



The Beautiful Game Theory - using mathematics to resolve human conflicts

Game theory mathematics is used to predict outcomes in conflict situations. Now it is being adapted through big data to resolve highly contentious issues between people and the environment.

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Game theory is a mathematical concept that aims to predict outcomes and solutions to an issue in which parties with conflicting, overlapping or mixed interests interact.

In 'theory', the 'game' will bring everyone towards an optimal solution or 'equilibrium'. It promises a scientific approach to understanding how people make decisions and reach compromises in real-world situations.

Game theory originated in the 1940s in the field of economics. The Oscar-winning movie [A Beautiful Mind \(2001\)](#) is about the life of mathematician John Nash (played by Russell Crowe), who was awarded the [1994 Nobel Prize in Economic Sciences](#) for his work in this area.

Although the concept has been around for many decades, the difference now is the ability to build it into computer-based algorithms, games and apps to apply it more broadly, said Professor Nils Bunnefeld, a social and environmental scientist at the University of Stirling, UK. This is particularly true in the age of big data.

‘Game theory as a theoretical idea has long been around to show solutions to conflict problems,’ he said. ‘We really see the potential to move this to a computer to make the most of the data that can be collected, but also reach many more people.’

Conservation conflicts

Prof Bunnefeld led the EU-backed [ConFooBio](#) project, which applied game theory to scenarios where people were in conflict over resources and the environment. His team wanted to develop a model for predicting solutions to conflicts between food security and biodiversity.

‘The starting point was that when we have two or more parties at loggerheads, what should we do, for example, with land or natural resources? Should we produce more food? Or should we protect a certain area for biodiversity?’ he said.

The team focused on seven case studies, ranging from conflicts involving farmers and conservation of geese in Scotland to ones about elephants and crop raiding in Gabon.

ConFooBio conducted more than 300 game workshops with over 900 people in numerous locations including Gabon, Kenya, Madagascar, Tanzania and Scotland.

Ecological challenges

Prof Bunnefeld realised it became necessary to step back from pure game theory and instead build more complex games to incorporate ecological challenges the world currently faces, like climate change. It also became necessary to adopt a more people-based approach than initially planned, to better target the games.

‘Participants included people directly involved in these conflicts, and in many cases that were very unhappy,’ said Prof Bunnefeld.

‘Through the games, we got high engagement from communities, even from those where conflict is high and people can be reluctant to engage in research. We showed that people are able to solve conflicts when they trust each other and have a say, and when they get adequate payments for conservation efforts.’

The team developed a modelling framework to predict wildlife management outcomes amid conflict. Freely available, it has been downloaded thousands of times from the [ConFooBio website](#).

Conservation game

The researchers also created an accessible game about conservation called [Crops vs Creatures](#), in which players decide between a range of options from shooting creatures to allocating habitat for conservation.

Prof Bunnefeld hopes these types of game become more available on a mainstream basis via app stores – such as one on conflicts in the realm of biodiversity and energy justice in a separate initiative he works on called the Beacon Project. ‘If you tell people you have an exciting game or you have a complex model, which one are they going to engage with? I think the answer is pretty easy,’ he said.

‘In the ConFooBio project, we’ve been able to show that our new models and algorithms can adapt to new situations and respond to environmental and social changes,’ added Prof Bunnefeld. ‘Our models are useful for suggesting ways of managing conflicts between stakeholders with competing objectives.’

Social media dynamics

Another project, [Odysceus](#), harnessed elements of game theory to investigate what social media can tell us about social dynamics and potentially assist in the early detection of emerging social conflicts.

They analysed the language, content and opinions of social media discussions using data tools.

Such tools are required to analyse the vast amount of information in public discourse, explained Eckehard Olbrich, coordinator of the Odysceus project, and a physicist at the Max Planck Institute for Mathematics in the

Sciences in Leipzig, Germany.

His work is partially motivated by trying to understand the reasons behind the polarisation of views and the growth of populist movements like far-right organisation Pegida, which was founded in his hometown of Dresden in 2014.

The team created a variety of tools accessible to researchers via an open platform known as [Penelope](#). These included the likes of the [Twitter Explorer](#), which enables researchers to visualise connections between Twitter users and trending topics to help understand how societal debates evolve.

Others included two participatory apps known as the Opinion Observatory and the Opinion Facilitator, which enable people to monitor the dynamics of conflict situations, such as by helping interlink news articles containing related concepts.

Patterns of polarisation

‘These tools have already allowed us to get a better insight into patterns of polarisation and understanding different world views,’ said Olbrich.

He said, for example, that his team managed to develop a model about the effect of social feedback on polarisation that [incorporated game-theoretic ideas](#).

The findings suggested that the formation of polarised groups online was less about the traditional concept of social media bubbles and echo chambers than the way people build their identity by gaining approval from their peers.

He added that connecting the dots between game theory and polarisation could have real-life applications for things like how best to regulate social media.

‘In a game-theoretic formulation, you start with the incentives of the players, and they select their actions to maximise their expected utility,’ he said. ‘This allows predictions to be made of how people would change their behaviour if you, for instance, regulate social media.’

Olbrich added that he hopes such modelling can furnish a better understanding of democracy and debates in the public sphere, as well as indicating to people better ways to participate in public debates. ‘Then we would have better ways to deal with the conflicts we have and that we have to solve,’ he said.

But there are also significant challenges in using game theory for real-world situations, explained Olbrich.

Varying outlooks

For example, incorporating cultural differences into game theory has proved difficult because such differences may mean two people have hugely varying ways of looking at a problem.

‘The problem with game theory is that it’s looking for solutions to the way a problem can be solved,’ added Prof Bunnefeld.

‘Having looked at conflicts over the last few years, to me it is clear that we can’t solve conflicts, we can only manage them.’ Building in factors like climate change and local context is also complex.

But game theory is a useful way to explore models, games and apps for dealing with conflicts, he said. ‘Game theory is, from its very simple basics to quite complex situations, a good entry point,’ said Prof Bunnefeld.

‘It gives us a framework that you can work through and also captures people’s imagination.’

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More info

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- [ConFooBio](#)
- [Odyceus](#)