

# Game plan: Undergrad's research explores ways to predict arms race

By Niki Kapsambelis

Part of a series profiling undergraduate researchers provided by University of Pittsburgh Office of the Provost.

On the surface, Tim Adamo might seem like the prototypical Pitt sophomore: He lifts weights at the Petersen Center, dabbles in soccer, and roots for the Steelers.

It's the things you can't see that set him apart—qualities like his voracious curiosity, his interest in game theory, and his plan to apply both as he perfects a model that forecasts the course of an international arms race.

"He's way off the charts," says G. Bard Ermentrout, University Professor of Computational Biology in the Department of Mathematics and one of Adamo's advisors on his game theory project. "I have not seen anybody like this at all. I've had a bunch of very talented undergrads through the Honors College, but this guy is a singularity."

Adamo's interest in game theory originated before he even arrived on campus. At home in Middletown, Maryland, he first began exploring mathematical modeling of political systems. Early in his freshman year at Pitt, he read Lewis Fry Richardson's *Arms and Insecurity*, a post-World War I treatise that Adamo describes as "the Old Testament of arms race literature."

The basic premise behind Richardson's work is a simple mathematical model of differential equations meant to represent two fundamental forces, or countries, facing off in an arms race. One equation shows a side spending money on arms in relation to what the opposing side spends. Another illustrates society's resistance to its government's expansion of arms, which retards buildup.

As the theory goes, "if you could do this for two adversaries, you could actually predict whether or not this arms race would end," explains Jack Ochs, a professor of economics and another of Adamo's advisors.

But like many subsequent game theorists and other critics, Adamo found flaws in Richardson's work, and thought he might improve upon them. For example, nothing in the original model explained any reason for the arms race.

"He recognized that an arms race involves essentially strategic interaction—that is, what one party might think is best for itself depends upon what the other

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— Tim Adamo, Pitt sophomore

party is doing. And that's the essence of the game," says Ochs. "In a game, the best move for you to take depends in general upon what moves you anticipate your opponent is going to take."

Adamo decided to alter Richardson's equations to make them more consistent with game theory. The work won him a coveted role as an undergraduate who is already pursuing funded research. The bulk of his work was completed over the summer, "when I didn't have classes to worry about," he says.

The result of that summer's work was a paper describing the arms race as one of Top Dog: "You win when the other person concedes," says Ochs.

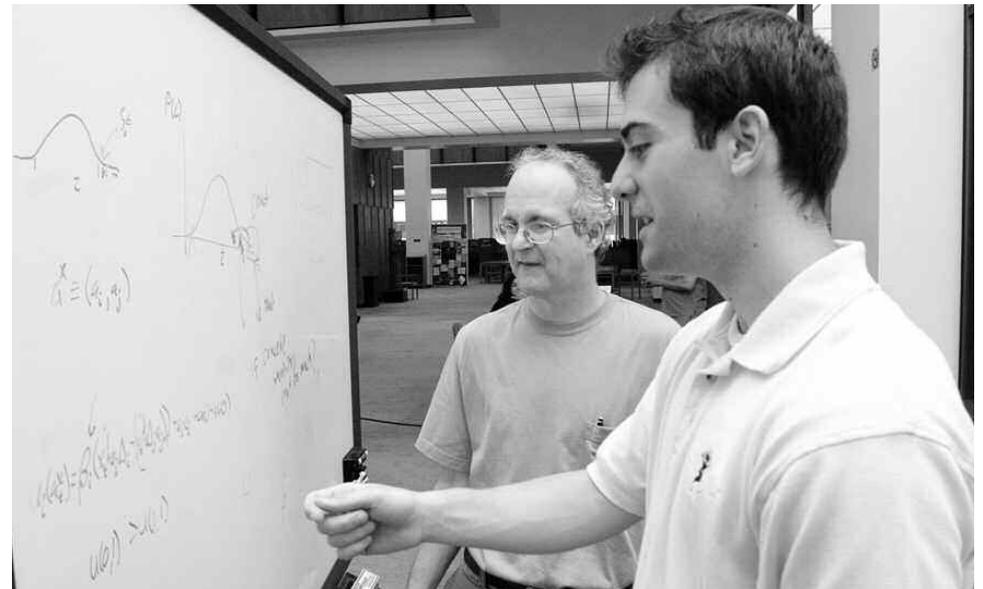
"This may be a project that he could pursue for many years," Ochs adds. "He's spending more time on this, at least in my estimation, than most students spend on a regular course. This is really the kind of person the world needs."

Though declared as a mathematics major, Adamo plans to add majors in physics and psychology, graduating with three majors before pursuing a PhD in mathematics and a career in academia.

"He's already tearing apart a lot of the current models that these sociology guys use, and maybe that's what they need," says Ermentrout. "Maybe he's the guy to do that kind of shakeup."

Within the next year to two years, he hopes to add measures of uncertainty and mistakes that will realistically simulate the international arena. Ultimately, he hopes to produce a paper of publishable quality. And though arms race modeling became somewhat passé with the end of the Cold War, recent concerns about arms development in North Korea and Iran have sparked renewed interest.

"Arms races are almost a defining characteristic of our international political system," says Adamo, although he adds, "If I'm honest, I'm doing this because I get a kick out of it. I really like the mathematical aspects, being able to relate it to real-world applications."



Dr. Bard Ermentrout (left) and undergraduate researcher Tim Adamo work on mathematical models for Adamo's Brackenridge Fellowship research project.

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