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## Introductory remarks on the history of game theory

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### Abstract

I give some personal reactions to the development of game theory as it found application in economic analysis during the last half-century. I discuss which contributions have in fact found use and, in particular, what was the role of *Theory of Games and Economic Behavior* in light of previous and subsequent developments.

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I have been asked to make some historical remarks to help open the First International Congress of the Game Theory Society. These are not to be interpreted as the result of serious historical inquiry on my part. They are rather my reactions, now and in the past, as I remember them. I add that last phrase because recall is always imperfect. I have found that firmly held memories of mine and, I assume, anyone else's, can be wrong. About 30 years ago, I had a conversation with a then-young applied mathematician who did some interesting work on games. He maintained that all games had perfect recall; those that did not, like bridge, were artificial formulations. Bridge should properly be thought of as a four-person game of perfect recall in which the payoff functions within each pair happened to be the same. He could not believe me when I assured him that I had forgotten theorems that I had proved; he probably understands better now.

I did do some reading in history on one point, the origins of the mixed strategy concept. What was remarkable was the failure of several historians to report accurately what was on a printed page. The fascinating story took me many hours of library work to resolve different accounts to my satisfaction, although I should say that Georges Guilbaud and Harold Kuhn had the story correct from the beginning. Following publication of a book on games of chance by the early 18th century French mathematician Pierre Remond de Montmort, there was a correspondence between him and Nicholas Bernoulli (there are

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actually two Bernoullis by that name; this is the younger). These letters were printed in the second edition of Montmort's book dated 1713. Among other problems, they discussed the play of a game of cards in which strategy entered. They found that, for certain initial deals, there was no move for one player such that the best response to the best response was the original move. Montmort consulted some friends of his, including an Englishman resident in France named Waldegrave. To be precise, "Waldegrave" is the way the name would be pronounced phonetically, but English friends assure me the English pronunciation would be "Walgrave." Indeed, that is the family name of one of the currently leading politicians of Great Britain.

In the course of the letters, Montmort, presumably in consultation with Waldegrave, develops very explicitly the idea of a mixed strategy. In fact, they propose making the choice with the aid of an auxiliary randomizing device. Then, in a letter from Waldegrave quoted to Bernoulli by Montmort, the minmax principle (for this game) is stated and proved.

No one involved seems to have regarded this as any more novel than the solution of various complicated questions in combinatorial probability. No one asked if the same reasoning could be applied to other games of strategy. When Isaac Todhunter wrote his history of probability theory in 1865, he summarized Montmort's book and the letters contained in the second edition, but he completely missed the idea of mixed strategies and the principle that minmax equals maxmin. Only after these principles had been rediscovered was it possible to see that Waldegrave had already found them.

The importance of von Neumann and Morgenstern's *Theory of Games and Economic Behavior* was recognized immediately; review articles were commissioned by leading journals, and such reviewers as Leonid Hurwicz and Jacob Marschak had no doubt that they were dealing with a major intellectual event which would change the course of economic thought. What was it that was or appeared to be new at the time and what has in fact been the change in economic analysis? (I am being a little parochial in referring to economics, even though the authors emphasized that subject in their title. From the beginning and even within the book, the potential impact on other strategic social situations was recognized, and there has certainly been an appreciation of the implications of game theory for political science.)

The very idea of a game, of a mutual outguessing, was a surprise. It should not have been, since, as I shall discuss later, game-theoretic reasoning had been used in economics since Cournot in 1838, but somehow it appeared to be an isolated idea. Oskar Morgenstern had indeed made much of the difficulties in economic forecasting, when each individual takes actions based on his or her expectations of others' actions. But this work, even though translated into English, had not made any great impact. That the dilemma could be resolved by mixed strategies in zero-sum two-person games was another staggering idea. We know today that Émile Borel understood this possibility from 1921 on; but no one relevant knew of his work, and he never conjectured the minmax principle in full generality. Suddenly, the general question of consistency of expectations was simultaneously raised and resolved.

Of course, the general idea of a strategy, the reduction of games to normal form, was itself exciting. It looked much more like a concept anyone could have thought of than the minmax theorem, but still it was a highly liberating observation.

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