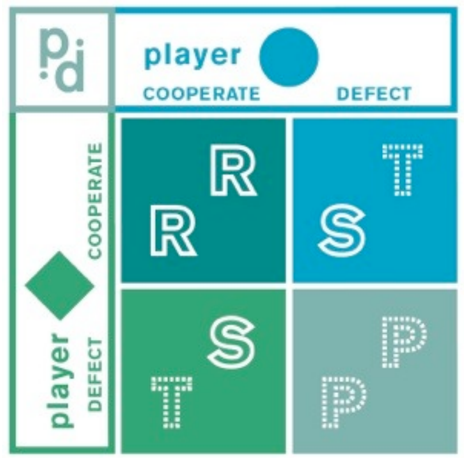
Two colors represent the players

Non-numerical

Shape fill and overall background color signal the outcome of each strategy pair

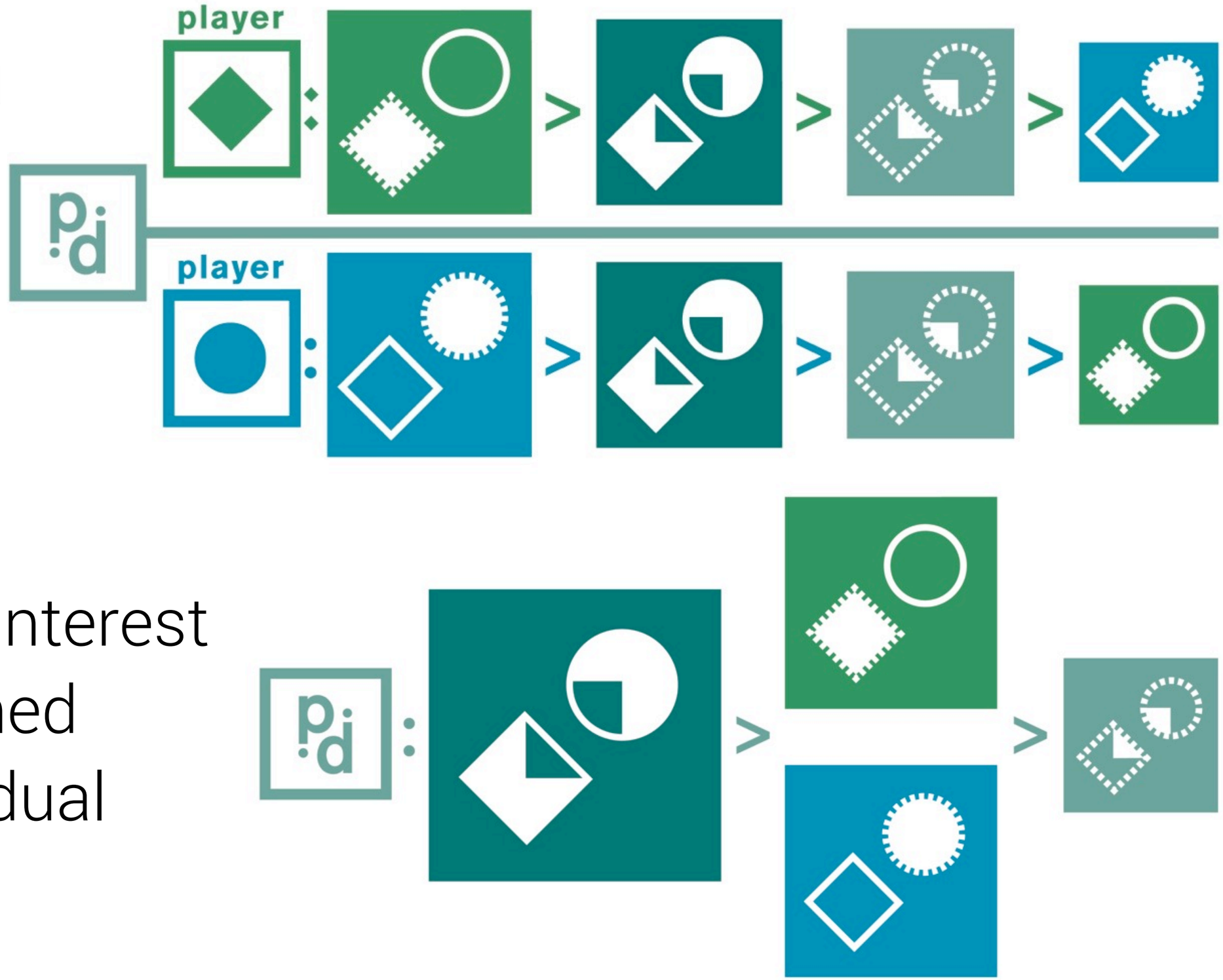
Shape-coded

Two shapes provide an additional representation of each player

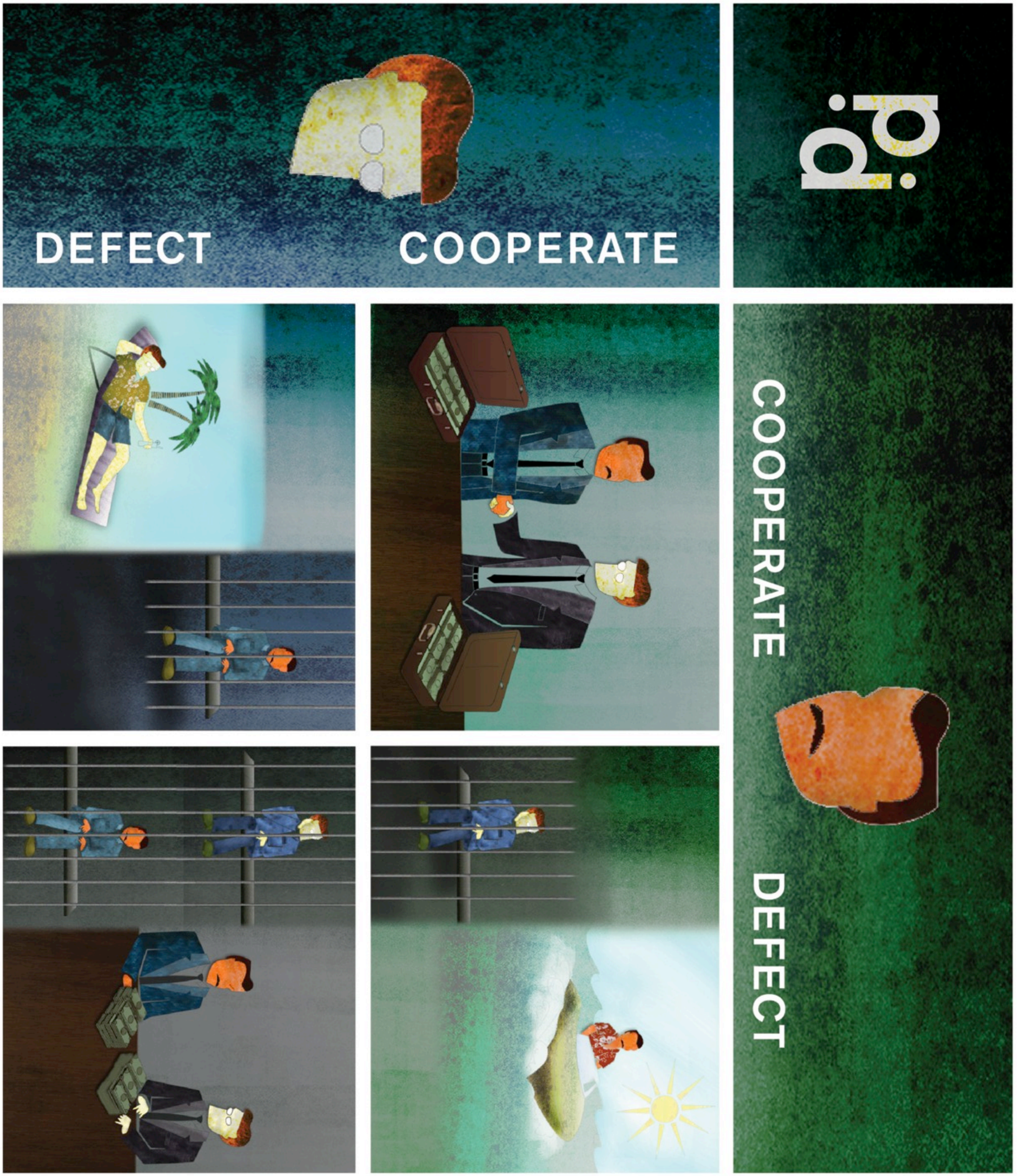


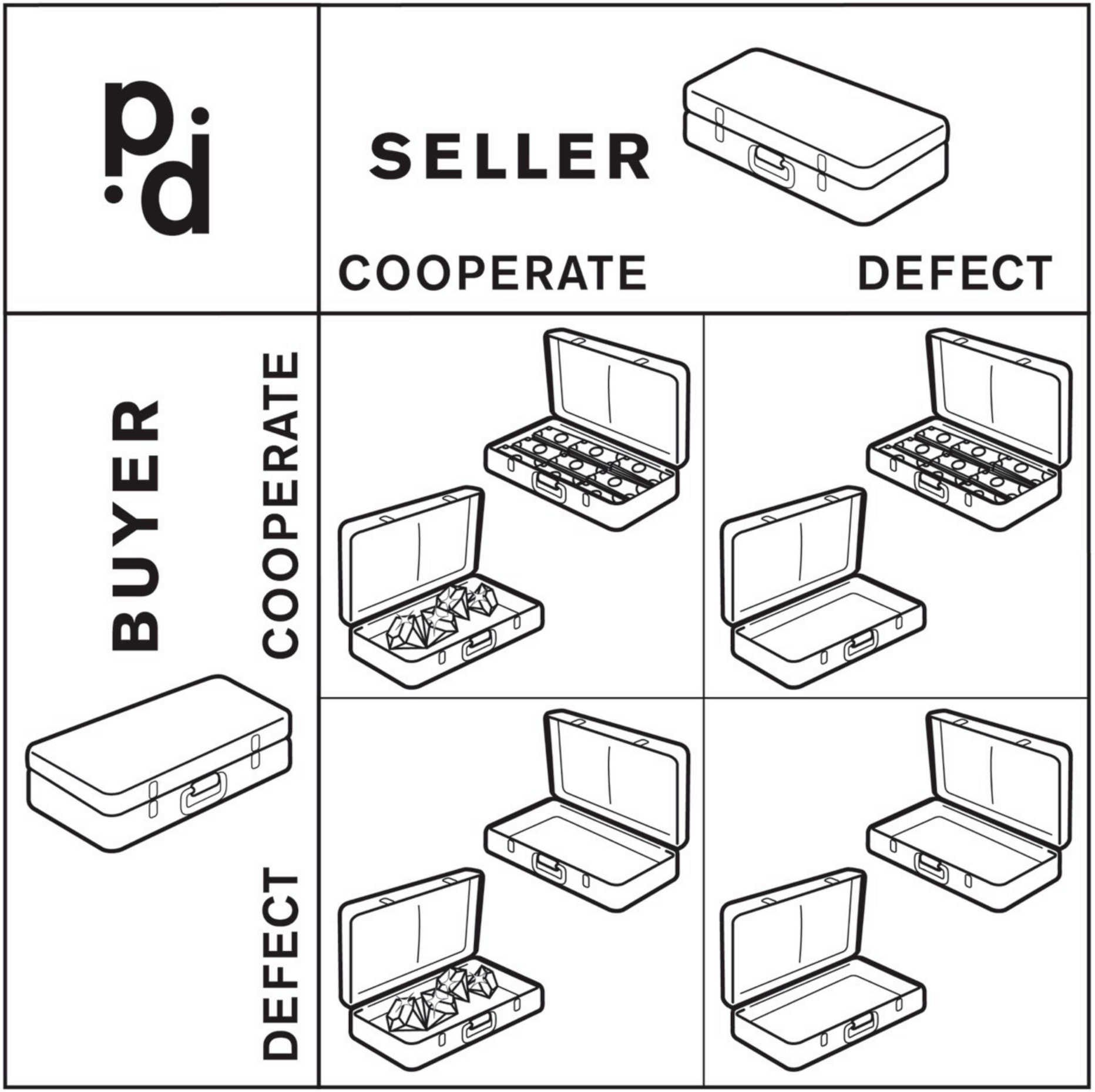
Source: http://egip.christopherxjjensen.com

Conflicting individual interests



Collective interest is not aligned with individual interests


DEFECT
COOPERATE
p.p
COOPERATE
DEFECT


SELLER
COOPERATE
DEFECT
BUYER
COOPERATE
DEFECT

		against opponent playing : C	against opponent playing : D
score earned by playing :	C	3	0
score earned by playing :	D	5	1

Easy Iterated Prisoner's Dilemma

*Created in collaboration with **Jean Ho Chu** (Media Artist/Designer & Graduate Student at Georgia Tech)*

★ Allow students to set up Axelrod IPD tournaments of their own design

★ Provide multiple visualizations to help students analyze tournament results

★ Provide an interactive activity that can be easily embedded into Learning Management Systems

Results for Tournament #2 | Grid | Network | Details | Graph
History for Tournament #1
Recap | Questions

Learn
Background
Rules
History
Implications

Close

RULES OF THE ITERATED PRISONER'S DILEMMA

The Iterated Prisoner's Dilemma (IPD) is a simple game. During each round, a pair of players compete to earn the most points. Each player chooses to either "cooperate" (C) or "defect" (D). As the two tables below show, the payoff for cooperating or defecting depends on what the opposing player chooses:

Scores for one player based on the strategy employed by an opponent :

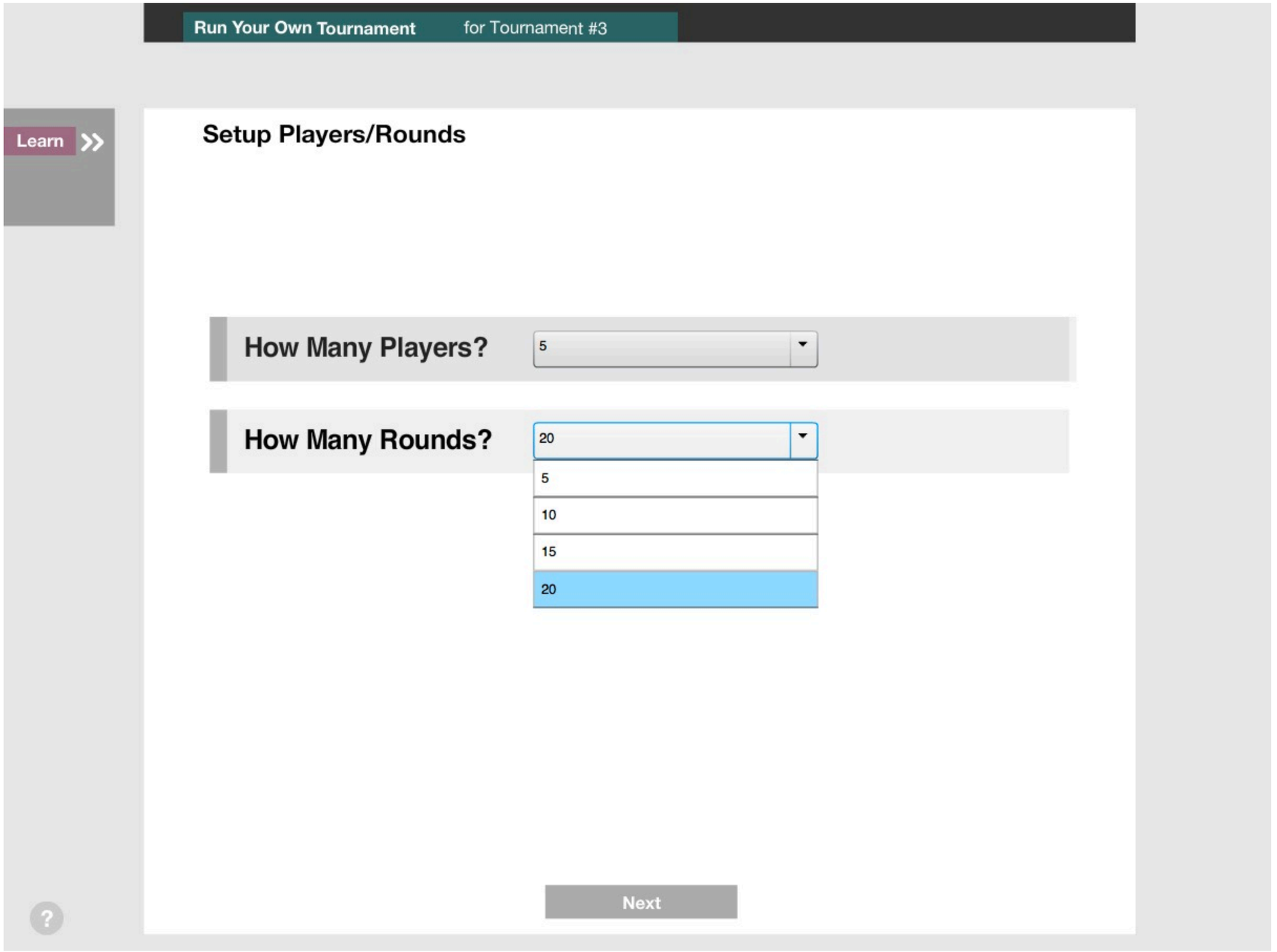
score earned by playing :	against opponent playing : C	against opponent playing : D
C	3	0
D	5	1

Scores for both players based on the four possible combinations of play :

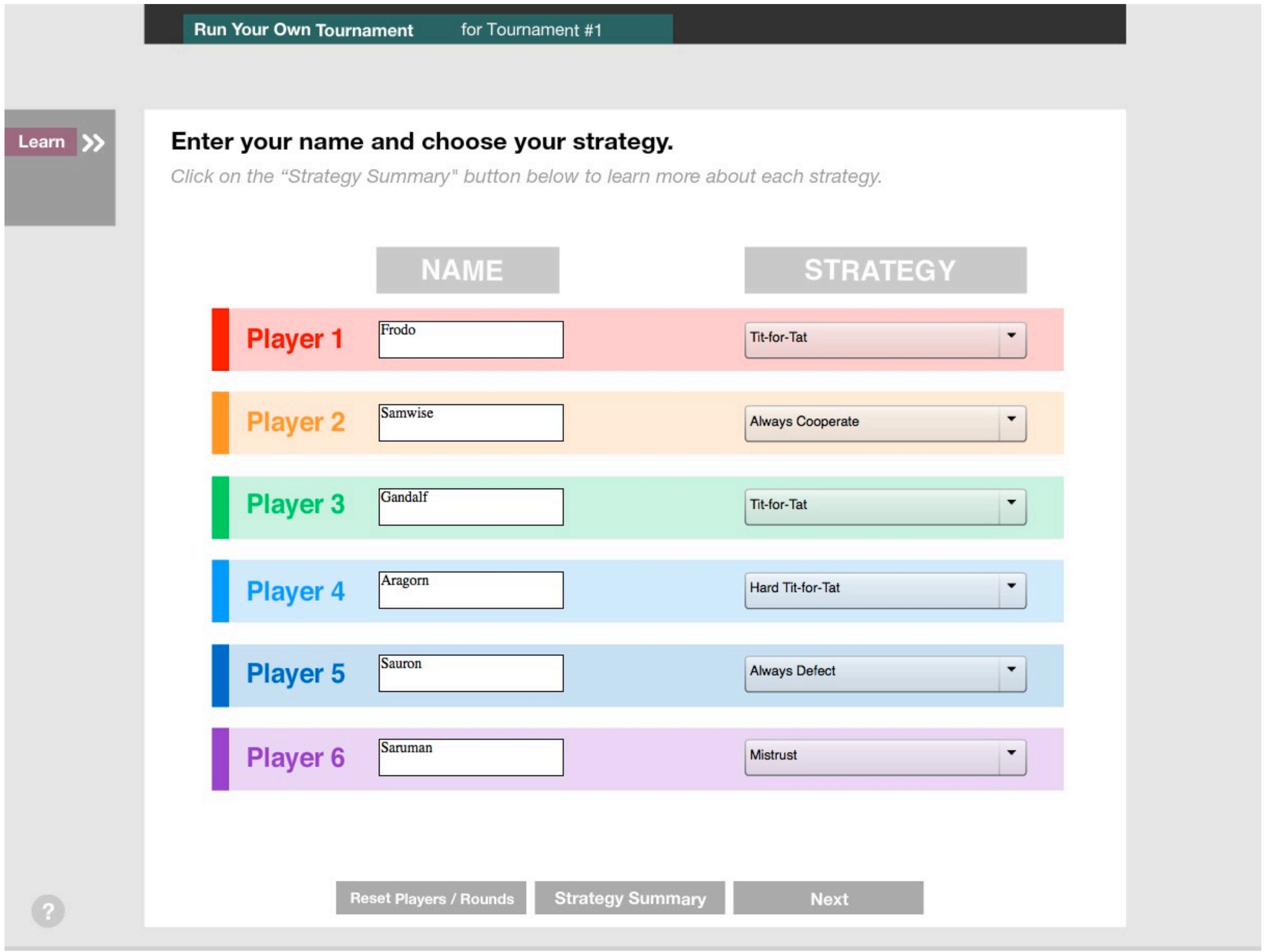
Player 1 :	player 2 : C	player 2 : D
C	3 / 3	5 / 0
D	0 / 5	1 / 1

In the IPD, players compete in succession for a set number of rounds. The entire set of rounds played between a particular pair of players is called a match. In an IPD tournament, there is one match conducted between every possible pair of players. The winner of the tournament is the player who has earned the most points in matches played against all the other players.

"Learn" pages acquaint students with IPD tournaments

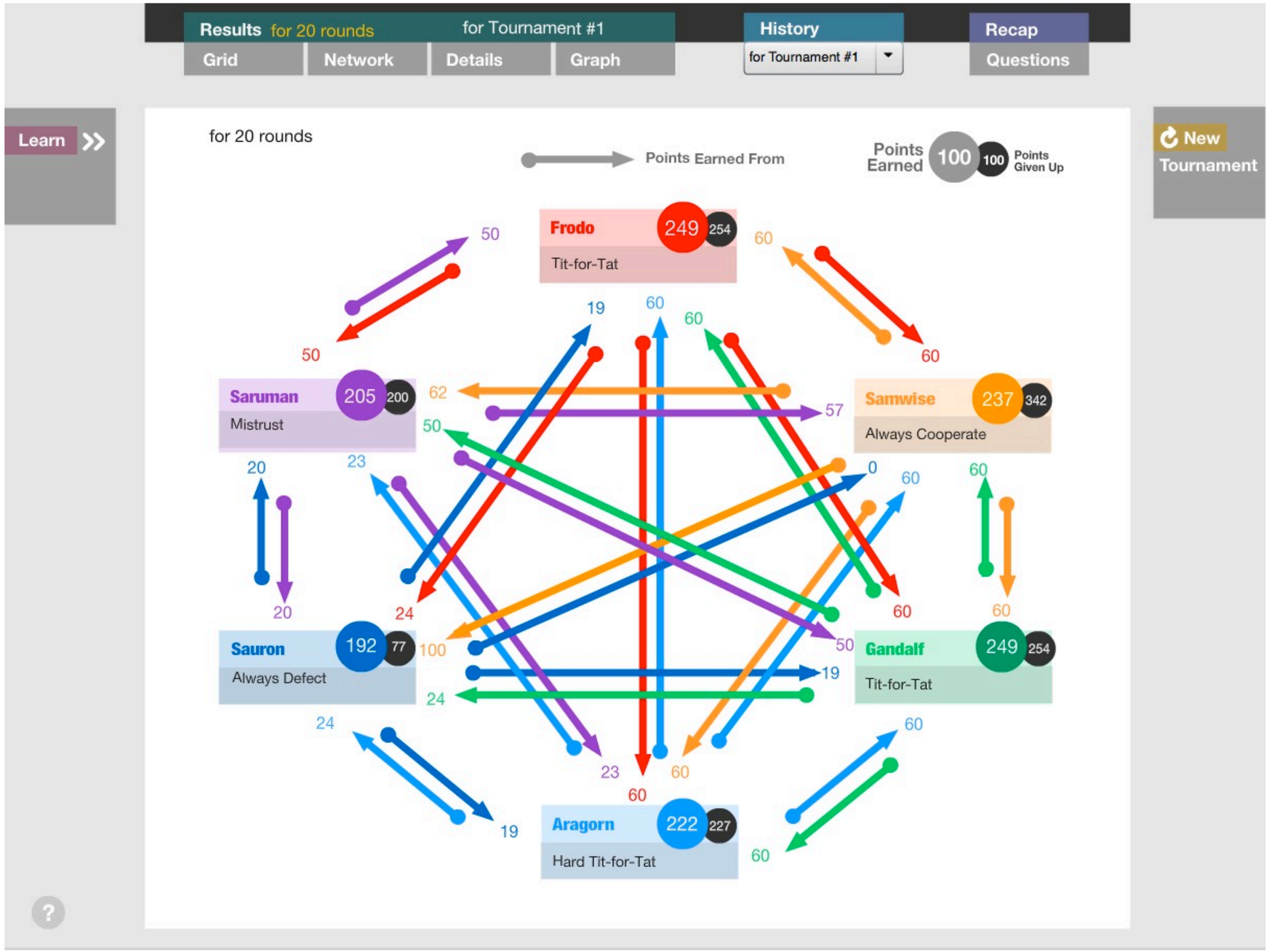


Students can alter the tournament group size and duration

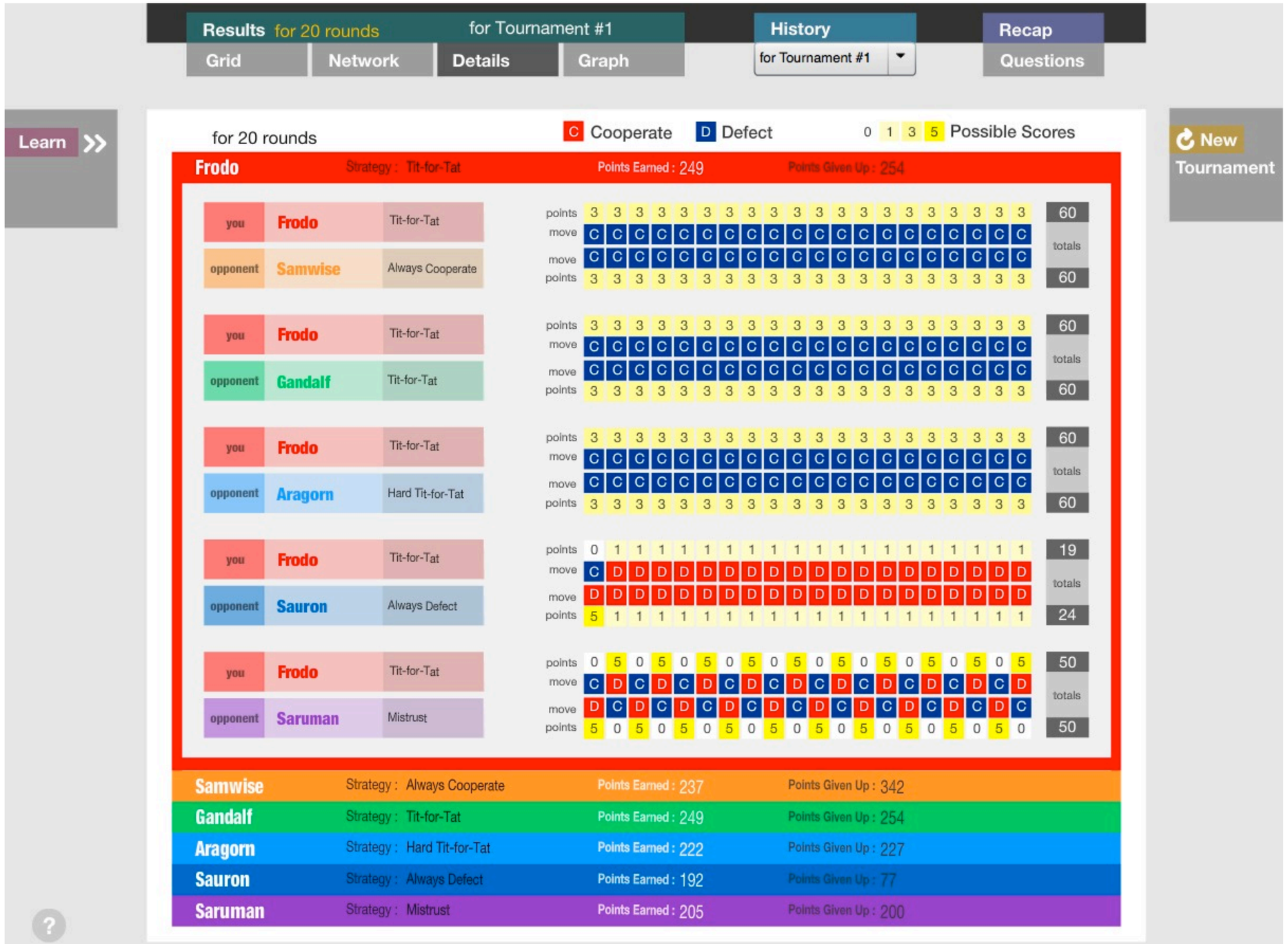


Students assign "players" a variety of strategies

Results grid shows points earned and yielded



Results network shows head-on-head results



Detailed view allows students to analyze match results

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Do these tools work?

★ Anecdotally “yes”, but we all know the value of anecdote alone

★ Need for these teaching tools to be used in more classrooms to obtain reasonable sample size

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★ The design of this presentation was inspired by a web theme designed by Olivia Hu