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rainy days 2006

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Bach or Stravinsky?

Human behavior as game-playing

Martin J. Osborne

Your decision to attend this festival probably depended on the availability of other cultural events during recent weeks. And the organizer no doubt considered the existence of those other events when scheduling the festival. In the argot of game theory, you and the organizer are «players.» So too is anyone else whose decisions depend on other people's actions.

Game theory is an approach to understanding human behavior that conceives of decision-makers as players in games. Most situations we face don't come with a book of rules like the ones for parlor games or sporting events. But a game theorist tries to design rules that capture the constraints faced by decision-makers and asks «What actions would be chosen by players facing these rules?» If the predicted actions are similar to the behavior of real-life decision-makers, then the model helps us «understand» that behavior.

Take an example far from the world of music. Political parties have to choose platforms for an upcoming election. The platform chosen by each party affects not only its chance of election but also the chances of the other parties. Suppose there are only two parties (an assumption that works better in the UK and USA than it does in continental Europe). Further suppose that we conceive of a platform as a number – we compress all the complexities of economic and social policy into a single index – and impose on our players (the parties) the rule that they have to choose platforms simultaneously. Then a game-theoretic analysis leads to the conclusion that the parties will both choose the same platform – the one favored by the voter exactly at the middle of the political spectrum. That prediction appears, to some observers at least, to be roughly in line with actual political outcomes.

This analysis, like any game-theoretic analysis, is founded on the assumption that each player has a well-defined objective and takes actions deliberately in an attempt to achieve that objective. We might assume that the objective of the organizer of a music festival, for example, is to maximize the size of the audience, or to reach a target audience and at the same time earn glowing press reviews. A game-theorist chooses an objective for each player that seems to best capture the player's motivation; she seeks to deduce the implications of these objectives, without questioning their wisdom.

Players' objectives typically conflict. Let's say that you wish to go out with a friend. Suppose that two concerts are available; one program is dominated by Bach, the other by Stravinsky. You prefer Bach, but your friend prefers Stravinsky. Even though you prefer Bach, you would rather attend the Stravinsky concert with your friend than listen to Bach alone. Symmetrically, your friend would rather attend the Bach concert with you than listen to Stravinsky alone.

In a game-theoretic analysis of this situation, the two of you are players. What combinations of actions are likely? Or, in game-theoretic parlance, what combinations of actions are «equilibria»? If you choose Bach, your friend's best

choice is also Bach; and given that your friend chooses Bach, your best choice is Bach. Thus if you both choose Bach, neither of you wishes to change your mind, assuming that the other one sticks to Bach. Put differently, your both choosing Bach is «stable»; if you both expect (perhaps based on your past experience) that the other will choose Bach, then choosing Bach is best for each of you. Your both choosing Stravinsky is also an equilibrium, for similar reasons. You prefer Bach, but if your friend chooses Stravinsky, you can do no better than choose Stravinsky – you prefer to go out with your friend rather than listen to your favorite composer alone – and certainly your friend prefers to listen to Stravinsky if that's what you choose.

The outcome in which you go to *different* concerts, however, is not an equilibrium. If you go to hear Bach and your friend goes to hear Stravinsky, for example, then your action is not optimal. Given your friend's action, you are better off choosing Stravinsky. (In addition, taking *your* action as fixed, your friend is better off choosing Bach.)

The conclusion of this game-theoretic analysis is that you will either both go to hear Bach or both go to hear Stravinsky; both pairs of actions are «equilibria.» The analysis is silent about which of the two will occur.

Wouldn't it make sense for the two of you to communicate and agree on the concert to attend, as part of a long-term plan? Perhaps you'll go to hear Bach this time and agree that next month you'll go to the concert preferred by your friend. To incorporate this consideration we'd have to design a different game. That game would be no less susceptible to analysis, though that analysis would be more complex.

Here's another simple illustration of the same game-theoretic tool, though the topic, motivated by the Cold War, is a good deal more weighty. Each of two countries has the option of arming itself or remaining unarmed. The best outcome for each country is that they both remain unarmed: it saves the expense of the arms and avoids the risk of a devastating war. The worst outcome for each of them is that they both acquire costly arms. But if one country acquires arms, the other is better off doing so, in case it needs to defend itself from attack. What is the best action for a country that faces an unarmed opponent? Let's assume that in this case arming is the best option, because it gives the option to attack.

Which pair of actions is an equilibrium in this game? Only the dismal outcome in which both countries acquire arms! No other outcome is stable, because acquiring arms is a country's better action whether or not the other country does so. Both countries prefer the outcome in which neither acquires arms, but their individual incentives inexorably lead to the outcome in which they both prepare to defend themselves from attack. (The game is a version of the famous «Prisoner's Dilemma».)

This result depends, of course, on my assumptions. If we assume that a country facing an unarmed opponent is better off remaining unarmed than acquiring arms, then another equilibrium emerges: both countries remain unarmed. My point is not that a game-theoretic analysis of the arms race necessarily leads to the conclusion that all countries will arm themselves. Rather, the example illustrates one possible game-theoretic analysis – an analysis whose conclusion depends on the exact assumptions about the players' preferences.

A final example gives the flavor of a different variety of game-theoretic argument. A supermarket chain is considering building a store in your neighborhood, to challenge the supremacy of the existing branch of a competing chain. Its choice is to enter the market or not. If it enters, the existing store has to decide how to react. Let's compress its options into two. One possibility is that it acquiesces to

the presence of the new store, lowering its prices – and its profit – a little to share the market with the entrant. The other possibility is that it aggressively fights the newcomer, which will cause both it and the newcomer to lose money.

Would we expect the chain to enter the market? Certainly entry would not be sensible if the incumbent were to respond by fighting, because entry for the challenger would result in its losing money. But will the incumbent respond by fighting if the challenger enters? Not if it cares about its own profit, as we are assuming: once the challenger enters, the incumbent's best action is to share the market. If the incumbent could, it would *commit* to fighting. Such a commitment – effectively, a credible «threat» – would deter the challenger. But if no commitment is possible then the challenger can deduce that its entry will be met with acquiescence, and our analysis leads to the conclusion that entry will occur.

Game theory sees us all as «players.» A game theorist specifies objectives that reflect our motivations and designs rules that reflect the constraints we face – an exercise that is more of an art than a science. Given these objectives and rules, game theoretic arguments generate «equilibrium» outcomes. If these outcomes resemble the ones we observe in the world, the theory may help us to understand the reasons for these outcomes – and may suggest institutional changes that will lead to outcomes in which we are all better off.