Game Theory and Its Applications in the Social and Biological Sciences

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Game Theory and its Applications in the Social and Biological Sciences

Second Edition

Andrew M. Colman

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Contents

Preface to the First Edition

The primary aim of this book is to provide a critical survey of the essential ideas of game theory and the findings of experimental research on strategic interaction. In addition, I have reported some new experiments using lifelike simulations of familiar kinds of strategic interactions, and included discussions of recent applications of game theory to the study of voting, the theory of evolution, and moral philosophy. The time has (alas) long since passed when a single person could reasonably hope to be an expert on all branches of game theory or on all of its applications, and I have not attempted to achieve the impossible. But I thought it worthwhile, none the less, to aim for a fairly comprehensive coverage of important topics, with particular emphasis on those that seemed to be most relevant to naturally occurring strategic interactions.

Game theory and the experimental gaming tradition have grown up in relative isolation from each other. Game theorists, in general, remain largely oblivious of the empirical studies that have been inspired by the theory, and experimental investigators have tended to assume that the nuts and bolts of the theory do not concern them. Both parties are the losers from this divorce, and I have therefore tried to contribute towards a reconciliation by examining in detail, for the first time in a single volume, both sides of the story.

My goal has been to introduce and evaluate the fundamental theoretical ideas, empirical findings, and applications as clearly as possible without over-simplifying or side-stepping important difficulties. In so far as I have succeeded, this is the kind of book that I should have liked to have read when I first became interested in game theory and experimental games, or better still, before I developed any interest in these matters. Wherever possible, I have attributed seminal contributions to their originators and cited the original sources: ideas are almost invariably expressed more clearly and forcefully by their inventors or discoverers than by subsequent commentators. But I have also cited many useful review articles, which will be of assistance to readers wishing to pursue particular topics in depth.

The most important chapters [the numbering of chapters has been amended here to correspond with the second edition] for social psychologists and others whose primary interest is in such strategic phenomena as cooperation, competition, collective equilibria, self-defeating effects of

individual rationality, coalition formation, threats, altruism, spite, escalation, social entrapment, and so forth, are chapters 1, 2, 3, 6, 7, 8, and 9. Mathematically inclined readers should pay special attention to chapters 3, 4, 6, 8, 10, and to the Appendix in which the minimax theorem is rigorously proved. The chapters most relevant to sociology, economics, and politics are chapters 1, 2, 3, 6, 8, 9, and 10. Biological applications are discussed in chapter 11, but chapters 1, 2, 6, 7, and 9 provide a necessary background. Philosophical applications are dealt with primarily in chapter 12, to which chapters 1, 2, 3, 6, 9, and 11 provide the necessary background. Most of the translations from original French and German sources in chapter 12 and elsewhere are my own.

I am indebted to a number of people who contributed to this book in various indirect ways. In particular, I am grateful to Michael Argyle, Alan Baker, Barbara Barrett, Dorothy Brydges, Roy Davies, Julia Gibbs, Gabriele Griffin, John Lazarus, Nicholas Measor, Richard Niemi, Ian Pountney, Albert W. Tucker, Diane Williams, Bill Williamson, and the Research Board of the University of Leicester. I should be delighted to receive comments from readers, indicating their reactions to the final product.

Andrew M. Colman

Preface to the Second Edition

The first edition of this book was entitled *Game Theory and Experimental Games: The Study of Strategic Interaction* and was published by Pergamon Press in 1982. It aimed to bridge the gap between game theory and its applications by providing an introduction to the theory and a reasonably comprehensive survey of some of its major applications and associated experimental research. Its more specific objectives were to explain the fundamental ideas of mathematical game theory from first principles and to provide an introductory survey of experimental games and other applications of the theory in social psychology, decision theory, evolutionary biology, economics, politics, sociology, operational research, and philosophy.

The first edition was favourably received and generously reviewed on both sides of the Atlantic and adopted as a text for a number of specialist courses. Demand for the book, though modest, remained remarkably steady for many years, but theoretical developments and new empirical findings accumulated over the years, making the need for a revision of the original text increasingly difficult to ignore. This second edition is so radically revised as to be hardly the same book, and I believe it to be a significant improvement on the first. The principal changes that I have introduced are as follows. I have modified the title, at the suggestion of the publisher, to indicate the scope of the book more accurately. I have corrected the errors and plugged the gaps that have been pointed out to me, and I have introduced numerous amendments and improvements to every chapter. I have thoroughly updated the contents of the book to include significant or interesting theoretical developments and empirical research findings related to coordination games, social dilemmas, strategic aspects of evolutionary biology, framing effects, strategic voting, and many other areas of research. In the light of comments from readers and reviewers I have introduced a little more formal mathematics where omitting it seems to have created more problems than it solved.

In addition, I have improved the book's coverage by incorporating into this second edition a number of important topics that have developed recently or were missing from the first edition for other reasons. Chapter 3

now includes a great deal more theoretical and empirical work on coordination games and the minimal social situation. Chapter 6 includes a section on subgame perfect and trembling-hand equilibria and a further section on bargaining solutions for two-person cooperative games; chapter 7 includes a discussion of Axelrod's tournaments of Prisoner's Dilemma game computer programs and a brief review of cross-cultural comparisons of cooperativeness; chapter 8 is renamed and largely rewritten to include a detailed review of the major theories of coalition formation; chapter 9 is renamed and restructured and includes a discussion of the Chain-store paradox and backward induction; chapter 10 is renamed and restructured and incorporates material on strategic voting, which was in a separate chapter of its own in the first edition, and a discussion (requested by a number of readers) of proportional representation voting procedures, chapter 11 is renamed and includes a refutation of the notion that the strongest always survive in evolutionary games, and chapter 12 is renamed and restructured and includes discussions of philosophical problems related to coordination games and Newcomb's problem.

I no longer believe that "ideas are almost invariably expressed more clearly and forcefully by their inventors or discoverers than by subsequent commentators", as I said in the preface to the first edition. I now believe, on the contrary, that innovators sometimes struggle to understand their own inventions or discoveries and that their successors often understand and explain them better. I have therefore been more liberal with my citations of secondary sources in this edition.

I remain indebted to the people who helped me with the first edition and were acknowledged in its preface. Preparation of this edition was facilitated by Grant No. L122251002 from the Economic and Social Research Council as part of the research programme on Economic Beliefs and Behaviour. Numerous thoughtful readers in Britain, the United States, the Netherlands, and elsewhere have made helpful suggestions that have been incorporated into this second edition, and I am grateful to them all. They are too numerous to list exhaustively, but special thanks are due to Jerome Chertkoff, whose thoughtful review in *Contemporary Psychology* included constructive suggestions for improvement that I have implemented fully, to Werner Tack and Manfred Vorwerg, who also offered important practical advice that I have followed, to Michael Bacharach of Oxford University and other colleagues involved in the Framing, Salience and Product Images research project for inspiration and advice, to Brian Parkinson and David Stretch, who provided useful comments, to Roy Davies, who helped me to improve the mathematical appendix and the general presentation of this edition, to Zhu Zhifang of Wuhan University in the People's Republic of China, who discovered an important though deeply hidden error while working on a Chinese translation of the book, and to Kathy Smith for preparing many of the payoff matrices. But in spite of everyone's help and

my own best efforts, this book is not free of errors. It cannot be error-free, because if it were, then the sentence immediately preceding this one would be an error, which would mean that it was not error-free after all. I should be grateful to readers who spot any more serious defects or who have any other comments to make.

Andrew M. Colman