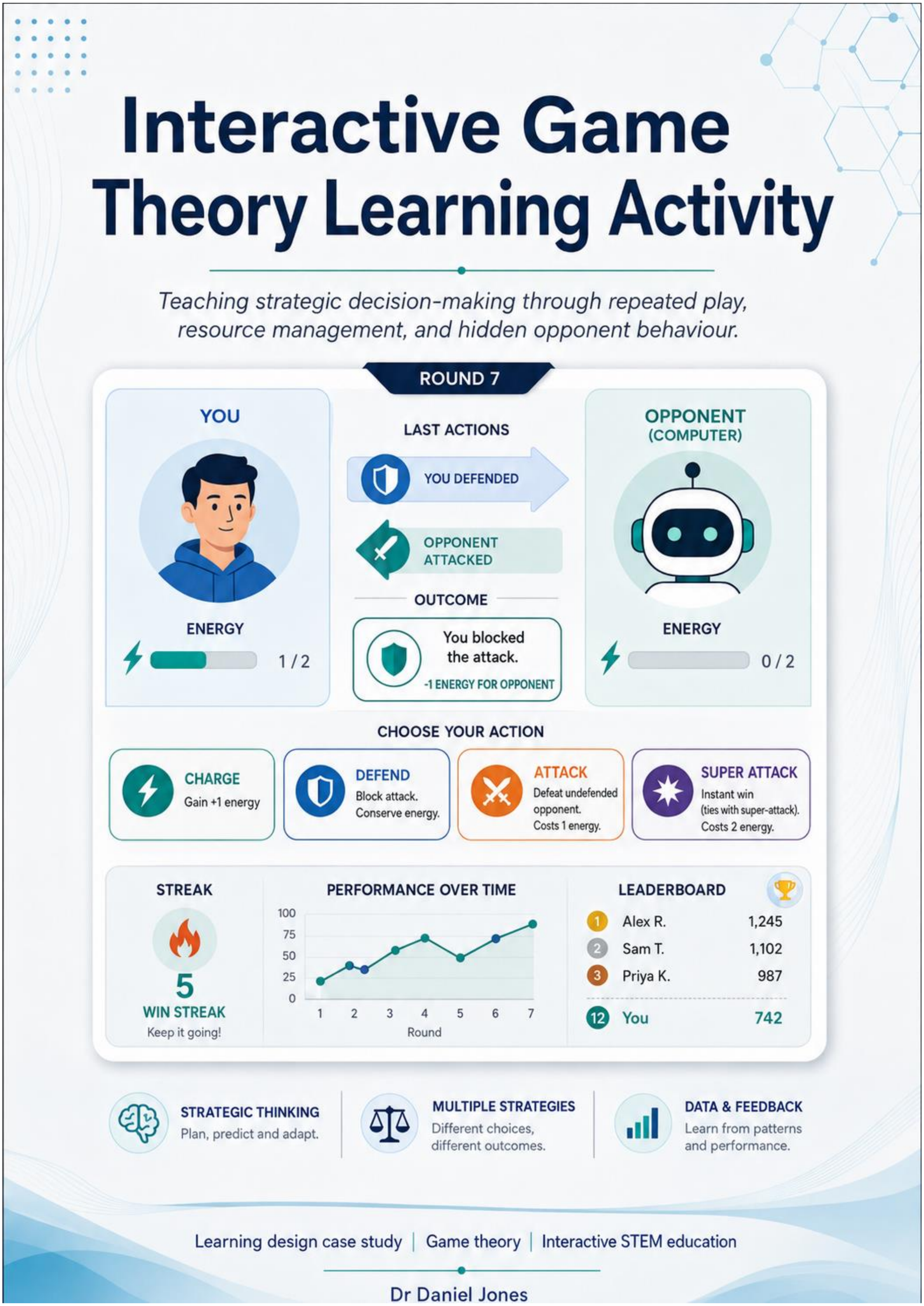

Interactive Game Theory Learning Activity
Teaching strategic decision-making through repeated play, resource management, and hidden opponent behaviour.
ROUND 7
YOU
ENERGY
1 / 2
LAST ACTIONS
YOU DEFENDED
OPPONENT ATTACKED
OUTCOME
You blocked the attack.
-1 ENERGY FOR OPPONENT
OPPONENT (COMPUTER)
ENERGY
0 / 2
CHOOSE YOUR ACTION
CHARGE
Gain +1 energy
DEFEND
Block attack. Conserve energy.
ATTACK
Defeat undefended opponent. Costs 1 energy.
SUPER ATTACK
Instant win (ties with super-attack). Costs 2 energy.
STREAK
5
WIN STREAK
Keep it going!
PERFORMANCE OVER TIME
100
75
50
25
0
1 2 3 4 5 6 7
Round
LEADERBOARD
1 Alex R. 1,245
2 Sam T. 1,102
3 Priya K. 987
12 You 742
STRATEGIC THINKING
Plan, predict and adapt.
MULTIPLE STRATEGIES
Different choices, different outcomes.
DATA & FEEDBACK
Learn from patterns and performance.
Learning design case study | Game theory | Interactive STEM education
Dr Daniel Jones

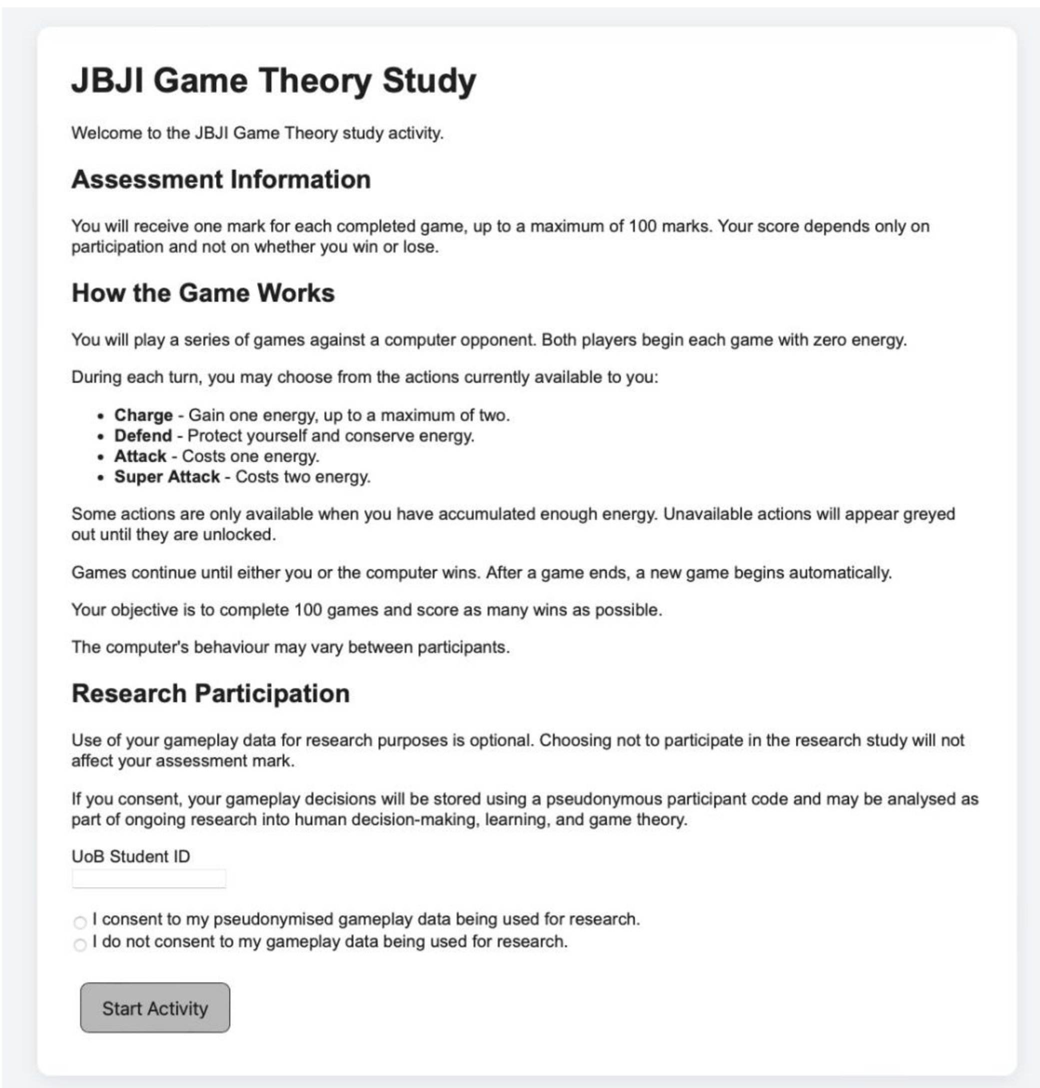
Interactive Game Theory Learning Activity

Short case study for Brilliant - Math Learning Designer application

Summary

I designed and built an interactive, web-based game theory activity for Year 3 undergraduate students at the Jinan-Birmingham Joint Institute. The activity teaches strategic decision-making by embedding a rock-paper-scissors-style best-response cycle inside a richer energy-management game. Students learn by playing repeatedly against a hidden computer opponent, observing immediate feedback, managing resources, and adapting their strategy over time.

Audience	Year 3 undergraduate Game Theory students at the Jinan-Birmingham Joint Institute
Scale	Designed for an alpha test with approximately 250 students; beta version planned for approximately 500 students
Format	Web-based repeated strategic game with immediate feedback and progress tracking
Technology	Flask, SQLite, HTML/CSS, session tracking, pseudonymous participant codes, leaderboard, exportable data
Status	Designed and built; alpha study coming soon



JBJI Game Theory Study

Welcome to the JBJI Game Theory study activity.

Assessment Information

You will receive one mark for each completed game, up to a maximum of 100 marks. Your score depends only on participation and not on whether you win or lose.

How the Game Works

You will play a series of games against a computer opponent. Both players begin each game with zero energy.

During each turn, you may choose from the actions currently available to you:

- **Charge** - Gain one energy, up to a maximum of two.
- **Defend** - Protect yourself and conserve energy.
- **Attack** - Costs one energy.
- **Super Attack** - Costs two energy.

Some actions are only available when you have accumulated enough energy. Unavailable actions will appear greyed out until they are unlocked.

Games continue until either you or the computer wins. After a game ends, a new game begins automatically.

Your objective is to complete 100 games and score as many wins as possible.

The computer's behaviour may vary between participants.

Research Participation

Use of your gameplay data for research purposes is optional. Choosing not to participate in the research study will not affect your assessment mark.

If you consent, your gameplay decisions will be stored using a pseudonymous participant code and may be analysed as part of ongoing research into human decision-making, learning, and game theory.

UoB Student ID

- I consent to my pseudonymised gameplay data being used for research.
- I do not consent to my gameplay data being used for research.

Start Activity

Learning Design Challenge

Game theory is often introduced through formal objects such as payoff matrices, Nash equilibria, and mixed-strategy calculations. The design challenge was to make these ideas experiential before formalising them. I wanted students to feel why prediction, exploitation, randomisation, and state-dependent reasoning matter.

Interactive Solution

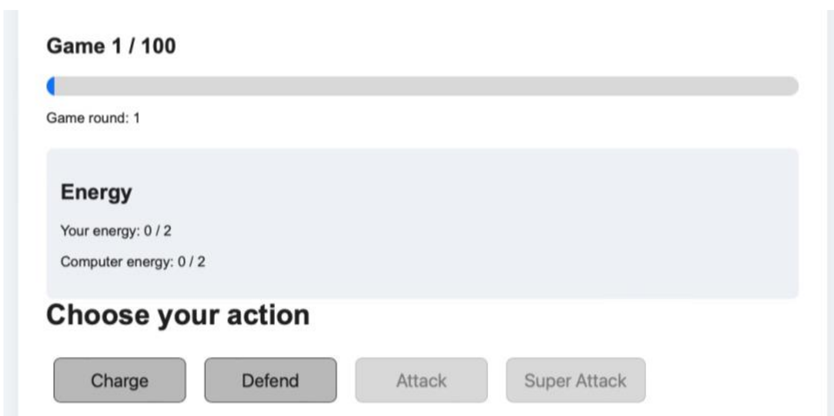
Students play a sequence of up to 100 games against a computer opponent. Each game starts at energy state (0, 0), with both the student and computer holding zero energy. On each turn, the student chooses from the actions currently available: Charge, Defend, Attack, or Super Attack. Actions are state-dependent: Attack requires one energy, and Super Attack requires two energy. Unavailable actions are greyed out in the interface.

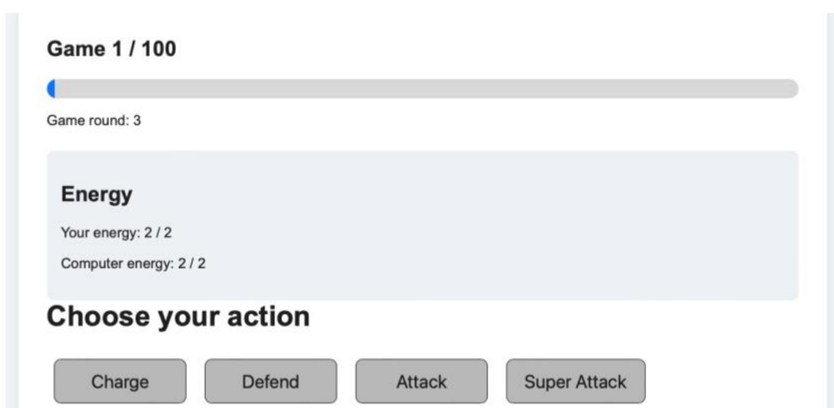
Hidden Mathematical Structure

From the key state (1,1), the game contains a hidden cyclical strategic structure:

- Attack beats Charge: the attacker wins immediately if the opponent tries to build energy.
- Charge beats Defend: the charger reaches two energy and can threaten Super Attack next turn.
- Defend beats Attack: the attacker spends energy and falls behind, allowing the defender to build toward a decisive threat.

This disguises a rock-paper-scissors-style best-response cycle inside a resource-management game. The mathematical pattern is not announced at the start; learners encounter it through repeated play, immediate feedback, and changing energy states.





Feedback and Motivation

After each decision, students see what they chose, what the computer chose, and whether the game continues or has been won/lost. The interface tracks games won, games lost, continuing/draw decisions, current win streak, best win streak, and progress toward the 100-game target. A leaderboard based primarily on best winning streak encourages engagement while leaving assessment tied to participation rather than performance.

Previous Decision

You chose **Attack**. The computer chose **Charge**.

You won the game. A new game has begun.

Current Score

Games Won: 1

Games Lost: 0

Continuing/Draw Decisions: 0

Current Win Streak: 1

Best Win Streak: 1

View Leaderboard

Leaderboard

Rankings are based on best winning streak achieved. Ties are broken using total wins and rounds played. Participants need at least 20 rounds to be leaderboard eligible.

Rank	Participant Code	Best Streak	Wins	Rounds Played	Win %	Status
🥇	F7QIS5TH	2	3	21	14.3%	Eligible
🥈	QM3O3PDC	1	1	283	0.4%	Complete
—	FEFECEW6	1	1	10	10.0%	Needs 10 more rounds
—	0TAZ1EO9	0	0	6	0.0%	Needs 14 more rounds
—	86386V9T	0	0	5	0.0%	Needs 15 more rounds
—	**ZPLJSV0O (You)**	**0**	**0**	**3**	**0.0%**	**Needs 17 more rounds**

Back to game

Why This Is Relevant to Brilliant

Brilliant-style learning works best when learners discover mathematical structure by doing. This project demonstrates my ability to turn abstract mathematical ideas into an interactive, puzzle-like experience; to sequence learning from intuition to formal analysis; and to design feedback loops that encourage experimentation, reflection, and problem-solving from first principles.

The activity also shows practical product-oriented learning design: a student-facing flow, state-based interaction, hidden opponent assignment, pseudonymous participation, progress tracking, a leaderboard, and exportable data for later analysis.

Current Status and Next Development

The activity has been designed and built for an upcoming alpha test with approximately 250 Year 3 Game Theory students at JBJI. A beta version is planned for approximately 500 students. Because the alpha test is upcoming, I present this as a learning-design case study rather than as an outcomes report.

The next iteration would add guided reflection prompts and visualisations of opponent frequencies, learner choices by state, win rates, and expected payoff comparisons, helping students connect their gameplay experience to formal game-theoretic analysis.