

Contact: Mary Ann Meyers, Ph.D., Senior Fellow

Purpose

he purpose of this symposium is to explore the uses and limits of game theory in explaining ethical behavior and illuminating the nature and dynamics of moral order and even, perhaps, moral transformation. It takes place in the fiftieth anniversary year of the death of John von Neumann whose groundbreaking 1928 paper "Theory of Parlor Games" proved the famous minimax theorem and whose later book (with Oskar Morgenstern), *Theory of Games and Economic Behavior* (1944), presented a groundbreaking mathematical theory of economic and social organization, based on a theory of games of strategy, that revolutionized economics and was soon used to analyze many real-world phenomena involving policy choices.

The interest of von Neumann and his successors in such practical application becomes clear when we consider that societies exist to a large extent because of the collective benefits that can come from group actions, especially in regulating public goods. This is cooperation at a level higher than some game theorists are addressing-and learning how to model hierarchical multi-levels of competition and cooperation presents game theory with an important challenge. In human culture, the empirical evidence clearly demonstrates the immense powers and influence of groups. The data raise difficult theoretical questions about how groups form and the role, from earliest times, of innovations in religious concepts in maintaining the integrity and ethical identities of groups. In practice, such norms and ideals can support the creation of beneficent new mentalities, institutions, and group practices as well as systems of morality and justice. But they also may drive inter-group conflicts involving out-group hatred and xenophobia. Enmity seems built into the fabric of history; yet, evidence also exists for growing recognitions of mutually beneficial interdependence and cultural evolution towards more expanded notions of moral community. The globalizing economy has created an arena of competition and cooperation within which ever enlarging group identities involve debates over the scales of shared rules-of-the-game. Similarly, the loss of biodiversity has brought forth a new domain of concern and action where the daunting task is to develop group identity on a planetary scale.

But game-theoretic approaches generally have been used to study cooperation among individuals, without attention to the formation and persistence of collectives, and the

Masthead Credit: Chuck Elliott/Stone/ Getty Images interplay between individuals and the collectives to which they belong. The fifteen scientists and scholars gathered at Princeton University come to examine how such approaches can be extended to consider the broader questions that cross scales of organization, from individuals to cooperatives to societies. How do groups form, how do institutions come into being, and when do moral norms and practices emerge? By expanding traditional analyses to meta-game situations, can we explain how heuristics, like concepts of fairness, arise, and how they become formalized into the ethical principles embraced by a society? Are there ways to distinguish "good" from "evil" normative behaviors; and if so, can we understand when one or the other will emerge? How can game theory model the concept of moral transformation in groups as well as individuals? Can we define the "goodness" of human behaviors in terms of benefits for the collective or other entities beyond the individual? Can game theory help predict when goodness will grow and when it will decline? What maintains the robustness of social contracts? Can game theory identify common properties of the implicit strategic exchange that operates as religious beliefs in believers but as something else in nonbelievers? What aspects of game-theoretical analysis of moral behavior may be changed when players hold strong convictions about the existence of a divine, omnipresent moral being and the likelihood that one's actions have consequences that transcend the game itself? The conversation addressing these questions takes place under the aegis of the John Templeton Foundation.



Approach

"When a stranger sojourns with you in your land, you shall not do him wrong. The stranger who sojourns with you shall be to you as the native among you, and you shall love him as yourself: for you were strangers in the land of Egypt"

Leviticus 19:33-34

he symposium is part of the Templeton Foundation's *Humble Approach Initiative*. The goal of the initiative is to bring about the discovery of new spiritual information by furthering high-quality scientific research. The "humble approach" is inherently interdisciplinary, sensitive to nuance, and biased in favor of building linkages and connections. It assumes an openness to new ideas and a willingness to experiment. Placing high value upon patience and perseverance, it retains a sense of wondering expectation because it recognizes, in Loren Eisley's haunting phrase, "a constant emergent novelty in nature that does not lie totally behind us, or we would not be where we are." A fundamental principle of the Foundation, in the words of its founder, is that "humility is a gateway to greater understanding and open[s] the doors to progress" in all endeavors. Sir John Templeton believes that in their quest to comprehend foundational realities, scientists, philosophers, and theologians have much to learn about and from one another. The humble approach is intended as a corrective to parochialism. It encourages discovery and seeks to accelerate its pace.



Chair

John Templeton Foundation



Oskar Morgenstern and John von Neumann at Spring Lake, ca. 1946

Courtesy of the Institute for Advanced Study Simon Asher Levin, an internationally renowned mathematical ecologist, is George M. Moffett Professor of Biology at Princeton University and director of its Center for Biocomplexity. His research focuses on understanding how macroscopic patterns and processes are maintained at the level of ecosystems and, indeed, the biosphere in terms of ecological and evolutionary mechanisms that operate primarily at the level of organisms. In writing about his work, he integrates empirical studies and mathematical modeling with an emphasis on how to extrapolate across scales of space, time, and organizational complexity. Dr. Levin's current studies include plant communities as well as marine open-ocean and inter-tidal systems. A graduate of Johns Hopkins University, he earned a Ph.D. in mathematics at the University of Maryland in 1964. Joining the Cornell mathematics faculty as an assistant professor the next year, he was made a professor of applied mathematics and ecology in 1977 and, five years later, also named the Charles A. Alexander Professor of Biological Sciences. He accepted his Princeton professorship in 1992. Most recently a Visiting Miller Research Professor at the University of California at Berkeley, Dr. Levin also has been a visiting professor at the University of Maryland, the University of Washington, the University of British Columbia, the Weizmann Institute, the University of Kyoto, Stanford University, All Souls College, Oxford, Woods Hole Oceanographic Institution, and the Institute for Advanced Study at Princeton. He has delivered numerous named lectures. A member of the National Academy of Sciences and of the American Philosophical Society, Dr. Levin is a fellow of the American Academy of Arts and Sciences and of the American Association for the Advancement of Science. His many other honors include the 2007 Distinguished Scientist Award of the American Institute of Biological Sciences as well as the A. H. Heineken Prize for Environmental Sciences of the Royal Netherlands Academy of Arts and Sciences, the Distinguished Landscape Ecologist Award of the U.S. Regional Association of the International Association for Landscape Ecology, the MacArthur Award and a Distinguished Service Citation of the Ecology Society of America, the first Okubo Lifetime Achievement Award given by the Society for Mathematical Biology and the Japanese Society for Theoretical Biology, the Distinguished Statistical Ecologist Award of the International Association for Ecology, and the Phi Beta Kappa Biology Colloquium Award. He holds honorary degrees from Eastern Michigan University and Whittier College. Dr. Levin serves as chair of the science board of the Santa Fe Institute,

chair of the council of the International Institute of Applied Systems Analysis, vice chair of the Committee of Concerned Scientists, and a member of the science board of the Institute for Medical BioMathematics in Israel. Editor-in-chief of the Princeton University Press (PUP) Series in Theoretical and Computational Biology and comanaging editor of PUP's Monographs in Population Biology and its Complexity Series, he also is honorary editor of the Bulletin of Mathematical Biology and currently a member of the editorial boards of a dozen scientific journals and of the advisory boards of eight other scientific publications. He is the author or co-author of nearly 400 scientific papers, the editor-in-chief of the five-volume Encyclopedia of Biodiversity (2001), and the co-editor (with M. C. Press and N. J. Huntley) of Ecology: Achievement and Challenge (2001), (with Akire Okubo) of a revised and updated second edition of Okubo's classic monograph Diffusion and Ecological Problems: Modern Perspectives (2001), (with Peter Kareiva) of The Importance of Species: Perspectives on Expendability (2003), and, most recently, (with Zhilan Feng and Ulf Dieckmann) of Disease Evolution: Models, Concepts, and Data Analyses, a topical overview of current techniques and challenges in mathematical evolutionary epidemiology, which was published by Oxford University Press last year. Dr. Levin is also the author of Fragile Dominion: Complexity and the Commons (Perseus Books, 1999 and Basic Books, 2000), an explanation of how the new science of complexity can be applied to understanding and alleviating ecological problems besetting the planet.



A philosopher internationally acclaimed for his work in political and moral theory, the philosophy of language and mind, and African and African-American intellectual history, Kwame Anthony Appiah is the Laurence S. Rockefeller Professor of Philosophy and the University Center for Human Values at Princeton University. He is also a novelist. Dr. Appiah writes about issues of personal formation, multiculturalism, and nationalism. His critique of large collective identities exposes threats to freedom and community, and he has increasingly argued for an "ethical universal" that transcends social fragmentation and bridges differences amongst us. Born in London, a child of mixed ancestry, he grew up in Ghana, his father's country, during its first days of independence and returned to England, home of his mother's family, to complete his secondary education at the Bryanston School. He went on to study at Clare College, Cambridge, where he took first class honors, and earned a Ph.D. in philosophy from Cambridge University in 1982. Dr. Appiah's teaching career has been pursued largely in American universities. He went to Yale as an assistant professor of philosophy and Afro-American studies in 1981 and was promoted to associate professor four years later. He moved on to Cornell, where he had been a Junior Fellow in the Society for the Humanities during his last year on the Yale faculty, as a visiting associate professor in 1986 and was named a professor of philosophy in 1989. The next year he accepted appointment as professor of philosophy and literature at Duke University, and in 1991, he went to Harvard as professor of Afro-American studies and philosophy. He was named to the Charles H. Carswell Professorship in 1999, a post he held until taking up his present position at Princeton five years ago. Dr. Appiah has given numerous invited lectures throughout the United States and in Canada, England, France, Germany, Ghana, and South Africa. A member of the American Academy of Arts and Sciences and the American Philosophical Society, he has held Woodrow Wilson, Andrew W. Mellon, and Walter Channing Cabot fellowships. He is the recipient of honorary degrees from the University of Richmond, Colgate University, Bard College, Fairleigh Dickinson University, and Swarthmore College. Currently chair of the board of the American Council of Learned Societies and president of the Eastern Division of the American Philosophical Association, he is also a member of the visiting committee of the Harvard University Libraries. He previously served as an editor or on the editorial boards of fifteen scholarly journals and presently serves as advisory editor of Critical Studies in

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Robert Axelrod Steven J. Brams John E. Hare Dominic D.P. Johnson Ehud Kalai Eric S. Maskin Martin A. Nowak Barry O'Neill Elinor Ostrom Thomas C. Schelling Karl Sigmund Brian Skyrms Robert Sugden Black Life and Culture, as an editorial consultant to African Philosophical Inquiry, on the editorial boards of Perspectives in Auditing and Information Systems and Ethnic and Racial Studies, and as publisher of Transition. In addition to more than 125 articles published in academic journals and essays in volumes of collected works, he has served as editor or co-editor of nineteen books, including (with Henry Louis Gates) Africana: The Encyclopedia of African and African-American Experience (2005), and, most recently, (with Martin Bunzl) Buying Freedom, which was published by Princeton University Press in 2007. Dr. Appiah is the author or co-author of fourteen other books, including three novels. His first two monographs, Assertion and Conditions (1985) and For Truth in Semantics (1986), were on specialized topics in the field of language and logic. They were followed by Necessary Questions: An Introduction to Philosophy (1989), a textbook that remains widely-read in a revised version, Thinking It Through (2003). But the book for which he is best known and for which he won both the Annisfield-Wolf Book Award and the Herskovits Award of the African Studies Association is In My Father's House (1992), an analysis of Africa's struggle for selfdefinition in a world dominated by Western values in which he examines cultural issues through the lens of technical philosophy. Written with Amy Gutmann, his next book, the prize-winning Color Consciousness: The Political Morality of Race (1996), focuses on African-Americans, and in it, Dr. Appiah concludes that the "concept of race" is intellectually empty, though he also addresses the gap between what he considers cognitive truth and the historic reality of life in America. His second co-authored book, an annotated edition of 7,500 proverbs in the language of the Asante entitled Bu Me Bé: The Proverbs of the Akan (2002), was a collaboration with his mother, the novelist and children's writer Peggy (Margaret Cripps) Appiah. It was followed by a widely-acclaimed study, The Ethics of Identity (2005), in which Dr. Appiah connects the moral obligations of individuals with collective allegiances. His most recent book, Cosmopolitanism: Ethics in a World of Strangers, which was published last year by W. W. Norton and (in London) Allen Lane and won the Arthur Ross Book Award of the Council on Foreign Relations, outlines the ancient, humane philosophy, advanced first by the Cynics in Greece, of "world citizenship" and its potential to usher in an era of global understanding. A new book, Experiments in Ethics, based on his 2005 Flexner Lectures at Bryn Mawr College, will be published this fall by Harvard University Press.



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Masthead Credit: Chuck Elliott/Stone/ Getty Images interplay between individuals and the collectives to which they belong. The fifteen scientists and scholars gathered at Princeton University come to examine how such approaches can be extended to consider the broader questions that cross scales of organization, from individuals to cooperatives to societies. How do groups form, how do institutions come into being, and when do moral norms and practices emerge? By expanding traditional analyses to meta-game situations, can we explain how heuristics, like concepts of fairness, arise, and how they become formalized into the ethical principles embraced by a society? Are there ways to distinguish "good" from "evil" normative behaviors; and if so, can we understand when one or the other will emerge? How can game theory model the concept of moral transformation in groups as well as individuals? Can we define the "goodness" of human behaviors in terms of benefits for the collective or other entities beyond the individual? Can game theory help predict when goodness will grow and when it will decline? What maintains the robustness of social contracts? Can game theory identify common properties of the implicit strategic exchange that operates as religious beliefs in believers but as something else in nonbelievers? What aspects of game-theoretical analysis of moral behavior may be changed when players hold strong convictions about the existence of a divine, omnipresent moral being and the likelihood that one's actions have consequences that transcend the game itself? The conversation addressing these questions takes place under the aegis of the John Templeton Foundation.



Kwame Anthony Appiah **Robert Axelrod** Steven J. Brams John E. Hare Dominic D.P. Johnson Ehud Kalai Eric S. Maskin Martin A. Nowak Barry O'Neill Elinor Ostrom Thomas C. Schelling Karl Sigmund Brian Skyrms Robert Sugden Robert Axelrod, the Mary Ann and Charles R. Walgreen Professor for the Study of Human Understanding at the University of Michigan, is widely known for his research in mathematical modeling, international security affairs, and complexity theory. His principal current interests are in the emergent properties of social systems and in the political and social effects of the information revolution. An honors graduate of the University of Chicago, he earned his Ph.D. in political science with distinction at Yale University in 1969. He then joined the political science faculty of the University of California at Berkeley as an assistant professor, a post he held until moving to the University of Michigan in 1974 as an associate professor of political science and a research associate of the Institute of Public Policy Studies. Promoted to professor of political science and public policy six years later, he was named Arthur W. Bromage Distinguished University Professor in 1987 and awarded his present chair last year. Dr. Axelrod has been a visiting scholar at the London School of Economics and at the Center for Advanced Study in the Behavioral Sciences in Stanford, California. A member of the American Academy of Arts and Sciences, the National Academy of Sciences (NAS), the American Philosophical Society, and the Council on Foreign Affairs, he has held a Council on Foreign Relations Fellowship and a National Science Foundation NATO Fellowship and has been a recipient of a MacArthur Prize, a Franklin L. Burdette Pi Sigma Alpha Award, a NAS Award for Behavioral Research Relevant to the Prevention of Nuclear War, and a number of honors from the University of Michigan, including a Russell Lectureship, a Distinguished Faculty Achievement Award, and an Excellence in Research Award. Dr. Axelrod has been a Germeshausen Distinguished Lecturer at the Massachusetts Institute of Technology's Sloan School of Management and received honorary degrees from Yale University and Georgetown University. He is the author of more than sixty articles published in scholarly journals or as chapters in volumes of collected works, several of which have won prizes, the editor of two books, and the author or co-author of five others, including Conflict of Interest: A Theory of Divergent Goals with Applications to Politics (1970), Framework for a General Theory of Cognition and Choice (1972), The Evolution of Cooperation (1985), The Complexity of Cooperation: Agent-Based Models of Competition and Collaboration (1997), and, most recently, (with Michael D. Cohen) Harnessing Complexity: Organizational Implications of a Scientific Frontier, which was published by the Free Press in 2000 and has been

praised for providing business leaders with expert guidance into how natural innovation occurs and how to exploit its power.



Kwame Anthony Appiah Robert Axelrod **Steven J. Brams** John E. Hare Dominic D.P. Johnson Ehud Kalai Eric S. Maskin Martin A. Nowak Barry O'Neill Elinor Ostrom Thomas C. Schelling Karl Sigmund Brian Skyrms Robert Sugden A leading political scientist and an authority on game theory, social-choice theory, and fair division, **Steven J. Brams** is a professor of politics at New York University. Among the applications he has made of his theories are several to domestic politics, especially to voting and elections, international politics, notably to crises and wars, and theological issues. In Biblical Games: Game Theory and the Hebrew Bible (1980 and 2003), he uses the mathematical theory of games to analyze selected stories from the Hebrew Bible that are rich in conflict and intrigue and, by reducing complex situations to a few critical decisions, demonstrates the rationality of the players. In Superior Beings: If They Exist, How Would We Know? (1983 and 2007) and Theory of Moves (1994), he shows how a major reformulation of classical game theory can help elucidate the role that different kinds of power may have in conflict outcomes and how players' choices may be affected by misinformation. A graduate of the Massachusetts Institute of Technology, Dr. Brams received his Ph.D. in political science from Northwestern University in 1966. He was a research associate at the Institute for Defense Analysis and an assistant professor at Syracuse University before joining the NYU faculty in 1973. He has held visiting appointments at the University of Michigan, the University of Rochester, the University of Pennsylvania, the Institute for Advanced Studies in Vienna, the University of California, Irvine, the University of Haifa, Yale University, and the Russell Sage Foundation. Dr. Bram has been president of both the Peace Science Society and the Public Choice Society. His work has been supported by the Social Science Research Council, the Guggenheim Foundation, the American Association for the Advancement of Science, the Public Choice Society, the Ford Foundation, the United States-Israel Binational Science Foundation, the Sloan Foundation, the United States Institute of Peace, the National Science Foundation, the Russell Sage Foundation, and the NYU Research Challenge Fund. He has published some 240 research papers and is the coeditor of two books and the author or co-author of fourteen others. His most recent books are (with Alan D. Taylor) The Win-Win Solution: Guaranteeing Fair Shares to *Everybody* (W. W. Norton, 1999), a blueprint for getting to "yes" in conflict negotiation, and Mathematics and Democracy: Designing Better Voting and Fair-Division Procedures, which will be published later this year by Princeton University Press and shows how social-choice and game theory can make political and social institutions more democratic.



Kwame Anthony Appiah Robert Axelrod Steven J. Brams **John E. Hare** Dominic D.P. Johnson Ehud Kalai Eric S. Maskin Martin A. Nowak Barry O'Neill Elinor Ostrom Thomas C. Schelling Karl Sigmund Brian Skyrms Robert Sugden John E. Hare, the Noah Porter Professor of Philosophical Theology at Yale University, is a British-born classicist and ethicist. He is best known for his widely acclaimed book, The Moral Gap (1996), in which he develops an account of the need for God's help in meeting the moral demands of which God is the source. Educated at Balliol College, Oxford, where he took first class honors, Dr. Hare studied at Princeton University on a Watkins Fellowship and earned his Ph.D. in classical philosophy in 1975. Before going up to university, he had taught for a year at a high school in Kashmir, and he began his collegiate teaching career at Lehigh University as a lecturer in philosophy in 1974. Named a full professor in 1987, he moved on to Calvin College as a professor of philosophy in 1989, a position he held until appointed to his Yale chair in 2003. He also has been a visiting member of the University of Michigan philosophy faculty, a visiting fellow in the humanities at the Medical College of Pennsylvania, an American Philosophical Association Congressional Fellow, and a staff associate on the Foreign Affairs Committee of the U.S. House of Representatives. Elected an honorary member of Phi Beta Kappa, Dr. Hare is the recipient of a Lindback Award for Distinguished Teaching, a Pew Evangelical Fellowship, and a senior fellowship awarded by the Center for Philosophy of Religion and Erasmus Institute at the University of Notre Dame. He has delivered the Stob Lecture at Calvin College, the initial Calvin Lectures in 1999-2000, and one of four 2005 Gifford Lectures at the University of Glasgow. The author of some fifty-five articles published in scholarly journals, he is also the author of six books. In addition to The Moral Gap, which won the Institute for Advanced Christian Studies Book Prize, they include, most recently, God's Call (2001), a discussion of the divine command theory of morality, which he champions against theories based in natural law, Why Bother Being Good? (2002), a non-technical apologetic for Christian beliefs, which argues that morality cannot be adequately grounded in reason alone but needs a firm basis in faith (or something that will do theology's work), and God and Morality: A Philosophical History, which was published earlier this year by Blackwell and evaluates the ethical theories of Aristotle, Duns Scotus, Kant, and the author's father, the utilitarian philosopher R. M. Hare, with close attention to the similarities among the philosophers and the relationship of their work to theism.



Kwame Anthony Appiah Robert Axelrod Steven J. Brams John E. Hare **Dominic D.P. Johnson** Ehud Kalai Eric S. Maskin Martin A. Nowak Barry O'Neill Elinor Ostrom Thomas C. Schelling Karl Sigmund Brian Skyrms Robert Sugden An evolutionary biologist turned political scientist with a special interest in how new research on human nature is challenging foundational theories in international relations and conflict resolution, Dominic D. P. Johnson is a lecturer in politics at the University of Edinburgh and a fellow in the Branco Weiss Society of Science. He recently completed a three-year appointment as a fellow in the Society of Fellows at Princeton University and a lecturer in Princeton's Woodrow Wilson School of Public and International Affairs. Dr. Johnson is a graduate of the University of Derby, where he took first class honors. He received a D.Phil. in biology from Oxford University in 2001 and a Ph.D. in political science from the University of Geneva in 2004. He has been a fellow at the Olin Institute for Strategic Studies at Harvard University, a science fellow at the Center for International Security and Cooperation at Stanford University, and a visiting fellow in the Global Fellows Program of the International Institute at the University of California at Los Angeles. His work revolves around the impact of evolution, psychological biases, theory of mind, and religion on the origins of human disputes and human cooperation. He has looked recently at the role of belief in supernatural punishment on the undertaking of shared efforts for the common good. In addition to more than thirty articles published in scholarly journals and chapters in volumes of collected works, he is the author of two books, Overconfidence and War: The Havoc and Glory of Positive Illusions (2004) and (with D. R. Tierney) Failing to Win: Perceptions of Victory and Defeat in International Politics, which was published last year by Harvard University Press and explores the psychological factors that predispose leaders, media, and the general public to perceive outcomes of crises and wars as victories or defeats



Ehud Kalai is the James J. O'Connor Distinguished Professor of Decision and Game Sciences in the Kellogg School of Management at Northwestern University. He also holds a professorship of mathematics in Northwestern's College of Arts and Sciences. Dr. Kalai's research is in the areas of game theory, economics, and the interface of game theory with operations research and computer science. He pioneered studies of strategic rational learning and the robustness of large games and made major contributions to the subjects of cooperative game theory and bargaining, social choice, strategic algorithms, and strategic complexity. Born in Israel, he received his B.A. degree from the University of California at Berkeley and a Ph.D. in mathematics from Cornell University in 1972. He then accepted an assistant professorship in statistics at Tel Aviv University. In 1975, Dr. Kalai moved to the Kellogg School where he was promoted to full professor in 1978, appointed the Charles E. Morrison Professor of Decision Sciences in 1982, and named to his present chair in 2001. He has coordinated the Nancy L. Schwartz Memorial Lecture series since its inception in 1982 and has been the director of the Kellogg Center for Strategic Decision-Making for the past twelve years. A fellow of the Econometric Society, he has been a Sherman Fairchild Scholar at the California Institute of Technology, a Distinguished Visitor at the University of California at San Diego, the Oskar Morgenstern Research Professor at New York University, and twice winner of the Outstanding Professor Award of Kellogg's Executive Masters Program. He has delivered named lectures at the University of Pennsylvania, Tel Aviv University, the University of California at Los Angeles, and Tulane University among other institutions. Dr Kalai founded the journal Games and Economic Behavior in 1989 and continues to serve as its editor-in-chief. Together with Robert J. Aumann, he founded the international Game Theory Society in 1998 and served as its president for three years. He is a former member of the editorial boards of Mathematical Social Sciences and The Journal of Economic Theory and currently serves on the editorial board of the International Journal of Game Theory. His work, consisting of more than sixty articles, has been published in leading scholarly journals and other publications.

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Kwame Anthony Appiah Robert Axelrod Steven J. Brams John E. Hare Dominic D.P. Johnson Ehud Kalai **Eric S. Maskin** Martin A. Nowak Barry O'Neill Elinor Ostrom Thomas C. Schelling Karl Sigmund Brian Skyrms Robert Sugden Albert O. Hirschman Professor of Social Science at the Institute for Advanced Study in Princeton, Eric S. Maskin is particularly known for his work on mechanism design and dynamic games. His current research includes comparing different electoral rules, examining the effect of evolution in repeated games, and studying coalition formation. A graduate of Harvard University, where he earned a B.A. and took his Ph.D. in applied mathematics in 1976, he went on to Cambridge University as a research fellow at Jesus College. He joined the economics faculty of the Massachusetts Institute of Technology in 1977 and was promoted to full professor in 1981. In 1985, he accepted a professorship of economics at Harvard. Dr. Maskin was appointed to his present position in 2000. He is concurrently a visiting lecturer in economics at Princeton University with the rank of professor. An honorary fellow of St. John's College, Cambridge, he has been a visiting overseas fellow there, an overseas fellow at Churchill College, Cambridge, a distinguished visiting scholar at Monash University in Australia, and an honorary professor at Wuhan University in China. He is a fellow and former president of the Econometrics Society and a fellow of the British Academy and of the American Academy of Arts and Sciences. His many other honors include a Guggenheim Fellowship, a Sloan Research Fellowship, the Erik Kempe Award, and Harvard's Galbraith Teaching Prize. He has been an advisor to the Polish and the British governments and to the Bank of Italy and delivered invited lectures throughout North America as well as in the United Kingdom, Europe, the Middle East, and Asia. Currently editor of Economics Letters and an associate editor of Games and Economic Behavior, Review of Economic Design, the *QR Journal of Theoretical Economics*, and the *International Journal of Game Theory*, he also serves an editorial advisor of the Journal of Developing Areas and as an advisory editor of Division of Labor and Transaction Costs and Economics. Dr. Maskin has contributed more than one hundred papers to academic journals or essays to volumes of collected works, and he has edited or co-edited three books, including, most recently, (with András Simonovits) Planning, Strategy, and Transformation, which was published in 2000 by the MIT Press.



Martin A. Nowak is a professor of biology and mathematics at Harvard University whose research demonstrates the power of mathematics to illuminate diverse aspects of evolutionary biology. He is the founding director of Harvard's Center for Evolutionary Dynamics. Dr. Nowak has analyzed the consequences of mutation and natural selection in virus infections and cancer progression, pioneered a mathematical approach for the evolution of human language, and invented spatial reciprocity and stochastic game dynamics of finite populations. He is engaged in an ongoing study of the evolution of cooperation and co-directs, with Sarah Coakley, a research program in the Evolution and Theology of Cooperation funded by the John Templeton Foundation. An Austrian by birth, he studied at the University of Vienna where he took first class honors in biochemistry and received his Ph.D. in mathematics in 1989. He went on to Oxford University as an Erwin Schrödinger Scholar and worked there with Lord (Robert McCredie) May with whom he co-authored his first book, Virus Dynamics: Mathematical Principles of Immunology and Virology (2000). As Guy Newton Junior Research Fellow at Wolfson College, Oxford, he held a Royal Society Research Grant. He subsequently was named a Welcome Trust Senior Research Fellow in Biomedical Sciences, the E. P. Abraham Junior Research Fellow at Keble College, Oxford, and then a senior research fellow at Keble. Dr. Nowak became head of Oxford's Mathematical Biology Group in 1995 and, in 1997, was appointed professor of mathematical biology, a post he held until moving to Princeton a year later to establish the first research program in theoretical biology at the Institute for Advanced Study. He accepted his present position in 2003. A corresponding member of the Austrian Academy of Sciences, Dr. Nowak is the recipient of Oxford's Weldon Memorial Prize, the Albert Wander Prize given by the University of Bern, the Akira Okubo Prize of the International and Japanese Society for Mathematical Biology, the Roger E. Murray Prize awarded by the Institute for Quantitative Research in Finance, the David Starr Jordan Prize given jointly by Stanford, Cornell, and Indiana universities, and the Henry Dale Prize of The Royal Institution. He has delivered numerous named lectures in the United Kingdom, Europe, and the United States and is a former member of the Templeton Foundation Board of Advisors. Dr. Nowak is the author of more than 250 papers published in scientific journals. His latest book, Evolutionary Dynamics, which was published by Harvard University Press last year, provides an overview of the powerful yet simple laws that govern the evolution

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A scholar who investigates decision-making in social and political contexts, Barry O'Neill is a professor of political science at the University of California at Los Angeles. His main focus is the use of game theory to study foreign policy decisions with a view to preventing war. He has worked on the resolution of disputes involving honor and is currently studying issues around group apologies, as well as the notion of good faith in negotiation and communication in general. He also is examining the relationship between perceptions of national prestige and a desire for weapons of mass destruction. A graduate of the University of Michigan, where he received both his B.A. and, in 1976, his Ph.D. in mathematical psychology, he began his teaching career at Queen's University in Kingston, Ontario. In 1979, he joined the faculty of Northwestern University as an assistant professor of industrial engineering and management science and was promoted to associate professor six years later. As the recipient of a SSRC/MacArthur Fellowship in International Security, he spent two years as a visiting scholar at the Massachusetts Institute of Technology, the University of California at Berkeley, the University of Maryland, and Yale University before moving on to York University in Toronto as an associate professor of political science and economics in 1989 and then, in 1992, to Yale University's School of Management as an associate professor of politics. Dr. O'Neill was a visiting scholar at Bonn University in 1998 and subsequently a visiting professor in the study of international relations at the Center for Rationality and Interactive Decision Theory at Hebrew University in Jerusalem. He went to Stanford University in 1999 as a visiting and acting professor of political science and a visiting fellow in Stanford's Center for International Security and Cooperation. He was named to his present position in 2001. Dr. O'Neill has recently been a visiting professor of economics at Yale and a visiting scholar at the Russell Sage Foundation. He serves as a member of the board of directors of the Institute for Global Conflict and Cooperation. In addition to numerous articles published in scholarly journals, he is the author of Honor, Symbols and War (University of Michigan Press, 1999 and 2001), a book which uses game theory to analyze the symbolic nuances of words and actions in international negotiations and conflict resolution and won the American Political Science Association's Woodrow Wilson Foundation Award. He is currently preparing a manuscript on long standing myths about public policy.

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Elinor Ostrom is Arthur F. Bentley Professor of Political Science at Indiana University and founding co-director of the university's Workshop in Political Theory and Policy Analysis. She also serves as founding director of the new Center for the Study of Institutional Diversity at Arizona State University. An expert on collective action and the management of shared resources, she has focused her scholarly attention on the integration of research findings in the cognitive sciences into a workable set of models for exploring and explaining human choices in various institutional settings. A graduate of the University of California at Los Angeles, where she earned a baccalaureate degree with honors and took her Ph.D. in political science in 1965, Dr. Ostrom spent a year as a visiting assistant professor of government at Indiana University before accepting appointment to the permanent faculty. She was promoted to associate professor of political science in 1969 and named a full professor in 1974. She chaired the political science department for four years and served as co-director of the Center for the Study of Institutions, Population, and Environmental Change at Indiana for a decade. Dr. Ostrom also has served as president of the Midwest Political Science Association, the American Political Science Association (APSA), the Public Choice Society, and the International Association for the Study of Common Property, as well as on the advisory boards of numerous scholarly and governmental organizations. A fellow of the American Academy of Arts and Sciences and the American Association for the Advancement of Science, she is a member of the National Academy of Sciences (NAS) and the American Philosophical Society. She holds honorary degrees from the University of Zurich, the Institute of Social Studies in The Hague, Luleå University of Technology in Sweden, the University of Michigan, Sweden's Uppsala University, and Humboldt University in Berlin. Among her many other honors are the APSA's James Madison Award, the Sustainability Science Award of the Ecological Society of America, the NAS's John J. Carty Award for the Advancement of Science, a Lifetime Achievement Award given by the Atlas Economic Research Foundation, Uppsala University's Johan Skytte Prize in Political Science, the Thomas R. Dye Service Award, the Miriam Mills Award, the Donald Campbell Award of Policy Studies Organization, the Frank E. Seidman Distinguished Award in Political Economy, and the Harold and Margaret Sprout Award given by the International Studies Association. Dr. Ostrom has served on the editorial boards of nineteen academic journals. The winner last year of a Cozzarelli Prize for a paper published in the

Kwame Anthony Appiah Robert Axelrod Steven J. Brams John E. Hare Dominic D.P. Johnson Ehud Kalai Eric S. Maskin Martin A. Nowak Barry O'Neill **Elinor Ostrom** Thomas C. Schelling Karl Sigmund Brian Skyrms Robert Sugden *Proceedings of the National Academy of Sciences*, she has published some 245 articles and chapters in volumes of collected works. She is the editor or co-editor of eighteen books, including (with Robert Keohane) *Local Commons and Global Interdependence: Heterogeneity and Cooperation in Two Domains* (1995), (with James Walker) *Trust and Reciprocity: Interdisciplinary Lessons from Experimental Research* (2003), (with T. K. Ahn) Foundations of Social Capital (2003), (with Basudeb Guha-Khasnobis and Ravi Kanbur) *Linking the Formal and Informal Economy: Concepts and Policies* (2006), and, most recently, (with Charlotte Hess) *Understanding Knowledge as a Commons: From Theory to Practice*, which was published by the MIT Press earlier this year. Dr. Ostrom also is the author or co-author of another ten books. They include *Governing the Commons: The Evolution of Institutions for Collective Action* (1990), an examination of shared ownership of natural resources, and *Understanding Institutional Diversity* (2005), a study that uses game theory to understand the analysis of diverse economic, political, and social institutions.



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Kwame Anthony Appiah Robert Axelrod Steven J. Brams John E. Hare Dominic D.P. Johnson Ehud Kalai Eric S. Maskin Martin A. Nowak Barry O'Neill Elinor Ostrom **Thomas C. Schelling** Karl Sigmund Brian Skyrms Robert Sugden Nobel laureate in economics Thomas C. Schelling shared his 2005 Bank of Sweden prize with Robert Aumann for enhancing understanding of conflict and cooperation through game theory analysis. Dr. Schelling is Lucius N. Littauer Professor of Political Economy Emeritus at Harvard University and Distinguished University Professor Emeritus at the University of Maryland. He was one of the designer's of the United States' Cold War nuclear strategy and played a major role in establishing "strategic studies" as an academic field. In addition, his internationally renowned work, including his widely-translated book, The Strategy of Conflict (1960, 1963, and 1980), prompted new developments in game theory and accelerated its use and application throughout the social sciences. Dr. Schelling is celebrated for the originality and creativity of his theorizing and the intellectual rigor of his policy analysis. Moving easily from real-world issues to elegant models, he distilled the essence of problems ranging from nuclear deterrence and racial segregation to smoking to global warming. A graduate of the University of California at Berkeley, he worked briefly as an analyst at the U.S. Bureau of the Budget before going on to Harvard University where he was elected a Junior Fellow of the Society of Fellows and earned a Ph.D. in economics in 1951. After completing his doctoral examinations, he took leave to serve with the administration of the Marshall Plan in Europe and then on the White House staff as a foreign policy advisor to the President. He left what had become the Office of the Director for Mutual Security in 1953 to join the faculty of Yale University as an associate professor of economics. His primary theoretical interest was bargaining theory, and he came to see that an immediate and important application of the kind of game theory he had taken up was in military foreign policy, especially nuclear warfare. Dr. Schelling served on the senior staff of the Rand Corporation for a year and went to Washington with a small contingent attached to the staff preparing for the 1958 Geneva Convention on Measures to Safeguard against Surprise Attack. The position he argued in two papers was that arms control should be oriented towards measures that precluded either side's acquiring a "first-strike" capacity, an objective that entailed assuring the safety of retaliatory nuclear weapons. He held that the only viable position regarding their use would be "no weapons," not some quantitative or qualitative limits. Accepting a professorship in economics at Harvard in 1958, Dr. Schelling divided his time between the economics department and its Center for International Affairs, then, from its establishment in 1969, the John F. Kennedy

School of Government of which he was considered a "founding father". He was named Littauer Professor in 1974, a title he held until his retirement in 1990. He then accepted appointment as Distinguished University Professor at Maryland where he offered courses in the economics department and the School of Public Policy until retiring again in 2003. A fellow of the American Academy of Arts and Sciences and a Distinguished Fellow of the American Economic Association, he is a member of the National Academy of Sciences (NAS) and of The Institute of Medicine. Dr. Schelling has served as president of the Eastern Economic Association and the American Economic Association. He is a recipient of the Frank E. Seidman Distinguished Award in Political Economy and the NAS Award for Behavioral Research Relevant to the Prevention of Nuclear War. He holds honorary doctorates from the RAND Graduate School of Policy Analysis and Erasmus University in Rotterdam. In addition to some two hundred papers published in academic journals or as chapters in volumes of collected works, he is the author of nine books. He wrote two classical economic studies before The Strategy of Conflict, selected as a "Citation Classic" by the Institute of Scientific Information, and followed it with Strategy and Arms Control (1961 and 1985), which he co-authored with Morton H. Halperin, Arms and Influence (1966), Micromotives and Macrobehaviors (1978), Thinking Through the Energy Problem (1979), and Choice and Consequence (1984). His most recent book, Strategies of Commitment and Other Essays, was published by Harvard University Press earlier this year.



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Kwame Anthony Appiah Robert Axelrod Steven J. Brams John E. Hare Dominic D.P. Johnson Ehud Kalai Eric S. Maskin Martin A. Nowak Barry O'Neill Elinor Ostrom Thomas C. Schelling **Karl Sigmund** Brian Skyrms Robert Sugden Karl Sigmund, professor of mathematics at the University of Vienna, is one of the pioneers of evolutionary dynamics. A graduate of the Lycée Francais de Vienne, he continued his studies at the University of Vienna's Institute of Mathematics and took his Ph.D. in 1968. He pursued post-doctoral work at University of Manchester, the Institut des Hautes Etudes in Bures sur Yvette near Paris, the Hebrew University of Jerusalem, the University of Vienna, and the Austrian Academy of Sciences. In 1973, he was appointed an associate professor of mathematics at the University of Göttingen and the next year named a full professor at Vienna's Institute of Mathematics. He headed the institute for several years. Dr. Sigmund's early work involved statistical mechanics and dynamical systems. He became increasingly interested in biomathematics and game theory. Collaborating with colleagues, he pursued studies in mathematical ecology, chemical kinetics, population genetics, and, especially, evolutionary game dynamics and replicator equations. With Martin Nowak and others, he worked on game dynamical approaches to questions related to the evolution of cooperation in biological and human populations. In 1984, he began a research affiliation he continues today with the Institute for Applied Systems Theory in Laxenburg, Austria. In recent years, he has undertaken research related to the history of mathematics, in particular, the famed Vienna Circle. He co-edited the mathematical works of Hans Hahn and Karl Menger and, in 2006, organized an exhibition on the exodus of Austrian mathematicians fleeing the Nazis, as well as an exhibition on Kurt Gödel. He has given numerous invited lectures, including a plenary lecture at the International Congress of Mathematicians in 1998. A former president of the Austrian Mathematical Society, Dr. Sigmund is a member of the Austrian Academy of Sciences and of the Leopoldina. He formerly served as managing editor of Monatshefte für Mathematik and has published more than 150 papers in leading scientific journals and chapters in volumes of collected works. The coeditor of seven books, he is the co-author of five others and the author of Games of Life: Explorations in Ecology, Evolution, and Behaviour (Oxford University Press, 1984 and 1993).

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> A philosopher who has written extensively about decision theory and game theory, Brian Skyrms is the UCI Distinguished Professor of Social Science, professor of economics, and professor of logic and philosophy of science at the University of California at Irvine. He also holds a professorship in philosophy at Stanford University. His writing is currently focused on the evolution of conventions, signals, social structure, and the social contract. His earlier work included studies in philosophical logic, causation, decision-making, game theory, and the foundations of probability. Dr. Skyrms uses dynamic models to understand the evolution of norms of justice, commitment, mutual aid, property, and meaning. He is recognized for making significant contributions to the understanding of ethics, specifically, why, if self-interest is a primary human motivation, ethics exist. A graduate of Lehigh University, where he received baccalaureate degrees in both economics and philosophy, he earned a Ph.D. in philosophy at the University of Pittsburgh in 1964. After teaching at California State University in Northridge, the University of Delaware, and the University of Michigan, he was appointed an assistant professor of philosophy at the University of Illinois at Chicago and promoted to full professor in 1970, a post he held until accepting a professorship in logic and philosophy at Irvine in 1980. He was named to his additional professorship in economics, as well as UCI Distinguished Professor of Philosophy, in 1997 and to his present chair in social science two years later. Dr. Skyrms directs UCI's Interdisciplinary Program in the History and Philosophy of Science. He has been a Guggenheim Fellow, a Humanities Council Senior Fellow and Old Dominion Fellow at Princeton University, a President's Research Fellow in the Humanities, a National Science Foundation Fellow, and a fellow at the Center for Advanced Study in the Behavioral Sciences. A former president and director of the Philosophy of Science Association and a former president of the Pacific Division of the American Philosophical Association (APA), he has served on the governing boards of the APA and the Western Center of the American Academy of Arts and Sciences and currently serves on the boards of UCI's Institute for Mathematical Behavioral Science and Center for Decision Analysis. Dr. Skyrms is a member of the American Academy of Arts and Sciences and the National Academy of Sciences and a fellow of the American Association for the Advancement of Science. Among other honors, he is the recipient of the Paul Silverman Award in Foundations of Ethics, the Lakatos Prize for Evolution of the Social Contract, a

Distinguished Alumnus Award for Excellence from the University of Pittsburgh, and a UCI Distinguished Lectureship for Research Award. He serves on the editorial boards of eight scholarly journals and of the *Stanford Encyclopedia of Philosophy*. In addition to more than one hundred articles published in academic journals or as chapters in volumes of collected works, he is the co-editor of seven books and the author of six others, including *Choice and Chance: An Introduction to Inductive Logic* (1966, 1975, 1986, and 2000), *Causal Necessity* (1980), *Pragmatics and Empiricism* (1984), *The Dynamics of Rational Deliberation* (1990), a philosophical discussion of game theory entitled *Evolution of the Social Contract* (1996), and, most recently, *The Stag Hunt and the Evolution of Social Structure*, a study of ideas of cooperation and collective action, which was published by Cambridge University Press in 2004.



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Robert Sugden, a professor of economics at the University of East Anglia, uses a combination of theoretical, experimental, and philosophical methods to investigate issue in welfare economics, social choice, the foundations of decision theory and game theory, and the evolution of social conventions. Educated at the University of York, where he took first class honors and earned distinction in history and economics, he went on to University College, Cardiff, for a master's degree in economics before returning to York, where he was awarded a D.Litt. in economics in 1988. He began his teaching career there as a lecturer in economics in 1971, moved to the University of Newcastle upon Tyne as a reader in economics in 1978, and accepted his present position in 1985. Dr. Sugden held a Leverhulme Personal Research Professorship at East Anglia for five years and currently holds an Economic and Social Research Council personal research fellowship. He has been a visiting research associate as well as the James M. Buchanan Visiting Fellow at the Virginia Polytechnic Institute and State University, a visiting research fellow at the Australian National University, a visiting professor at the University of California at Davis, and a visiting scholar at Bowling Green State University, the University of British Columbia, and the University of Victoria in British Columbia. A fellow of the British Academy, he was formerly a member of the Council of the Royal Economic Society. He currently serves on the editorial boards of Theory and Decision, the Journal des Economistes et des Etudes Humaines, Economics and Philosophy, Utilitas, Politics, Philosophy and Economics, the Journal of Economic Psychology, and the Journal of Institutional Economics. The author of more than ninety papers published in academic journals, Dr. Sugden is the co-editor (with Benedetto Gui) of Economics and Social Interaction (2005), a book in which economic concepts are used for understanding interpersonal phenomena within the spheres of markets and productive organizations, and, most recently, (with Natalie Gold) of Beyond Individual Choice: Teams and Frames in Game Theory (Princeton University Press, 2006), a book by the late Michael Bacharach, which was unfinished at the author's death. He is the coauthor of four books and the author of two others, The Political Economy of Public Choice (1981) and The Economics of Rights, Co-operation and Welfare, an influential study, first published by Blackwell in 1986 and re-issued by Palgrave Macmillan in 2004, which shows how conventions of property, mutual aid, and voluntary supply of public goods can evolve spontaneously out of interactions of self-interested individuals and

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