

Uri Weiss
Joseph Agassi

Games to Play and Games not to Play

Strategic Decisions via Extensions
of Game Theory

 Springer

Studies in Systems, Decision and Control

Volume 469

Series Editor

Janusz Kacprzyk, Systems Research Institute, Polish Academy of Sciences,
Warsaw, Poland

The series “Studies in Systems, Decision and Control” (SSDC) covers both new developments and advances, as well as the state of the art, in the various areas of broadly perceived systems, decision making and control—quickly, up to date and with a high quality. The intent is to cover the theory, applications, and perspectives on the state of the art and future developments relevant to systems, decision making, control, complex processes and related areas, as embedded in the fields of engineering, computer science, physics, economics, social and life sciences, as well as the paradigms and methodologies behind them. The series contains monographs, textbooks, lecture notes and edited volumes in systems, decision making and control spanning the areas of Cyber-Physical Systems, Autonomous Systems, Sensor Networks, Control Systems, Energy Systems, Automotive Systems, Biological Systems, Vehicular Networking and Connected Vehicles, Aerospace Systems, Automation, Manufacturing, Smart Grids, Nonlinear Systems, Power Systems, Robotics, Social Systems, Economic Systems and other. Of particular value to both the contributors and the readership are the short publication timeframe and the worldwide distribution and exposure which enable both a wide and rapid dissemination of research output.

Indexed by SCOPUS, DBLP, WTI Frankfurt eG, zbMATH, SCImago.

All books published in the series are submitted for consideration in Web of Science.

Uri Weiss · Joseph Agassi

Games to Play and Games not to Play

Strategic Decisions via Extensions of Game
Theory

Uri Weiss
Van Leer Jerusalem Institute
Polonsky Academy
Jerusalem, Israel

Joseph Agassi
Tel Aviv University
Herzlia, Israel

ISSN 2198-4182 ISSN 2198-4190 (electronic)
Studies in Systems, Decision and Control
ISBN 978-3-031-27600-2 ISBN 978-3-031-27601-9 (eBook)
<https://doi.org/10.1007/978-3-031-27601-9>

© The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer Nature Switzerland AG 2023

This work is subject to copyright. All rights are solely and exclusively licensed by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors, and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

About My Teacher, Friend, and Coauthor—Joseph Agassi



Joseph Agassi (1927–2023)

“There was a man—and look, he is no more. The music of his life suddenly stopped”.¹ Joseph Agassi has passed away. He was my teacher, friend, and coauthor. Along with the many people who benefited greatly from his wisdom, free mind, and extreme generosity I am in deep sorrow. We know that Agassi was very old—he was almost 96 years old—but as in Auden’s poem: “I thought that love would last forever: I was wrong”.²

Agassi was first of all a person of truth. He was a genius, the most educated person I have ever known. He had encyclopedic knowledge, and he made breakthroughs in several academic fields. Agassi was a critical person who taught critical thinking (He told me: I do not preach to critical thinking, this is what Popper did, I recommend about it). He taught generations of students how to be free personally and politically. He deviated from dogmas and established opinions, and not in order to deviate (he

¹ *Chaim Nachman Bialik*, “After My Death”, translated by Ruth Nevo.

² Funeral Blues By: W. H. Auden.

was accompanied by the advice of his personal teacher, Karl Popper: do not try to innovate), while following protocol and the rules of aristocratic etiquette (he used to say to me: Agassi is a wild one but always according to the protocol); he was an intellectual who bravely challenged the foundations of the Israeli system and proposed an original alternative. He was extremely generous, who is always ready to share his knowledge, and a person of self-respect.

Agassi has contributed to many fields:

Agassi was dedicated to his vision of making Israel a liberal state [1]. He strictly resisted the nondistinction between religion and nationality in Israel. He claimed that it leads to denied discrimination against the non-Jewish citizens of Israel. This prevents peace. Hence, Agassi encouraged a public discourse about the constitution and particularly: which kind of state the Israelis wish to establish? “What do we wish to be”? Agassi supported the vision of Hillel Kook of choosing to establish an Israeli nationality, and that Israel should be the state of the Israeli nation, which includes non-Jewish citizens and does not include those who are not Israeli citizens (mainly, Jews who are not Israeli citizens). Agassi articulated this idea and made it a philosophical systemization and wrote its historiography. It is an extremely courageous book that challenged the most fundamental dogmas of Israel and broke a taboo.

Agassi has written the most important paper about Israeli law [2]. He claimed that in Israel we do not have a rule of law, but a rule of arrangements. There is no state in which the law is respected to the full degree by the authorities, but in liberal countries, the default is that the authorities behave according to the law, while in Israel the default is that they behave according to arrangements that may contradict the law. According to the law, civil servants must not discriminate against non-Jews citizens, while according to the arrangement they are expected to discriminate against them (and otherwise they may lose their jobs). There cannot be a rule of law in Israel because of the strong will to discriminate against the non-Jewish citizens, but Israelis deny it. This is a price Israel pays for discriminating. Agassi has studied from Spinoza on how hate destroys the person who hates.

Agassi has contributed to the investigation of the Talmud. He pointed out that in the Talmud even factual questions may be legal questions and that in the Talmud, knowledge is not only a matter of nature but also of conventions [3]. The Talmud may reply consciously to legal questions about reality answers that contradict reality. This thesis of Agassi challenges the legal traditional distinction between legal questions and factual questions. This may be illustrated by the paradox that O. J. Simpson was founded unguilty in criminal law but has been obliged to pay damages for this murder. In my conversation with Agassi, he offered me extremely interesting insights about the Talmud. He told me that it took him years to understand that the Talmud is not an orthodox book. Agassi has adopted much from the Talmud. He was fascinated by the institution of Teiku, in which the Talmud concludes that we cannot conclude which side is right in the controversy, and the question remains open. He adopted several Talmudic arguments, such as “there is no end to this”, which means that the argument is too strong, so we cannot follow it: if we adopt it we can do nothing. He saw the Talmud as a book with different traditions, and he appreciated the more liberal one. He

resisted the approach in Israel that is hostile to the Talmud. He said that when we are not hostile we can take what we wish. Agassi in his writing had a Talmudic approach by making the controversies transparent. He admired the model of studying in the tradition of Yeshiva (i.e., those of adults). He recommended the democratization of education, and he saw the traditional Yeshiva (the traditional Jewish school of adults) as a real-life model for this, but he criticized the traditional Yeshivas for excluding women. Maybe the key to understanding Agassi is that he left religion but took a lot and very selectively from the liberal stream of the Talmud and combined it with Western philosophy, particularly the liberal one. Agassi recommended liberalism as possible. He criticized those who recommended liberalism without this limitation since full liberalism is impossible.

Regarding the history and philosophy of science, Agassi criticized the literature on the history of science that skips the mistakes of great scientists, sometimes even lying in order “to protect” them [4]. (He laughed that people asked him: what do you have against Newton?). Agassi also criticized scientists because they tend to skip the discussion about metaphysics. He claimed, “Legitimizing the use of metaphysics in scientific research constituted a far-reaching methodological revolution, invalidating the inductivist demands that science be guided by empirical information alone. Thus, science became tentative... [T]aking science to be the effort to explain facts in a comprehensive manner, makes some metaphysics unavoidable, and presents the better metaphysics as the possible frameworks within which older scientific theories may be reinterpreted and improved and newer ones may be developed [5]”.

Similar to his criticism about the history of science, Agassi proposed distinguishing technology from the history and philosophy of technology [7]. In the history and philosophy of technology, we should also be interested in technologies that have failed. Agassi pointed out the common confusion between science and technology and the philosophy of science and the philosophy of technology. He argued that all philosophers of science equate applied science with technology, “whereas it is clear that technology includes, at the very least, applied science, invention, implementation of the results of both applied science and invention, and the maintenance of the existing apparatus, especially in the face of unexpected changes, disasters, and so forth”. [8]. He was proud that he established the field of the philosophy of technology.

Agassi considered institutional individualism to be Popper’s great contribution to the philosophy of social science, and he developed this thesis. Agassi rejected both the polar view of individualism since society has existing institutions that influence the decisions of individuals and the polar view of collectivism [8]. He claimed that we should decide what the content of the institutions is: what are their aims and interests? They are not natural, but we decide what they should be. He claimed, “institutions can be explained as inter-personal means of co-ordination, as attitudes which are accepted conventionally or by agreement”. I told him that his view should change all the discourse about the question: what the corporation is? The corporation is what society chooses it to be, and then we should ask: what the corporation should be?

Agassi was a great teacher of writing [9]. His main advice was to think about the reader and serve him. He recommended having an imagined reader the author is

writing for. He saw the choice of the question as the most important part of the paper, and he recommended discussing the agenda and the importance of the question. He recommended choosing questions that have many possible answers, to expose them and discuss them critically. His principle in writing was transparency: when there are difficulties in your thesis, make them a part of your essay and discuss them openly. He warrens from the common mistake of losing the sense of proportion in writing, then one cannot finish his paper. He recommended writing the first draft quickly and then correcting it, and not to fear repeating yourself.

I owe Agassi for many extremely interesting conversations. We have investigated how to make game theory useful, particularly to promote peace. We concluded that game theory is most useful by choosing which games not to play, particularly games that may lead to war (or games that may lead to such games), and the best way to do that is by adopting a policy of unconditional honesty (i.e., respecting international law) and conditional generosity. Methodologically we have recommended making game theory part and parcel of social science. We worked on this project until his last days. It was a great right for me to have such a relationship with him and to enjoy his cleverness and generosity. I am grateful to you, Agassi.

Uri Weiss

References

1. Agassi, J.: *Liberal Nationalism for Israel: Towards an Israeli National Identity*. Gefen Publishing House Ltd, (1999)
2. David, Y. (ed.): *The State of Israel: Between Judaism and Democracy*. Jerusalem: Israel Democracy Institute. Joseph Agassi Israel: A State Governed by Rule-of-Law or Rule-by-Arrangement? <https://www.tau.ac.il/~agass/joseph-papers/arrangement.pdf>
3. Agassi, J.: Conventions of knowledge in Talmudic law. In: *Studies in Jewish Legal History in Honor of David Daube*, pp. 16–34 (1974)
4. Agassi, J.: *Towards an Historiography of Science*. Wesleyan University Press (1967)
5. Agassi, J.: The place of metaphysics in the historiography of science. *Found. Phys.* **26**, 483–499 (1996)
6. Agassi, J.: The confusion between science and technology in the standard philosophies of science. *Technol. Cult. JSTOR*. **7**(3), 348–66 1966. <https://doi.org/10.2307/3101933>. Accessed 4 Feb 2023
7. Agassi, J.: *The Confusion Between Science and Technology in the Standard Philosophies of Science*. Springer Netherlands (1974)
8. Agassi, J.: Methodological individualism. *Br. J. Sociol.* **11**(3), 244–270 (1960)
9. Agassi, J.: *Dissertation Without Tears*. na (1999)

Contents

1	Introduction	1
1.1	What is Game Theory?	4
1.2	The Uses of Game Theory	7
1.3	Game Theory and Peace	10
1.3.1	On Trust and Information	13
1.4	Equilibria	15
	References	16
2	Strategic Decisions	17
2.1	Preface	17
2.2	What is the Most Important Strategic Decision?	18
2.2.1	What and Who Determines the Game?	20
2.3	Conclusion	24
	References	24
3	Game Theory Encourages Peace	25
3.1	Game Theory Peace and Democracy	25
3.1.1	About Trust	25
	References	42
4	Game Theory for International Accords	45
4.1	The Political Aspect of Game Theory	45
4.2	A Comparison Between Our Approach and the Related Literature	50
4.3	Additional Morals to Learn from Aumann's Nobel Lecture (2005)	54
4.4	Conclusion	59
	References	59
5	Game Theory and Social Science	61
5.1	Game Theory and the Social Science I	61
5.2	Preliminaries	62
5.3	Part II	67

5.4	Conclusion	81
	References	82
6	The Game Theory of the European Union Versus the <i>Pax Romana</i>	85
6.1	Introduction: The Prisoner's Dilemma Versus the Stag Hunt	85
6.1.1	The Repeated Version	89
6.2	Against the Vision of the <i>Pax Romana</i>	91
6.3	In Favor of the Vision of the European Union	92
6.4	Conditional Generosity Versus Conditional Aggressiveness	99
6.5	A Game-Theoretical View of Brexit	100
6.6	Conclusion	102
	References	102
7	Playing the Game of International Law	105
7.1	Preface	105
7.2	Introduction	107
7.3	Historical Background	109
7.4	Kissinger Versus Keynes in Game Theoretical Perspective	114
7.5	From Negotiation to Litigation in Peace Processes	123
7.6	Realist Negotiation Versus Negotiation in the Shadow of the Law	128
7.6.1	The Distributive Effect	130
7.6.2	The Morals from the Above Example	131
7.6.3	The Reduction of Terrorism Effect	132
7.6.4	The Effect on the Chance to Achieve Peace	133
7.7	Conclusion	136
	References	137
8	Mutual Threat: The Cold War Game	141
8.1	The Cold War After 1949	141
8.2	The Repeated Chicken Game Versus the One-Time Chicken Game	145
8.3	A Game with Complete Information Versus Games with Incomplete Information	148
8.4	The Sequential Chicken Game Versus the Chicken Game	151
8.5	A Game with a Possibility to Coordinate by Communication and Agreements	152
8.6	The Mad	154
	References	156
9	Equilibria of War and Peace: Diverse Options of Cooperation	157
9.1	Preface	157
9.2	What is a Game?	157
9.3	Nash Equilibria	158
9.4	The Hostile Prisoner's Dilemma	159
9.5	Other Equilibria	161

9.6	Game Theory as Social Science	165
	References	170
10	The Game Not Chosen	173
10.1	Preface	173
10.2	Motivation	173
10.3	Definitions	174
10.4	The Game Not Chosen	175
10.5	New Equilibria	178
	References	183
11	Cooperative Game Theory Mobilized for Peace	185
11.1	Preface	185
11.2	The Map of the Possible Games	186
11.3	The Current State of Cooperative Game Theory	192
11.4	About the Need for Clarifications in Cooperative Game Theory	199
11.5	Conclusions	207
	References	208
12	A General Theory of Choice	211
12.1	Theory of Choice	211
12.1.1	Preface	211
12.2	Introduction	212
12.2.1	When to Accept a Proposal?	212
12.3	How to Choose?	218
12.4	Opportunity Cost Theory and a Proposal for Improvement Upon It	219
12.5	Game Theory	222
12.6	Decision Theory	224
	References	225
13	Toward Optimistic Future	227
	References	236

Chapter 1

Introduction



It is well known that the founding fathers of game theory have taught us how to analyse and how to play different games. Our debt toward them is even much bigger. The tools they gave us are even more useful. This book points out that game theory can contribute to the planners and players choosing which games to play, and most particularly which games not to play. Mechanism design theory has taught us that planners may choose the game to achieve the desired goals. Let us follow them: often it is very difficult to choose the game, but it is possible to choose a group of games, such as trade, and it is most particularly possible to choose which games not to play, such as risky games that may lead us to games that may lead to wars. Not only can the planners choose which games to play and which games not to play, but also the players.

How can game theory be useful in social science? The most important problem in political science is, how can we prevent wars and achieve peace? Can game theory help on this matter? Our main proposal is that game theory may signify in proposing help in deciding what games not to play. For the prevention of wars, the best precaution is to prevent risky games that may possibly lead to war. Thus, game theory helps avoid great mistakes. This clashes with the tradition that began with the very announcement—by von Neumann and Morgenstern—of game theory.¹ In their classical book every discussion of any game opens with a presentation of the rules of some game as given and as being played. In our discussion of this same situation, we begin not with the possible moves of the players but with their choosing what game to play (if any). We further propose a combination of two celebrated contributions, of John Nash² and of Abraham Wald.³ Nash has observed that a game may be stuck in an equilibrium state that is in the interest of all of its players to avoid, even when a much better equilibrium is available. Wald studied the choice of potential mistakes

¹ Von Neumann et al. [1].

² Nash [2].

³ Morgenstern [3].

to avoid.⁴ A discussion of these matters (in oversight of the cost of playing the game) should be applicable to diverse social situations, including unusual ones, such as playing or avoiding playing a game that may bring about bankruptcy, and such as the common mistake of avoiding games that involve only possible gain and no loss. Yet the focus of the following discussions will be the promotion of peace, and occasionally also of situations that may pertain to it.

Game theory or pure game theory comprises presentations of cases of conflict and of cooperation in some precise abstract situations, and particularly the analysis of such situations: what strategy, namely, a plan of action, is recommended for every player, and what are the possible results of the situation. Usually, discussions of pure game theory concern sets of strategies that will lead to equilibrium; applied game theory comprises analyses of possible uses of such abstract situations to the study of real-life cases of conflict and of cooperation; this includes—or should include—discussions of ambiguity in the applications of game theory to real life situations.

Game theorists hope to find in game theory the general principles of conflict and of cooperation. Game theory comprises studies of a few imagined abstract situations of conflict and of cooperation that should apply to many real cases of conflict and of cooperation. To that end, game theory presents these abstract situations in a standard set of assumptions regarding the diverse rules of diverse games, the diverse sets of information available to players and their diverse preferences and possible decisions as to how to play. Game theory offers advice to players in abstract games described in a standard abstract manner: it is a discussion of the possible results of a game given that all players wish to maximize their payoffs. Game theoreticians claim to be helpful to economists, political scientists, legal scholars and even biologists. The distinction between pure game theory and applied game theory is common, but there is constant ambiguity regarding it. The first book about game theory, and the one that established it, is called *Theory of Games and Economic Behaviour*; its authors, von Neumann and Morgenstern, considered applied game theory a description of economic behaviour and thus as a substitute for economic theory proper. This it is not.

Extended game theory goes further. It is a theory about the applications of game theory to economics, sociology, political science, international relations, law, and more. The present study focuses particularly on the possibility to use game theory as a means to encourage peace. We consider current game theory—pure and applied—too narrow, since its leading students systematically overlook some questions and some options that we deem important. In particular, they overlook the most important game that belongs to the mechanism design theory. This theory is wider than game theory: it adds to it the discussion of the choice of a game to play, particularly the choice that social planners regularly face.

This is the criticism of Nash on von Neumann and Morgenstern:

In *Theory of Games and Economic Behaviour* a theory of n -person games is developed which includes as a special case the two-person bargaining problem. But the theory they

⁴ Wald [4].

developed makes no attempt to find a value for a given n-person game, that is, to determine what it is worth to each player to have the opportunity to engage in the game.⁵

Nevertheless, game theorists continue considering games as given. The movement of mechanism design used game theory in order to design the desirable game from the point of view of the social planner. As the mechanism design theory presents a mechanism that enables reaching maximal utility given the preferences of all the players involved, we find it utopian and thus not realistic. Extended game theory recommends *avoiding* playing particular games. Extended game theory is an extension of the proposal—first worded by the philosopher Bertrand Russell—that every player in the cold war game should stop unilaterally playing it as it may lead to a nuclear disaster. Extended game theory includes the inquiry into the question, which institutions are essential in order to prevent war. For example, reputedly, freedom of information prevents war. Still, there is no demand for full disclosure of the preferences of every player, which demand is quasi utopian. As we will argue, at times even minimal improvements in the availability of information may improve the situation dramatically.

In real-life, we often do not know which game we are playing; game theory does not help here, as it allows for its arbitrary applications: it may easily lead to wrong conclusions in a questionable discussion that looks very imposing as ultra-rational. We suggest here—tentatively, of course—that game theory is most useful in helping improve decisions on the question, which games it is advisable to avoid playing. Our aim is to recommend avoidance of playing games that may lead to war, as well as some specific games to play and some specific games to avoid playing. Note that it is usually easier to avoid playing any particular game than to play any particular game, since normally a decision to play or plan a particular game has to meet several conditions, whereas for the opposite decision the failure to fulfil at least one condition suffices. Another neglected option is to play an unspecified member of a group of games; it is a common practice in trade; it is sometimes a game of bilateral negotiation that rests on information that is obviously incomplete; it may be a game with many potential sellers and buyers but with imperfect competition—for want of information; which is the usual case. Generally, establishing a particular game is hard, whereas to play the group of games of trade is easier. The greatest mistakes in this case concern not how to play, but whether to play. We suggest that the best way to prevent playing a risky game in international relations is to adopt a strategy of respecting international law and being conditionally generous (as we will describe below). Honesty and conditional generosity should be at least the default option. This is by far superior to the strategy of conditional aggressiveness that several leading game theorists recommend and even in the interest of all players: it is both cheaper and more effective all round. Thus, the European Union model is preferable to the *Pax Romana: Si vis pacem, para bellum* (if you want peace, prepare for war). The latter game rested on a threat to punish rebels cruelly; in the European Union the peace today is such that even if one member-country can invade another and reach victory for sure without significant losses, it will be no temptation. This renders the

⁵ Nash [5].

EU peace both cheaper and more stable than the *Pax Romana*. When a country wishes to quit the European Union, it does not risk war, as the peaceful Brexit illustrates. Moreover, preventing nuclear war by establishing global institutions is safer than by mutual threat.

Freedom of information, particularly in issues pertaining to foreign policy and security, increases the likelihood of settling conflicts by peaceful means. States of emergency will then require (not stepped up censorship, but) a freedom of information increase. It precludes the posture of a wolf in sheep's clothing that has led to the mistake that brought about the disastrous Korean War. Even minimal improvements in the level of mutual trust or in the increase of available information may suffice to cause significant improvements: the difference between maximal mistrust and minimal trust is enormous; minimal trust gives opponents the chance to develop reputation that justifies trust. Hence, even a small peace demonstration led by a few respected citizens may prevent war! The difference between absolute no transparency and minimal transparency may make all the difference; minimal transparency changes the incentive to cooperate sufficiently (since absolute invisibility prevents influence on reputation), and thus a very small percent of courageous journalists may sustain democracy significantly.

We present here game theory, illustrate it with the two most important games, and discuss ways to make it a useful tool for preventing wars.

1.1 What is Game Theory?

Game theory includes discussions of abstract situations—of conflict and of cooperation. It differs from conventional studies of conflicts and of cooperation by focusing (not on any particular situation but) on general principles that fit many kinds of conflict and of cooperation. Von Neumann and Morgenstern, the founding fathers of game theory, seem to have sought the basic laws of conflict and of cooperation; their game theory concerns regularities in real cases of conflict and of cooperation: what must happen in a particular abstract game when every aspect of it is clearly determined, including the behaviour, beliefs and preferences of all players. Not so in real life, where this closed system cannot be more than a partial regularity. For example, game theory may contribute to the discussion of how incomplete information may affect the capacity to achieve cooperation. Its analyses may be applicable to diverse aspects of interactions—between countries, litigators, lovers or traders. In addition, game theory usually employs mathematical and logical tools, yet the most important and interesting games require very little mathematics. Game theory presents abstractions of situations by games. Von Neumann and Morgenstern [6] defined a game as the sum of its rules. This does not suffice, as games also depend on their payoff. Nash [2] defined a game as the number of its players, the potential strategy of each of them, and their payoffs in the possible results of the game. (Payoff

is the value of the result of the game to the player in the eyes of the player)⁶). In game theory, players choose their strategies, namely, plans of action. (A strategy may constitute a plan for only one action or for a series of consecutive actions.) Players choose strategies, aiming to maximize their payoff given their expectations. They can choose from given particular sets of options whose payoffs are given. The rules of the game determine the options that the players may choose. What distinguishes a game is the matrix of payoffs and the rules of the game. Game theory proposes some distinctions, particularly between one-time games and repeated games, as well as between games with complete information and games with only partial information. Game theory concerns the interdependence of the players in the interactions. Surprisingly, in some games the advisable policy of one party is independent of what the other player does. Here comes the contribution of Nash: he developed the theory of equilibrium of strategies. Usually, “strategy” and “policy” may serve as synonyms; in the language of game theory, “strategy” means exclusively a complete plan of action of one player. This renders the theory utopian: it is a plan for action in every possible stage of a game. The game is then in Nash equilibrium if and only if no player can benefit from changing their strategy unilaterally.

To repeat, a system is in Nash equilibrium if and only if all players respond optimally to the strategy of the other players: none of them can benefit from changing their strategy unilaterally. There may be situations in which the strategies of the players represent a Nash equilibrium, but the players do not know that they cannot benefit from changing their strategy unilaterally. This is particularly the case in which players are ignorant about the strategies of their opponents. In such situations, the claim that the game is in a Nash equilibrium is uninformative.

Equilibrium of strategies is socially significant if and only if the social context of the game in question is sufficiently stable. Nash was the first game theoretician to have accounted for the sad fact that a society may achieve the stability of a particular norm even though getting rid of that particular norm is in the interest of every player (of every member of that society). What stabilizes the undesirable norm is an incentive to stick to that norm as long as it is operative. The simplest everyday example is general distrust: societies whose citizens trust each other are better off than those in which the norm is distrust, where, nevertheless, incentives are for distrust.

The prisoner’s dilemma game is perhaps the most challenging among the familiar games. It is a game in which the surprise is that the optimal strategy of each player is independent of the strategies of the other, although on its face they should be dependent. In this game, the players will achieve mutual defection even though they will both benefit from moving from mutual defection to mutual cooperation. (The theory of this specific game comprises an existence theorem: mutual cooperation may be dismissed even when mutual cooperation is better for both players than mutual defection. Thus, this game is important for the theory of legislation.) This is its story: the police caught two-armed people near a bank shortly after a robbery took place there. The police can charge them with illegal possession of weapons but not with the commitment of an armed robbery. They isolate them and propose a plea bargain

⁶ Nash [7].

Table 1.1 The prisoner’s dilemma game

	Cooperate	Defect
Cooperate (namely, not testify)	Second best, second best	Worst, best
Defect	Best, worst	Third best, third best

to each of them separately: if one player testifies against the other, the testimony will not be used against the testifier; the testifier will get a reduced penalty. Four possible outcomes are present then. First, no player accepts the plea bargain; this is mutual cooperation; it brings lenient punishment to both. Second, each prisoner testifies against the other; this is mutual defection; it brings punishment for robbery to both but exempts them from penalty for illegal possession of weapons. Third, only one prisoner will testify against the other; the prisoner who betrays the other walks; the prisoner who does not testify, namely, who cooperates with the other, is punished for both the illegal possession of weapon and for armed robbery. Fourth, the other way around in a symmetric fashion. This then is the matrix for the prisoner’s dilemma game (Table 1.1).

This game, the prisoner’s dilemma, presents an incentive for each party to betray the other—whether the other cooperates or not. (The game precludes communication between players, but allowing for communication between players will not change the result given that they are indifferent to breaking promises with no penalty: given that they are not honourable.) In this game, even though each player depends on the options of the other, the choices that they make are interdependent. This is so for two reasons. First, the rules of the games prevent negotiations that may lead to enforceable agreements. On the face of it, the game refutes the theory of Smith [8] according to which the free marketplace will lead to optimality,⁷ but this impression is not true: Smith strongly supported enforcing contracts: as the game explains why the lack of a mechanism to enforce international agreements is so challenging. Second, what choice is better for one player is independent of the choice of the other. The mechanism of contract is one that comes to make the choice that is in the best interest of both players to be in the best interest of both of them, but again in this game contract meant to change the matrices are useless! Contracts are mechanisms for introducing new games by changing payoffs. But they are not always effective.

This game, the prisoner’s dilemma, is different from games in which enforceable agreements are possible and from games in which the choices of players depend on their expectations from each other. The most interesting game in which the choice of each player depends on expectations regarding the choice of the other player is the stag hunt game, and this dependence makes all the difference from the prisoner’s dilemma. We will present the conventional story but discuss only the payoff matrix. Two players hunt together. They will succeed in hunting a stag only if they cooperate, but they cannot coordinate their actions. Going for the stag, then, is risky: action on expectation of cooperation that is disappointed, brings about empty-hand: it is the

⁷ Smith [8].

Table 1.2 The stag hunt game

	Cooperate	Defect
Cooperate (namely, not testify)	Best, best	Least, second best
Defect	Second best, least	Third best, third best

loss of the opportunity to hunt rabbits. Going for rabbits, a hunter is better off if the other hunter goes for the stag—to avoid competition. This then is the stag hunt game’s matrix (Table 1.2).

Here the expectation of the partner’s defection causes defection all round. Both players then wish to imitate each other: if the mutual expectation is to defect, then the two will defect, and vice versa: either mutual expectation will fulfil itself. Both mutual cooperation and mutual defection are this in Nash equilibrium: in the repeated stag hunt game, no player will benefit from changing strategy unilaterally when the game achieves any of those equilibria. The game may achieve an equilibrium of mutual defection, even though both players prefer the other equilibrium. Contrary to the prisoner’s dilemma game, this is not a necessary result of the game between two rational players, but only a possible result.

The different stories illustrate the two kinds of interactions; what makes the difference is the difference between their payoffs. They share much: in both games, the players must choose whether to cooperate or to defect; in both cooperation is better than defection all round; in both the worst result for a player is due to the choice to cooperate with a defector. The difference between the games is that in the prisoner’s dilemma game betrayal is preferable even with a party that cooperates, whereas in the stag hunt cooperation leads to the best result for both parties. In real life, the absence of coordination is common, and it is usually due to mistrust. While the increase of trust may lead to an improvement in the stag hunt game, it will not lead to any improvement in the one-time prisoner’s dilemma game, and this is why it is so important to avoid playing the one-time prisoner’s dilemma game whenever it is possible, and why it is so important to make it possible to avoid from playing this game. Sometimes the players have the option to choose between the games. If the players distrust each other they may not see an incentive to move from the prisoner’s dilemma game to the stag hunt one, while if they trust each other they clearly do have such incentive.

1.2 The Uses of Game Theory

Regrettably, the discussion of how to use game theory is in great neglect. We propose that a clear distinction between game theory as a part of mathematics and as a part of social science may alleviate matters.

Pure game theory is a collection of (rather trivial) mathematical theorems. As such, it says nothing about reality. It comprises rather obvious consequences from sets of

rules that characterize games. An example that plays a central role in the theory is this: the rules that characterize the one-time prisoner's dilemma game make players choose the strategy of defection. This says nothing about how they play it if they communicate beforehand: the rules of the game preclude this option. Some game theorists say this communication makes no difference as long as there is no incentive to honour any agreement that it may generate. This is a mere conjecture and thus no part of pure game theory. Of course, that very conjecture may appear in the definition of a given game. The standard game theory ignores it, much to our regret: we find it very interesting. If the theory is developed—as we hope—then, of course, the conjecture, as well as its opposite, would appear in some games. Thus, for example, a game that describes its players as sufficiently honourable will have them honour all agreements anyway; and then communication leading to an agreement may make a great difference.

Pure game theory does not decide when sets of conditions each of which has real examples hold simultaneously or even whether they can hold simultaneously (for any reason). It cannot even decide the question, what game is being under observation. Any discussion of it is boring unless mixed with some discussion of its applications that happen to be interesting. Thus, authors of almost every game-theoretical paper smuggle into their discussions items that belong to applied game theory. This causes confusion. Moreover, since their ventures into applied game theory are casual, they are usually rather poor and possibly harmful for the cause of peace.

Mathematics does not discuss the real world; applied game theory does. Assertions of the former are certain; assertions of the latter are not. When a conclusion from a theory conflicts with observation, then at least one of its premises is erroneous. In the present discussion, this may describe a situation as a specific game, or it may describe the equilibrium that a particular society has reached. For this, it does not suffice to describe a game, but also to identify it in the real world. Mario Bunge has criticized game theory for the arbitrariness of its choice of options.⁸ He concluded that game theory is not profitably applicable to empirical studies. We share his criticism but not his dismissal of the theory: he overlooked the possibility that critical discussion of what game what people play may be enlightening and/or useful.

We recommend making game theory part-and-parcel of social science; we find the usefulness of applied game theory highest when it helps recommend what games are better to avoid playing—an option that the literature still overlooks. This is regrettable since it is easier to avoid playing a game than to play one. For, the description of a game is a collection of statements about conditions; to avoid playing a game, suffice it to avoid fulfilling one of its conditions, whereas to play it is to try to realize all of them simultaneously. Game theory is also useful when it recommends which group of games to encourage playing—for example, trade. This, again, the literature sadly overlooks, although it is clear that the choice of a group of games to play is easier than the choice of one game to play. Most important is not the choice of the plan of actions in a particular game, but the choice of the game itself. Thus, the super-game, in which players choose which game to play, is more important than the game

⁸ See Bunge [9].

itself. For example, the decision to marry paves the road to the choice of a mate. At times, but not always, it is the first choice that leads to the second. More importantly, the choice of the constitution is more important than the choice of a particular bill. Similarly, it is common to recommend—within some limits—the preference of a game of peace over a game of war, of games of democracy over dictatorships, etc. In many closed societies, people do not choose spouses. In less closed societies, people can choose spouses from given groups; the groups themselves cannot be chosen. In open societies, people can also choose whom to marry, even if this entails leaving the groups to which they belong. Liberalism is the view that the more options the better; this includes, specifically, the option not to choose or to postpone choice. Game theory can and should recognize this. This discussion obviously belongs to game theory as a part of social science.

Nash has suggested that every game has at least one Nash equilibrium. Game theorists find this fascinating. They overlook the fact that the importance of this point comes from the view of game theory as a part of social science. Nash himself has omitted from the version of his doctoral dissertation that he published as papers the sections that discuss motivation and applications despite their importance. Nash explained this: he said, he wished to have the dissertation published in a mathematical journal and these chapters are not mathematical.

Some game theorists find it disappointing that in many cases, possible Nash equilibria are not unique: they consider it a weakness of the theory. Philip Dybvig said in his prize Nobel lecture on 8 December 2022 that having a multi-equilibria was largely viewed as a defect in models, “if you do not have a unique equilibrium it is not a real economic model, because you cannot do prediction” but “having multi-equilibria can be the main point, it can be an important part of economics that we should be concerned about”. We agree. We consider the possibility of multi-equilibria a strength of the theory: it shows that at times some abstract situations offer stable options that are not optimal and this reflects real-life situations. Game theory may help face them intelligently in efforts to improve general situations, such as when what is needed is raising the received degrees of trust. The single equilibrium case may be better for providing a prediction about a society, but the multiple equilibria case may be better as social engineering, since it provides tools for choices of ways to solve social problems. Game theory can tell what equilibria are available and what ways to choose between them are available and, above all, what games it is better to refuse to play and possibly also at what cost.

We propose to combine traditional game theory with Abraham Wald’s decision theory. Wald’s model (*sans* probabilities) is very simple, as an example may illustrate: consider the choice to take an umbrella. This choice reflects four situations that render the choice correct or mistaken: carrying the umbrella or not carrying it, when it rains or when it does not. Each option has a cost and a benefit. Knowing this helps one decide without knowing whether it will rain. Wald’s theory is different from traditional game theory in some aspects. First, he considered the possibility of mistakes. Second, he does not demand (although he allows for) decision-maker’s assumptions of probabilities. The founding fathers of game theory are also the founding fathers of the expected utility theory, which is part of their book *Games and Economic*

Behaviour. In game theory, it is common to speak about the expected utility. Game theorists will ask in such a case if the cost of taking an umbrella is bigger than the expected benefit. The problem is that for applying such recommendations, decision-makers have to know the probabilities (the probabilities of rain in our example). A decision-maker may know that probability or not: more often, it is impossible for decision-makers to know the relevant probabilities. Third, Wald [4] enables players to choose their payoffs as part of the game. It is thus a theory of choice. Fourth and most significantly, Wald theory is not utopian: it gives the decision-maker a tool to handle cases with potential damages. Wald is much closer to Popper [10] who proposes social engineers think of ways to decrease pain before thinking about how to maximize happiness and to prefer reforms that include ways to correct their possible errors with minimal cost.

We mentioned Russel and Maskin. Let us praise other writers who proposed not to take the game as given. (Interestingly, it is much more common in the popular science of game theory). Martin Shubik [11] wrote on Thomas Schelling: “It was the work of a social scientist willing to take the mindset of game theory seriously but not willing to accept the rules of the game as given”. Brandenburger and Nalebuff [12] proposed: “The essence of business success lies in making sure you are playing the right game... Successful business strategy is about actively shaping the game you play, not just playing the game you find”. The goal of McAdams [13] is to show “how to change the game so that you can then enjoy a consistent strategic advantage over your competitors”. He assumes that the game can always be changed. We argue that adding the super-game helps decide what games to play, and particularly what games not to play, which is the most important strategic decision. The standard games in game theory do not include the option to change them or to avoid them, but it may be possible to choose what games to play and particularly what games not to play, if the players play a super-game. Games that may lead to wars, or even games that may lead to games that may lead to wars, should be avoided. In Chap. 8, we discuss the difference between Russel and Schelling. Schelling proposed to change the game, such that before the USSR makes its decision, the Americans make their decision, namely commit themselves. The main recommendation of Russel was to prevent this risky game.⁹

1.3 Game Theory and Peace

The study of the use of game theory to cases of war and peace belongs to political theory. These may be the views of peace-loving thinkers such as Smith [8], Keynes,¹⁰ Nash et al.,¹¹ or the alternative views of game theorists such as von Neumann and

⁹ Popper [10].

¹⁰ Keynes [14].

¹¹ Ellsberg [15].

Morgenstern [6], Schelling,¹² and Aumann.¹³ Aumann said this on Kenneth Arrow: “As an economist he recognizes the importance of incentives; but as a humanist, he cannot get terribly excited about them in a practical context.”¹⁴ Not exactly. Obviously, game theory can serve both peace lovers and others. This may excite us all.

Game theory divides games to zero-sum games and other games. In a zero-sum game, one party gains what the other party loses—as in betting. Otherwise, both parties may win and both may lose—as often happens in negotiations in which all parties involved find some cooperation useful. Free trade rests on the expectation of parties that trade to gain, and its repetition rests on realizations of that expectation. This is the great idea of Smith [8]. He said, “Trade which, without force or constraint, is naturally and regularly carried on between any two places, is always advantageous”. In the idiom of game theory, he has proved that usually, free trade is no zero-sum game. This has an important moral for the study of war and peace: the possibility to come to an agreement proves that even enemies need not limit themselves to zero-sum games. Smith discussed a situation with no threat to use force. Nash [2] went further when he presented the situation of negotiation: “A two-person bargaining situation involves two individuals who have the opportunity to collaborate for mutual benefit in more than one way”: he thus referred also to bargaining in the shadow of terrorism. (Thus, Nash has freed the bargaining theory of its utopian character.) This has an important moral: there should be at least bargaining about the bargaining with terrorists: a country should at least declare what they demand in order to bargain. Many commentators praised the resolute refusal to negotiate with terrorists expecting it to serve as a disincentive for kidnapping. Experience regrettably refutes this reasonable expectation. Thus, even in the very worst case, of negotiating with terrorists, the game need not be zero-sum: agreements may improve the likelihood to achieve cooperation. This is so even though the means to enforce international agreements are greatly wanted. Aumann considered in his Nobel lecture [17] as a “fundamental insight” the idea

that repetition is like an enforcement mechanism, which enables the emergence of cooperative outcomes in equilibrium—when everybody is acting in his own best interests.

Aumann is partly right but he went too far, as he ignored some options: even in some repeated games, mutual cooperation is possible though not necessary. Experience shows that agreements in unique situations may have positive, long-term effects—even with no means to enforce them. The observation of Aumann [19] that in one-time stag hunt games agreements do not ensure cooperation is obviously true; it does not have the force he ascribes to it, however, since, by definition, uncertain forecasts may be true. Thus, his conclusion is invalid: unenforced agreement in the one-time stag hunt game is not always useless: for honourable people promises bind even with no enforcement.⁴ To be more specific, when information allows the view

¹² Schelling [16].

¹³ Aumann [17].

¹⁴ Robert [18].

of a game as a prisoner's dilemma or as a stag hunt, its context may help making a decision about it. The more civilized society, the greater will be its disposition to prefer viewing it as a stag hunt rather than a prisoner's dilemma. This explains why detaching game theory from the social sciences is inadvisable; hence, it is advisable to be clear about what study belongs to mathematics and what study belongs to the social sciences—in general, and particularly in game theory. Considered a part of mathematics and, alternatively, considered a part of social science, the observation of Aumann [19] is erroneous or under-determined respectively.

We present this as an example of the different methodology between extended game theory and traditional game theory. We welcome game theory as mathematics, and we welcome game theory as social science, but we stress that the application of game theory to real-life does not have the status of mathematics. *Caveat emptor*.

Generally, the expectation from negotiations is that they are not zero-sum games. For, normally they are expected to lead to agreements that improve the likelihood of cooperation. An important example is international relations. Thus, citizens of countries in war may benefit from their demands from their governments to negotiate—at least about their condition for entering a negotiation. This is all the more so, and generally so, since compared with the usual conditional aggressiveness, conditional generosity almost always achieves more for significantly less, and at times even much more for much less. In the repeated prisoner's dilemma game, it is rational to respond to the “always cooperate” strategy by defection. On the face of it, this is a case of recommended conditional aggressiveness. This is a popular misperception—in oversight of the better option not to play. Thus, to play or not to play, that is the super-question, the super-game. Conditional generosity, when at all possible, is the cheapest as well as the best: the threat to reduce generosity is less expensive and more credible than the threat to fight. Even when the threat is to reduce trade, it is much cheaper than war. Finally, the strategy of conditional generosity may change the preferences of the opposite party, and more so the preferences of its citizens. This changes the game since by definition a game depends on its payoffs. This is a *coup de grâce*. Now, von Neumann and Morgenstern presented a game as the sum of its rules, thus unintentionally making each game obligatory and thus dependent on unspecified conditions, and thus inherently underdetermined and thus applicable only inherently vaguely. Thus, conditional generosity may shift the sides from repeated prisoner's dilemma to repeated stage hunt, since generosity may change the preferences of the opposite player. As peace is much more stable in the latter case than in the former, playing the game of choosing between these two games must lead to a resounding cheer for peace. As von Neumann and Morgenstern described a game as the sum of its rules, they inadvertently assumed that players are heteronomous, thus inadvertently rendering the liberal tradition of economics totalitarian, or at best rendering it vague. In Smith's theory, tastes are exogenous: players decide what they are since they are autonomous. This is lost in the presentation of von Neumann and Morgenstern that replaces the given preferences of the players with rules of given games with no discussion of the ability of players to switch games, or, more generally, to choose which game to choose. This makes the prisoner's dilemma loom large and prescribes refusal to cooperate with no hint of the answer to the question, when is

it advisable to cooperate and when not? Our answer is straightforward: before you play, see how you can increase your initiative: do not play every game, and never ignore the option of refusal to play some games: avoid playing unfriendly games. (Brainwashing looks friendly to its victims but is not.)

1.3.1 *On Trust and Information*

To repeat, at times, huge improvements may result from minimal changes in trust between players or even merely in the visibility of one player's strategy towards the other. In the repeated prisoner's dilemma game, the assumption of one player that the other player will always defect is an incentive to do likewise. On the opposite side, the assumption that there is even a very small chance that the other player will respond to cooperation by cooperation is an incentive to try this option—as long as its cost is reasonable. The case regarding information is even stronger. Consider the following variant of the repeated prisoner's dilemma: no player can see how the opponent behaves. It will then be in the best interest of each party to always defect, exactly as in the one-time prisoner's dilemma. This will be the case even when the actions of only one party are completely visible and the actions of the other are completely blocked. In that case, the incentive for the blocked party is to always defect, leading the other party to do the same. Consider altering the game so that there is a small probability that the actions of the invisible player will be visible, then the side whose actions are visible may adopt a strategy of cooperating until they detect defection. Thus, minimal information may alter a game in which cooperation is impossible to a game in which cooperation is possible and then chosen.

Let us give another example of choosing the game by encouraging generosity. An ancient Jewish text (*Bereshit Raba*, 38.3) recommends the strategy of responding to the initiated generosity with greater generosity: if someone gives you a gift, give them in response a more expensive gift in order to reward them for their friendly initiative. As both individual and state may adopt a strategy, it is a general agenda as a super-game: the choice of any game to play or not to play.

The above discussion regarding trust and information leads to an important moral regarding game repetition. Game theory applies as fundamental the distinction between games played once and repeatedly. In repeated games, cooperation may be possible even if its once-played variant excludes all cooperation. This is for example the case in the prisoner's dilemma. To show this a distinction is needed between two kinds of repeating a game, where in the act of playing a player can or cannot develop a reputation that alters responses of opponents. Moreover, taking account of the context of a game renders even the outcome of a one-time game indeterminate: reputation may signify even for playing a game only once. Thus, it matters more to distinguish between games in which it is possible to develop reputation and games in which it is impossible, than to distinguish between a once-played game and a repeatedly played game—although only the latter distinction appears in the

standard game-theory literature. This is regrettable, since reputation matters particularly in international relations, where mere visibility may create reputation and thus suffice to prevent war. Game theorists tend to emphasize that the repetition of the game enables cooperation. We add to this the observation that visibility enables cooperation and thus prevents war. This is the big advantage of the freedom of speech.

The advantage of transparency goes further. A player can incentivize other players much more effectively when transparent than when opaque. Even in a one-time play, a player can incentivize opponents better by applying transparency. For, the transparency of a strategy renders a one-time game similar to its repeated version, whereas making strategy opaque renders a game no more than a series of one time games by destroying the capacity of players to incentivize. Moreover, transparency prevents mistakes that may incite war. Transparency may prevent war: transparency of the strategy of readiness to go to war in response to invasion may prevent invasion: The case of the Korean War illustrates this by two well-known cases. Harry S. Truman misled the North Korean authorities when he declared that the United States of America will not protect South Korea: This encouraged North Korea to invade South Korea and the United States responded by war. The same kind of misinformation encouraged the 1990 Iraqi invasion of Kuwait that started the Gulf War. Hence, making the policies of the United States transparent could prevent these wars. More generally, to play a wolf in sheep's clothes is the worst policy, since it misleads and encourages aggressive conduct. Still, more generally, absolute mistrust is the worst attitude: it prevents the opportunity to develop a reputation for goodwill and dependability. For example, when Israeli Prime Minister Ehud Barak declared that the Palestinian leaders refused to negotiate peace so that Israel has no partner to peace-negotiation, he led to absolute mistrust and stopped the opportunity for cooperation for a long time.

The wise attitude for every nation is to choose a game of peace whenever possible. If negotiations fail, then it is advisable for parties in conflict to invite international arbitration—in the international court of justice, or in any other tribunal acceptable to both countries. For this, all they have to do is to commit themselves to this policy in advance; this commitment is operative when visible and credible. Changing the game of international relations by making it mandatory to accept the authority of some international courts in any possible future case of international dispute. This invites an improvement of the UN charter. Yet even without it, states can choose readiness to negotiate unilaterally—by accepting the jurisdiction of the International Court of Justice, and by expressing readiness to invite to that court any opponent with whom they cannot settle any dispute by peaceful means. This way every state will reduce dramatically the incentive to prepare to war against it or to terrorize it. This is in the best interest of any state, particularly when it declares no intention to invade its neighbours even if they can win for sure without loss. This reduces the incentive to run expensive arms races, to the advantage of all parties involved.

The obvious counter-example to our position, and one that still impedes the cause of peace, is the case of British Prime Minister Neville Chamberlain who negotiated peace with the German Nazi authorities. His goodwill was beyond question; he was ridiculed because he trusted the Nazi authorities that were manned with individuals

who had no concern for their reputation. The ridicule is justifiable only to the extent that this fact on the Nazi authorities was known. In any case, the lesson from World War II was learned: governments have to care for their reputations.

1.4 Equilibria

The most important game theorist is John Nash, who proposed the equilibrium known as Nash equilibrium.¹⁵ Nash enabled game theory to help investigate different real-life situations, particularly situations in which there is no absolute conflict between the players, and in which the players do not have a dominant strategy (as in the one-time prisoner's dilemma). Nash enabled the investigations of situations of mutual dependence. However, Nash theory should not be held sacred. We propose some expansion for Nash theory: we propose to investigate equilibria based on different types of mistakes, and we propose to investigate equilibria not only of the choice of a plan of action in a particular game but also in the choices of what game to play. Similar to Nash theory, as we will argue, the choice of a game or of a strategy may be inferior, and it may lead to inferior equilibria, particularly of war. For example, a country may adopt a strategy of war economy if its leaders overlook their ability to change both the game and the strategy.

Acknowledgement Polonsky Academy was an optimal academic home for me to write this book. I am grateful to the Polonsky family for their extreme generosity. I am grateful to Robert J. Aumann, my doctoral supervisor, for teaching me. This book expresses what I have studied from him, and also my disagreements with him regarding questions of war and peace and regarding how to make game theory. I admire the model of "Plato is my friend, but the truth is a better friend", or its Talmudic version: Rabbi Yohanan was disquiet and sad when his student who was used to challenge him was replaced by a student who always explained why Rabbi Yohanan is right. Aumann preaches for this Talmudic model, and I am grateful to him for this, and for encouraging me to challenge him. I thank Ehud Guttel for challenging me to investigate how cooperative game theory may be applied to law. I thank Omri Yadlin for exposing me to the beauty of game theory. I thank Eric Maskin for our conversations and particularly for his comment that what I propose is a minimalist approach. I thank Kenneth Arrow for dedicating his time to discuss this research project, and for inspiring me. I am particularly grateful to Arrow for his suggestion during our conversation that when players choose a game, this choice occurs in a super-game. I am grateful to my co-author, Professor Agassi, who has been incredibly generous toward me. We have had long conversations for 17 years and I miss him a lot.

I am grateful to Thomas Ditzinger, Springer's Editorial Director of the Interdisciplinary and Applied Sciences and Engineering. I am grateful to the series editor, Janusz Kacprzyk. I am grateful to the publishing editor of this book, Zainab Liaqat. I am grateful to Nareshkumar Mani for coordinating this book project. I thank Viju Falgon for handling the production of the book.

¹⁵ Nash [2].

References

1. Von Neumann, J., Morgenstern, O.: *Theory of Games and Economic Behavior*, 2nd rev. (1947)
2. Nash, J.F.: Equilibrium points in n -person games. *Proc. Nat. Acad. Sci.* **36**(1), 48–49 (1950)
3. Morgenstern, O.: Abraham Wald, 1902–1950. *Econometrica J. Econometr. Soc.* 361–367 (1951)
4. Wald, A.: Sequential tests of statistical hypotheses. *Ann. Math. Stat.* **16**(2), 117–186 (1945)
5. Nash, J.r., John F.: The bargaining problem. *Econometrica: J. Econometr. Soc.* pp. 155–162 (1950)
6. Neumann, J.V., Morgenstern O.: *Theory of games and economic behavior* (1944)
7. Nash, J.: Non-cooperative games. *Ann. Math.* 286–295 (1951)
8. Smith, A.: *The wealth of nations* (1776)
9. Bunge, M.: *Social Science Under Debate: A Philosophical Perspective*, 180 (1998) (ebook)
10. Popper, K.R.: *The open society and its enemies* (1945)
11. Shubik, Martin.: *Game theory and operations research: some musings 50 years later.* *Operations Research* **50**(1), 192–196 (2002)
12. Brandenburger, Adam M., Barry J. Nalebuff.: *The right game: Use game theory to shape strategy.* Vol. 76. Chicago: Harvard Business Review (1995)
13. McAdams, David.: *Game-Changer: game theory and the art of transforming strategic situations.* WW Norton & Company (2014)
14. Keynes, J.M.: *The economic consequences of the peace* (1919)
15. Ellsberg, D.: *The Theory and Practice of Blackmail.* Rand Corp Santa Monica CA (1968)
16. Schelling, T.C.: *The Strategy of Conflict* (1960)
17. Aumann, R.J.: War and peace. *Proc. Nat. Acad. Sci.* **103**(46), 17075–17078 (2006)
18. Aumann, R.J.: Economic theory and mathematical method: an interview. In: Feiwel, G.R. (ed.) *Arrow and the Ascent of Modern Economic Theory*, pp. 306–316. Macmillan, London (1987)
19. Aumann, R.: Nash Equilibrium are not Self-Enforcing in Gabszewicz, J., Richard, J and Wolsey L.(eds) *Economic Decision Making: Games, Econometrics, and Optimisation: Essays in Honor of Jacques Dreze* (1990)

Chapter 2

Strategic Decisions



2.1 Preface

Regarding games, what is the most important strategic decision (what is the most important component of a strategy)? Who determines a game? On what grounds? The legacy of Von Neumann and Morgenstern¹ may be enriched by applying a contribution of Nash² into the account of players' choice of agenda as their primary decision, their choice, before playing, of what games not to play (war games, for example) and what games to play. This choice is a game that precedes the games that traditional game theory studies.

What then is the most important component of a given strategic decision? Game theory obscures the choice of a game to play, and more so what game not to play, since this choice of a strategy encompasses a complete plan as to which action to choose in each possible development of any given game. In truth, players have much less at their disposal. Yet it is scarcely necessary: the practical moral from a discussion of any game for political science to examine, then, is reputably obvious: the most important strategic decision is how to keep the peace. To that end, both individuals and societies should refuse to hate: hostility, Spinoza has observed, is too expensive.³ The practical moral for any decision-maker is this: the most important strategic decision is what pitfalls to dodge, how to avoid playing games that may lead to bankruptcy. Next comes the decision of how to spot possible no-lose games. Adding all this to game theory renders it much more realistic. Since it is impossible to have a complete plan for a real game, rather than planning what to do in every possible development of a game, it is important to plan to avoid pitfalls. Also, in the case of a mistake possible to correct either globally or locally, to decide which option to choose.

¹ Von Neumann and Morgenstern [1].

² Nash [2].

³ Spinoza [3].

What determines the game? Von Neumann and Morgenstern said, a game is “simply the totality of the rules which describe it.”⁴ Hence, rules determine a game; hence, the way to change a game is to replace its rules. Nash proposed another view. Let us cite him and then discuss his view.

For us an n -person game will be a set of n players, or positions, each with an associated finite set of pure strategies; and corresponding to each player, i , a payoff function, p_i , which maps the set of all n -tuples of pure strategies into the real numbers.⁵

According to Nash, then, a game is the totality of its players, their positions, possible strategies, and possible payoff. His view is better than that of Von Neumann and Morgenstern, since it includes the possibility that they have overlooked: the payoff’s matrix is a function not only of the rules of the game: it also depends on choices of players (see below). He overlooked the division of labour between legislators or planners and individual players in the choice of the game to play, particularly the ability to change the game by changing some preferences. The question, what determines the game played, leads to the question, who chooses what game to play. Since the theory allows players to choose their values, it should likewise allow them to change the game, and even unilaterally. While mechanism design theory is a theory of ways for social planners to choose a mode of conduct, it does not include considerations regarding the ability of players to choose a game to play or to refuse to play. Hence, there is no need to fix payoffs: these may depend on the preferences of players and their changes—as happens systematically in every poker game. What is still missing is the study of mechanisms that prevent certain patterns of conduct (since love changes the game of the prisoner’s dilemma).

2.2 What is the Most Important Strategic Decision?

Traditional game theory starts each of its discussions with a given game and with one question about it: how to win it? This rests on a super-game, in which the choice of a game is made, and this possibly rests on the super-super game in which players also choose the game of choosing the game. This includes the decision to declare a war or to desist from it. When traditional game theorists consider a war, they ask how to win it, instead of asking whether to play it, namely, what generates the possibility to avoid a given war. Similarly, the most important decision in the field of auctions is in which auctions to participate.

The pioneering study of John von Neumann and Oskar Morgenstern defines “strategy” as a complete plan for a given game.⁶ A strategy of a given player, then, specifies how that player will act in any specific situation that the given game allows for: a strategy will thus prescribe for that player an action for each case in which action

⁴ Von Neumann and Morgenstern [1].

⁵ Nash [2].

⁶ Neumann Von J, Morgenstern O., *op. cit.*

depends on some possible information that is relevant to the game—according to the specified rules of that game. To put it in the wording that the social sciences employ, a strategy is a complete policy, a plan of action for any contingency. Nash [2] added a very significant contribution to this in his introduction of equilibria of strategies: a game is in a Nash equilibrium iff all players have no incentive to change their strategies; the strategy of each player is then the best response for the strategies of other players.⁷ Surprisingly, this allows a game to be in equilibrium even when an option is available for players to alter their strategies simultaneously to the benefit of them all. In such cases, the possibility of improvement—even a Pareto improvement—is not a sufficient incentive. What happens then (as the default option!) is that distrust leads players to forego the best equilibrium available. Viewed as a part of social science, this is an improved version of the generally received theory of the social contract: in the very first place it is a contract that precedes any cooperation. Current understanding of strategy within received game theory overlooks this.

An instance for this extension from political sciences is the case of one nation declaring war on another and winning it, even though peace is possible and is the better option for both. An instance from business studies is the case of opening a particular business and managing it perfectly, in situations in which it is better to join resources. A simpler case is conducting negotiations with people with whom it is better not to do business.

The work of Nash is thus useful. It offers strong arguments for preferring peace to victory as a default option. Game theory encourages strategic thinking: to consider what is the best option for a business management given the options given to the competition. What is the best option for a business management may depend on the expected decision of the competition. A case may also be of mutual dependence. Surprisingly, at times a preferred potential strategy for a business management is best regardless of the decision of the competition. Moreover, there is always the choice to play honestly or not. This issue appears already in the Talmud. The standard recommendation of the Talmud for business is to choose the strategy of honesty. This is the case since business is a repeatable mode of conduct: those engaged in business prefer to do business with those who play *bona fide*. Game theory ignores the obvious difference between the *bona fide* and the fly-by-night. Design theory investigates the question, what is the best mechanism of bidding, on which Eric Maskin has said (in his Nobel lecture, 2008):

We begin by identifying our desired outcome or social goal. We then ask whether or not an appropriate institution (mechanism) could be designed to attain that goal. If the answer is yes, then we want to know what form that mechanism might take.⁸

The current theory of efficient mechanism design may be too utopian to be profitably applicable to political science or to the study of strategic business management; hence, a theory may be useful that could serve to discuss this matter. As Karl Popper has recommended, applied social science is means for social engineering (1945):

⁷ Nash [2].

⁸ Maskin [4].

The piecemeal engineer will, accordingly, adopt the method of searching for, and fighting against, the greatest and most urgent evils of society, rather than searching for, and fighting for, its greatest ultimate good.⁹

Thus, the most significant achievement of game theory is in the suggestions of what venture is unwise to undertake. Indeed, wise entrepreneurs tend to shun bad undertakings. Prevention is much easier to work out than application, since every undertaking requires some conditions for its very applicability, and these are never too clear and seldom part of a theory. The moral may be, in business no less than in medicine, *Primum non nocere* [first of all, do no harm], except that loss of property is less intolerable than loss of life. A more sophisticated moral in business may be to reduce harm to minimum. (The last moral is in the spirit of the law and economics movement, particularly the law and economics of torts.)

2.2.1 *What and Who Determines the Game?*

What is a game? What and who determines the game? Von Neumann and Morgenstern [1] said, it is “simply the totality of the rules which describe it”. Nash [2] has proposed a different reply. Let us quote him in his formal words:

For an n -person game will be a set of n players, or positions, each with an associated finite set of pure strategies; and corresponding to each player, i , a payoff function, p_i , which maps the set of all n -tuples of pure strategies into the real numbers. When we use the term n -tuple we shall always mean a set of n items, with each item associated with a different player.

Martin Osbrone and Ariel Rubinstein have added this:

a game is a description of strategic interaction that includes the constraints on the actions that players in the game can take and the players’ interests but does not specify the actions that the players do take.

Kenneth Arrow has raised the obvious question that the theory should answer:

the rules of the game are social. ... these have definite rules which are constructed, indeed, by a partly social process. Who sets rules for real-life games?¹⁰

This includes the question, who sets the payoff for real-life games? These depend also on the preferences of players. These usually depend also on personal choices and of cultural values. Thus, for example, the same pattern that is a prisoner’s dilemma game for two particular players may be a stag-hunt game for another two particular players; this choice may depend on preferences. Thus, for example, when two players in a prisoner’s dilemma fall in love, their interaction pattern changes, even with no change of rules. Moreover, the same rule may lead to different conduct in different societies.

⁹ Popper [5].

¹⁰ Osborne and Rubinstein [6].

That a dramatic game change with no change of rules is possible is a refutation of the view of Von Neumann and Morgenstern. Consider the prisoner's dilemma game in which every player must choose if they will get 100 or their counterpart will get 300. The result of this game will be that each player will forego the opportunity to achieve 300 and be content to receive 100. Things change drastically when players fall in love, namely, they are as happy when their partners win a prize as when they do. This time they will play another game. Here players win 300 each and are as happy as if they win 600 each: love blocks the harmful conduct that rests on indifference to the lot of others. This is a significant advantage of love—or empathy—it blocks inefficiency! This is also a significant advantage of the social institutions that generate friendliness: they block inefficiency. Altruism prevents playing the prisoner's dilemma game. Hence, a game is not only a function of its rules, but also of the preferences of its players. Hence, the approach of Nash is much better. The game-theoretical insight that love prevents inefficiency supports the adage of W. H. Auden who said,

If equal affection cannot be,
Let the more loving one be me.

Love is likely to generate cooperation and thus promote efficiency.

Taylor and Nowak [7] argued that kin selection “leads to a transformation of the Prisoner's Dilemma payoff matrix”¹¹: a prisoner's dilemma game between strangers is not necessarily a Prisoner's dilemma game between siblings. The application of the same rules between lovers is much friendlier than between strangers. Hatred affects games the opposite way. It may cancel some favourable options and lead to some risks. Considered economically, reducing racist hatred increases competition to the general benefit. Reducing racism may shift the game from a monopolistic power to a competitive market, even with no change of rules. Hatred may also stabilize undesirable collusions: firms may collude implicitly by avoiding employment of members of a minority. Kenneth Arrow has asserted,

we cannot legitimately speak of equilibrium with respect to any one commodity; since supply and demand on any one market depends on the prices of other commodities, the overall equilibrium of the economy cannot be decomposed into separate equilibria for individual commodities.¹²

This renders reducing hatred a major concern for the economy as a whole. Moreover, as Thomas Schelling pointed out, small changes of discrimination may result in dramatic change.¹³ Also, small changes of rules may change the preferences of players in a way that transforms the game: as racism may close a certain market to a

¹¹ Taylor and Nowak [7].

¹² Arrow [8].

¹³ Schelling [9]. See also the “white flight” model of Schelling, *ibid.* Not only the conduct of players can depend on the demographic structure; feelings too can depend on it. In too many cases, considering a minority as a “demographic problem” led to atrocities. Even efforts to prevent a demographic structure that may lead to racism may lead to atrocities. Hence, not only the game of racism should be blocked, but also the game of blocking racism by racist means.

certain minority, members of it may create markets for substitutes or near-substitutes for it. In such cases, a society may have a market with (relatively) stable hate (playing hate game), and a market with (relatively) stable no-hate (playing democratic game); a small change in racism may shift that society from the democratic equilibrium to the racist one.¹⁴ (In one of the next chapters we will propose equilibria in the choice of games). The possibility of this super-game explains why it is not enough to play the democratic game of a market free of hate; even the super-game in which the hate game is blocked is inferior to a game with no racist sentiment.¹⁵ The wish to reduce hate may lead to effective changes of the constitution, the law, or law enforcement. Criminal law may be designed for revenge or to discourage crime by rendering it unprofitable. For the latter goal minimal punishment may suffice. In modern liberal countries the penalty is smaller and harder to impose than in backward countries, yet much more efficiently so. Likewise, hate may lead to more litigation and less settlement; it may oust settlement.

We are interested particularly in spreading peace and preventing war. As hate may lead to wars, it is advisable to prevent it even unilaterally. As it may make agreement impossible and thus lead to zero-sum games, replacing these with cooperation may oust some impediments for peace. Hate may lead to risky conduct such as war. Hate may also impede deterrence: the conviction that attack is unavoidable reduce the incentive for peace. In the stag hunt game hate may lead to the mistrust that leads to the failure of cooperation and thus to war. Unfortunately, hate may promote the interests of some politicians to promote hate. The rule that the first to stop fighting loses all makes incentive to continue fighting and thus it promotes hate. It is particularly important to prevent the game that W. H. Auden has described as

They hate for hate's sake.

¹⁴ This is parallel to the conclusion of Schelling (Ibid.):

Evidently if there are any limits to the minority status that either colour can tolerate and if initially complete segregation obtains, no individual will move to an area dominated by the other colour. Complete segregation is then a stable equilibrium. The concerted movement of blacks into a white area or whites into black could achieve some minimum percentage; but in the absence of concert, somebody has to move first, and nobody will.

¹⁵ During World War II, the UK blocked immigration of Jewish refugees in the wish to prevent the rise of antisemitism. Consider the role of hate in the employment market: when public administration positions are closed to members of a minority, this leads to their disproportional representation also in the private sphere, which may lead to hate. Moreover, according to Gary Becker discrimination will be neutralized by the free competition. If one firm does not employ minorities, it will be defeated by the firm that employs them. What is dismissed is that for such correction it is not enough that we will have firms that are ready to employ the people from the minorities in proportion to their percent in the population. In such a case the colour blind will employ only discriminated people until the market reaches equilibrium with no discrimination. This requires the presence of non-racist firms ready to employ discriminated workers much more than their portion in the population, until the discrimination is neutralized. There is no guarantee then for this presence, and then also for the neutralization of discrimination. Becker dismisses these cases as mere friction. See Becker [10].

This is a game in which one side says this (with or without justification), as it will lead to despair, to the conclusion “there will be no peace”, and then to abandon any attempt to achieve peace. It is particularly advisable to prevent this game in which people say:

There will be no peace.
 Fight back, then, with such courage as you have
 And every unchivalrous dodge you know of,
 Clear on your conscience on this:
 Their cause, if they had one, is nothing to them now
 They hate for hate's sake. (W. H. Auden)

Jewish tradition supports the protocol of resolving personal conflict by proscribing hatred:

Thou shalt not hate thy brother in thine heart: thou shalt in any wise rebuke thy neighbour, and not suffer sin upon him. (*Leviticus* 19:17)

Victims should ask their offenders for explanations.

Back to the view of Nash [2] about games. To repeat, he has proposed the following idea:

For us an n -person game will be a set of n players, or positions, each with an associated finite set of pure strategies; and corresponding to each player, i , a payoff function, p_i , which maps the set of all n -tuples of pure strategies into the real numbers. When we use the term n -tuple we shall always mean a set of n items, with each item associated with a different player.

This allows different preferences in the same game; it invites discussions of real games such as trade (between, say, suppliers and consumers). Can Nash allow for considering games as patterns of conduct studied in empirical social science? In the above quotation, Nash viewed the payoffs as depending on the rules of the game alone. He had extended game theory to include some interesting non-zero-sum games. This allows for a further extension, for the inclusion of political and legal institutions that may change some spontaneous order—to meet his spectacular observation that a spontaneous order may lead to results undesired all round. At that stage, Nash considered the payoff as given; he did not discuss the option of players' choice of payoffs. Later, game theorists have suggested the distinction between games with and without complete relevant information. This goes beyond the definition that Nash has proposed, as it excludes games whose rules do not determine their payoffs uniquely.

Consider the answer of Rubinstein and Osborne (in their canonical textbook, 1994) to the question, what is a game?

a game is a description of strategic interaction that includes the constraints on the actions that players in the game can take and the players' interests but does not specify the actions that the players do take.

This answer is better than that of von Neumann and Morgenstern. Does it suffice for covering the distinction between prisoner's dilemma game and stag hunt game? Suppose that it is in the interest of the players to minimize the time they have to

spend in jail, and that they can cooperate with the police or defect. Does this suffice in order to determine the game that they play? A possibly better view of games will be that a game is the totality of the components that may influence the developments and the results of playing it (including the preferences of its players).

2.3 Conclusion

The most important strategic decision is what game to play, and more so what game to refuse to play. If a game is given and playing it is decided, what remains to discuss may be, how to win it? That may be a war game. And then it may be better to play the game of making peace.

References

1. Von Neumann, J., Morgenstern, O.: *Theory of Games and Economic Behaviour* (1944)
2. Nash, J.: Non-cooperative games. *Ann. Math.* 286–295 (1951)
3. Spinoza, B.: *Tractatus Theologico-Politicus*, Chap. VI (1670)
4. Maskin, E.S.: Mechanism design: how to implement social goals. *Am. Econ. Rev.* **98**(3), 567–576 (2008)
5. Popper, K.: *The Open Society and Its Enemies* (1945)
6. Osborne, M.J., Rubinstein, A.: *A Course in Game Theory* (1994)
7. Taylor, C., Nowak, M.A.: Transforming the dilemma. *Evol. Int. J. Organ. Evol.* **61**(10), 2281–2292 (2007)
8. Arrow, K.J.: General economic equilibrium: purpose, analytic techniques, collective choice. *Am. Econ. Rev.* **64**(3), 253–272 (1974)
9. Schelling, T.C.: Models of segregation. *Am. Econ. Rev.* **59**(2), 488–493 (1969)
10. Becker, G.S.: *The Economics of Discrimination* (2010)

Chapter 3

Game Theory Encourages Peace



The most useful move in playing any game is often the decision, which games to avoid playing. This includes the avoidance of declaring war. The best encouragement to this is providing incentives for enhancing peaceful expectations. Game theory reveals the big advantage of trust, even of minimal trust, in situations that display characteristics such as those of the repeated prisoner's dilemma game, and of the stag-hunt game. Moreover, mutual cooperation is a possible result of the repeated prisoner's dilemma off the moves are visible during the game—at least partially. Without reputation, the players cannot make the necessary difference between the repeated and the one-time game, and then defection remains the dominant strategy. This is so since in this case each player knows that their actions will not influence the actions of the opponent. This invites institutions that promote freedom of information. Thus, game theory leads to much more peaceful, liberal, and friendly approach than some prominent experts on the theory propose.

3.1 Game Theory Peace and Democracy

3.1.1 *About Trust*

The world of crime pitches the prisoner's dilemma customarily against the awareness of the aspects of the context of the game that may interfere with its very rules. The way game theoreticians take account of the context of any given game is often the same: it is the simplest way to introduce a context (surreptitiously): it is the repeated game, and in the present case it is again the repeated prisoner's dilemma game. In the one-time prisoner's dilemma game, the context of the game does not influence its result. However, in the repeated game the context may make a big difference. The result of the game may depend on the norm in which it is played. It will depend on the expectations of each player regarding the strategy of the other, while the expectations may be mutually dependent, and on the information that they may possess on each

other. What social settings provide players of the repeated prisoner's dilemma with incentives to cooperate?

Notoriously, the situation in any such variant of the game differs significantly from that of the standard game. For, in some social settings the expectation of repetition of the game makes it worthwhile for both players to be trustworthy, or to build up trust—on the supposition that in the long run this is in the interest of both players, even though in the short run each player may lose. Undeniably, players of this repeated game can manage to establish trust, but not always. This situation appears not only among criminals. It prevails in all the situations that interest us here, namely, where parties agree that mutual trust is mutually advantageous (as it leads to cooperation) but that regrettably it is not within reach—such as the repeatedly encountered in tense borders, where the slightest loss of self-control of one party immediately raises the hostility of the other. Quite generally, the investment in raising trust is risky just because of the initial absence of trust that encourages despair. Compare two countries with high and with low prevalent morality. Citizens of both countries will agree that the prevalence of honesty improves the quality of the lives of its citizens, yet the citizens of the country with poor prevalent morality may do nothing about it for the absence of trust: the better-behaved individuals in such countries are significantly more vulnerable to maltreatment than others. Thus, the same situation with or without the possibility of trust reaches stable results, the socially optimal and pessimal respectively [1], pp. 115, 117 and 220].

The common level of cooperation can be raised—by persuasion or by force. For the reasonable use of force, two sets of tools are available, legal (taxation, tort law or criminal law) and social (reputation or social sanctions). These tools may similarly destroy all trust—by promoting betrayal. The argument for this is that trust is fictitious and the only real choice is between playing the active or the passive party to the game; this argument is *Realpolitik*. The German playwright Carl Zuckmayer wrote in his autobiography (1970) that the popularity of *Realpolitik* in Nazi Germany doomed the Nazi regime to failure even had it won the war—because it eroded all trust. ([2] See also [3, 4]). The error made there repeatedly is the identification of the repeatable version of a game with its unrepeatable version, in disregard for the ability to raise or lower trust. To raise trust within one society, legislation may proscribe betrayal. The most important cases of the avoidance of playing the prisoner's dilemma are consequences of diverse laws designed for the enforcement of contracts. For, the most important function of contracts is to facilitate unrepeatable cooperation with untrustworthy fly-by-night strangers.¹ In other words, contracts expand the marketplace. By its very function, of making it possible to do business with strangers, contract laws support the open society. Generally, when the market mechanism fails to enforce contracts between one-time players, liberalism requires legislators to step up the law.² A strong means for blocking the emergence of the

¹ This is the chief argument of the Chicago school of economics for their proposal to use legislation solely for the purpose of enhancing the market mechanism. Yet experience shows that the very tools that enhance openness may also enhance discrimination as a local equilibrium that is too stable for these tools to overcome [5].

² The above game theoretical discussion seems to suggest that contract law prevents the repeated prisoner's dilemma game or the stag hunt game. This would render state intervention against them

prisoner's dilemma game is to punish the abstention from punishing defectors. For example, Japanese custom requires ostracizing those who misbehave as well as those who fail to ostracize them. Consider a society in which everyone avoids anyone who opts for some specific action, and everyone avoids anyone who does not punish the one who opts for that action, and so on. This causes a Nash equilibrium: no player can benefit from unilateral strategic change. This situation may be stable even when all involved prefer a different option. This is what usually stabilizes closed societies, and for two possible reasons: closed societies are easier to split than to unify, and so their members usually oppose reforms even when they yearn for them. This is a huge achievement of Nash: he has shown that society may come to a stable norm that is undesirable, even in games in which many better stable norms are available. This way the philosophy of Nash differs from that of the Chicago School: they take it for granted that the policy of "hand-off" will always secure the optimum solution. Arrow's theory [6] shows the limitation of democracy; Nash's theory [7] shows the limitations of spontaneous order. We interpret Arrow as supporting Churchill's claim that democracy is no more than the least objectionable among the political system tried thus far; Nash shows that spontaneous order is also no more than the least objectionable order. The practical consequences of both invite discussions, since they definitely refute the default options as too utopian to serve as practical models.

Consider the prisoner's dilemma game repeated indefinitely with a fixed norm for cooperation and a fixed norm for defection. What conditions secure a Nash equilibrium in this game? Many Nash equilibria to this game are available. The two standard pairs of strategies that achieve it are mutual always-defect and mutual tit-for-tat. (The latter strategy invites the player to begin with cooperation, and to repeat in any other round of the game what the other did in the previous round.) Regrettably, in this game mutual always-cooperate strategy is not in a Nash equilibrium.³ For, the choice of this strategy comprises incentive for opponents to always defect. Therefore, mutual always-cooperate does not work in this game.⁴ Let us emphasize: whereas mutual tit-for-tat pair of strategies yield permanent mutual cooperation and is in a

superfluous, since these games may encourage mutual cooperation. Not so. The state plays a significant role in these games since they also allow for mutual defection, and as a stable option. Of course, as state intervention is costly, it is not always advisable. Whenever cooperation depends on trust, as is the case in the stag hunt game, state intervention may encourage trust. State intervention may also encourage mistrust. Consider a corrupt legal system that acts against fraud if and only if it defrauds the rich. But this happens even without corruption when suing for fraud is very costly. Whenever stakes are high, tests for trustworthiness are unreliable as they comprise intolerable temptations to lie. Admittedly, imposing laws that foster honoring contracts is the best means to prevent undesirable temptations, but this needs the backup of the reputation mechanisms. For, the effectiveness of contracts law is limited as a strong party may force a weak one to play the take-it-or-leave game, relying on high litigation costs to prevent the weak party from making use of the service of the courts. And then, only the need of the strong parties to protect their reputation will ameliorate the situation somewhat.

³ Game theory does not take into account that adopting the strategy of "always cooperate" may change the preferences of the other player and by this change the game.

⁴ Mutual always cooperate strategy is no Nash equilibrium since in this case every player has incentive to defect. The best response for always cooperate is always defect. Let us criticize this view: it is the best response, only if players who adopt the always cooperate strategy do not change their

Nash equilibrium in this game, mutual always cooperate is not: in cases in which players choose this strategy, the best response of their opponents is to always defect! To bring players in this game to cooperate, it is not sufficient that both players choose to cooperate; it also depends on the following condition: each player should be ready to respond by defection to (a sufficient degree of) defection. If each player adopts, say, tit-for-tat, then each player issues a threat to the other, but without ever realizing it! This surprising insight has led prominent game theorists to a strange conclusion: the decision to punish opponents heavily enough regardless of the price of the implementation of this decision renders this very implementation unnecessary! Aumann's lecture "Peace and War in the Middle East" presented the vision of *Pax Romana*. We disagree. Taking as the default option that the political situation is of the repeated prisoner's dilemma (or any other games) is often a grave error. Rather than offering the best recommendations for players in a given game, it is better to seek the best way to help them prevent it and to deliberate on the advisability of playing it once they are able to choose whether to play or not. One way of changing the game is by changing preferences: the choice of humanist and peaceful values may prevent many risky games. For example, the choice of liberal values may prevent a prisoner's dilemma game between police and demonstrators. The suppression of demonstrations notoriously incites violence. This leads to the intolerable justifications of slaying demonstrators. A particular game may include proportional military response; some game theorists would consider this game a sufficient justification for real action; our attitude—of questioning the wisdom of any choice of a game to play—should first raise the question whether the very decision to play that game is legitimate. Admittedly, a game in which unconditional cooperation comprises incentive for the opponent to defect, renders the strategy of unconditional cooperation inferior to conditional strategy (such as the one present in the repeated prisoner's dilemma). And then, whenever possible, the conditional strategy should not necessarily be conditional aggression. Conditional generosity may very well be superior to it. For, in real-life, where error is inevitable, *Pax Romana* is very risky: a mistake in reading the opponent's action may lead to war. Armament may lead to war in many other international games, such as the stag hunt, as it may offer incentives for increased aggressive conduct. The Romans did not consider this option, as they preferred always staying ready for war. The case of the prolonged tension between Israel and the Palestinians is similar: had Israel respected the right of Palestinians to protest

strategy when their opponents defect. Now, mainstream game theoreticians dismiss this criticism, on the strength of the observation that the last condition is fulfilled by definition: if the response to defection is any strategy other than always cooperate, then it is not the always cooperate strategy. To this we respond as follows. This observation reflects a problem within the very concept of strategy. It hides the tacit assumption: the choice of a strategy that each player makes is not open to replacement, since by definition every future replacement of the chosen strategy is a part of it. This tacit assumption contradicts the theory of Nash. He spoke of unilateral change of strategy. A change of strategy of a rational player they depends not only on how the opponent will implement their plan, but how they will change their plan. In real life every plan is open to change, especially from learning from experience. A rational player asks, does the way my opponent plays reflect a strategy or a plan that rests on it? This is an open problem in (the allegedly fully determined) game theory. It should be put on the agenda.

against the occupation, agreement to end the present tensions would possibly be significantly more likely.

Since mutual tit-for-tat leads to stable cooperation and mutual defection leads to stable defection, it is advisable to learn what makes the repeated games of the prisoner's dilemma end in cooperation or in defection and why. Needless to say, tit-for-tat is friendlier than always-defect. Possibly, people prefer to play in a friendly manner if they hope that their opponents will reciprocate; they will then naturally prefer tit-for-tat to always-defect in the infinite prisoner's dilemma, and will act accordingly if they expect opponents to play tit-for-tat. Unfortunately, mutual always-defect strategy is possibly in a Nash equilibrium in the infinite repeatable prisoner's dilemma. A little hope may suffice for overcoming this misfortune (see below). The result of the game then depends on the expectation of players from each other. Expectations thus reinforced themselves. This contributes to their stability.

We take it for granted that usually cooperation is socially valuable. (We will discuss exceptions soon.) The unrepeated and the repeated prisoner's dilemma differ here: only the repeated one allows for the possibility of the increase disposition to cooperate. This raises a practical question: what is the minimal change that would cause a significant increase of the disposition to cooperate? This obviously depends on the expectation of a rise in the disposition for cooperation (since other parameters are fixed). What then would raise expectations of a rise in the disposition for cooperation? Even a slight improvement of that expectation may suffice to improve the situation dramatically. Let us present first the literature about this matter, and then our view of it.

What is the game of international relation? Do the players play a finite repeated game, an infinitely repeated one, or at least a game with a potential to be infinitely repeated? A disagreement between those who suggest the eternity of nations and those who do not is possible.⁵ If the game is finite, then there raises the question: how the end of the game affects how the players behave in the beginning? We will review the literature on this. The literature specifically discusses this question in the finite repeated prisoner's dilemma, but it is a general question applicable to every finite game. Both the start of the game problem and the end of the game problem—for finitely or infinitely repeated games—invite discussion: how to begin a game and how to end it? (These questions arise in every move of every repeated game.) More particularly: what are players to do in the beginning of a game in which a player does not know the plan of the opponent? What may make the difference and make players cooperate?

The end-of-the-game problem in the repeated prisoner's dilemma is this. Since it is foolish to cooperate in the unrepeated prisoner's dilemma game, in the last round of the repeatable prisoner's dilemma it is likewise foolish to cooperate. Hence, cooperation in the penultimate round is foolish too. And so on back to the first round. Cooperation in the finitely repeated prisoner's dilemma game is thus also foolish.

⁵ This may also affect the attitude of players to risk. As [8] has observed, "It may be useful to note at this point that the boldness of the utility function implies that any individual must be predominantly a risk averter".

It looks then as if the recommended strategy for any player in the finitely repeated version is the same as in the unrepeated version of the game. Not so. First, the always-defect strategy is not dominant in the repeated game. For example, if one player plays tit-for-tat, it is not beneficial for the opponent to defect. This difference signifies, since it opens new options. Kreps et al. [9, 10] prove that in the finitely repeated prisoner's dilemma game, even a player's small expectation that the opponent will not choose defection in the very last stage may change dramatically the rational adoption of a solution to the end-of-the-game problem. A small degree of trust then helps dramatically reduce the force of end-of-the-game criticism. (Reduce, not fully dispel, since, as Kreps shows, although a small amount of trust may help players achieve a surprising level of cooperation, many last rounds may be played with mutual defections.) While trust cannot improve even minimally the situation in the one-time prisoner's dilemma, it may significantly improve the situation in the repeated one. For, if player A assumes that player B might (not necessarily will, merely might) assume that in the very final round of the game player A will cooperate, then this very assumption will serve as incentive to player A to cooperate in earlier rounds. If, however, player A assumes that player B will assume that player A will defect for sure in the very last round, then this very assumption will serve as incentive to player A to defect at once. Therefore, even a small degree of trust between players might make players partially cooperate, and thus be mutually advantageous. Suffice it that one player will minimally trust the other in order that they will (partially) cooperate.

Another handling with the end-of-the-game problem may be by pointing out that it is enough that players behave as if they consider the game infinite. For example, if the game is the prisoner's dilemma, players may behave as if it were a finitely repeated game. Moreover, it seems reasonable that in many a real context, players who expect to play the prisoner's dilemma game many additional times will behave like players in an infinitely repeated game. (That is to say, they will ignore the end-of-the-game problem.) Kreps et al. show that this is reasonable.⁶

Let us now move to the start-of-the-game problem, be the repetition finite or indefinite. A player convinced that the opponent will adopt the always-defect strategy will defect in every round. However, even merely allowing for the hypothesis that the opponent will respond to cooperation by cooperation already may raise the wish to try out this option. A reasonable expectation that the opponent will play tit-for-tat may induce a player to adopt it. The preference for the tit-for-tat over always-defect is thus easy to elicit. Otherwise, entertaining seriously the expectation that the opponent will adopt the strategy of always-defect will lead a player to adopt the same strategy, no matter how reluctantly.⁷

Suppose then that in the prisoner's dilemma game each player decides to defect in the first round and follow it by playing systematically as the other played did in the previous round. If they stick to their strategies, then they will defect in every round

⁶ On this problem see also [11–13].

⁷ In the repeated prisoner's dilemma, absolute trust may raise the same problem. The utter conviction of a player that the other player will always cooperate provides incentive to always defect. Otherwise, the incentive is to test any view by trying out cooperation—and then possibly change one's strategy.

of the game. If each player assumes that the opponent adopts a strategy of always-defect, then no player will see incentive to a unilateral change of strategy. Thus, if each player decides never to trust the other, then both will remain in an undesired equilibrium: this case offers no incentive for the players to change their strategy. Yet this case is *not* in a Nash equilibrium, since both players can benefit from changing their strategy, say, to tit-for-tat. However, it is in an equilibrium in the sense that no player finds incentive for a strategy change (in this case because of erroneous assessments). Assume that players do not change their strategies when they do not see incentive to do it. Then, they will cling to their strategies. The analysis of this situation by the tools proposed by Nash will not be satisfactory. Let us then propose the following tools.

The theory of the Levines [14] encourages to introduce a game-theoretical equilibrium that is more general: a game is in equilibrium iff no player sees incentives to change strategy unilaterally.⁸ (This is the case, for example, in the infinitely repeated prisoner's dilemma played under the following conditions. Each player decides to defect in the first round and follow it by playing systematically as the other party has played in the previous round. In addition, players assume that their opponents adopt the strategy of always-defect.) Whereas the characteristic of a Nash equilibrium is the absence of incentive for a strategy change, the characteristic of a game-theoretical equilibrium is the absence of awareness of such an incentive (whether it exists or not). The notice and the presence of an incentive may but need not go together, thus allowing for four options. Let us continue with distinctions. We call type 1 Nash equilibria the set of Nash equilibria in which both players know that they have no incentive to change strategies unilaterally. We call type 2 Nash equilibria the set of Nash equilibria in which some but not necessarily all players notice an incentive for a unilateral strategy-change.

Consider then the strategy for the indefinitely repeated two-player prisoner's dilemma game that displays its players' cautious attitude in the following manner. In the first round betray; in the second round, imitate the choice of the opponent in the first round; in the third round cooperate if the opponent chose to cooperate in the *first*

⁸ We follow here the Fudenberg and Levines [14], who expanded the theory of equilibrium beyond the customary Nash equilibrium by introducing a self-confirming equilibrium: "In a self-confirming equilibrium, each player's strategy is a best response to his beliefs about the play of his opponents, and each player's beliefs are correct along the equilibrium path of play. Thus, if a self-confirming equilibrium occurs repeatedly, no player ever observes play that contradicts his beliefs, even though beliefs about play at off-path information sets need not be correct".

We hope that this note renders this discussion clearer and more critical, particularly regarding the possibility of a survey of different common mistakes that social science proper must recognize as part-and-parcel of social life. Viewing cases that fall under the category of self-confirming equilibrium as including all refutable cases of *erroneous equilibrium*, broadens the category of game theoretical equilibrium and renders it broader than that of self-confirming equilibrium. (We suggest that self-confirming equilibrium does not include all refutable cases of *erroneous equilibrium*. True or not, this suggestion of ours invites further specifications or clarifications.) This raises the question, how much confirmation do we speak of. As Adam Smith has observed, all exploitation rests on error, as cooperation tops it every time. Yet exploitation prevails because it is so easy to confirm and so hard to refute.

round; otherwise imitate the behaviour of the opponent in the second round; in all other rounds imitate the last choice of the opponent. This strategy is cautious as it is not a recommendation to cooperate with one whose strategy is to always-defect; it is the repeated recommendation to cooperation with one who plays tit-for-tat with no more than one loss. If both players adopt this cautious strategy, then the game will be in constant mutual betrayal. Fortunately, this does not amount to a Nash equilibrium, since both parties will be better off if they alter their strategies, say, to tit-for-tat. Yet the following scenario is of an equilibrium: if both players adopt the cautious strategy but both mistakenly take the strategy of each other to be always-betray, then neither will see incentive to alter strategy unilaterally. The Nash equilibrium theory ignores equilibria based on stable error. Let us define: a game is *erroneous equilibrium*, iff incentives to change strategies unilaterally is there, but all players fail to notice it. There are two kinds of erroneous equilibrium, (empirically) refutable and irrefutable.

It is possible to summarize the situation adequately by comparing equilibria. A game is in a Nash equilibrium, iff no player has incentive to change strategy unilaterally. It is in a game theoretical equilibrium, iff no player sees incentives to change strategy unilaterally. The set of Nash equilibria differs from the set of game theoretical equilibria. A game in a Nash equilibrium with at least one player seeing incentive to change strategy unilaterally is not in a game theoretical equilibrium, whereas a game theoretical equilibrium that rests on a mistake is not in Nash equilibrium. Note: since people usually react to other people's actions rather than to their strategies, the view of observed equilibria in games with erroneous equilibria is nearer to the truth than the view of them Nash equilibria.

Consider now an international repeated prisoner's dilemma between (representatives of) hostile neighbouring countries that adopt cautious strategies. They are in a permanent state of war or at best in a permanent uneasy truce. In such cases, nations tend to support the attitudes of their representatives, as the ascription of the always-defect strategy to the opponent is popular. The received game-theory literature overlooks this situation, although it is in equilibrium, since it is not a Nash equilibrium.

The above equilibrium is undesirable. The change demanded in order to prevent or destabilize it is minimal. Suffice it that one party ascribes a minimal likelihood to the possibility that the strategy of the other side permits sufficiently many rounds of mutual cooperation. (If the strategy of the opponent is not fixed, it would suffice that one player ascribes to the other the readiness to desist from the always-defect strategy to one that permits sufficiently many rounds of mutual cooperation.) For that, minimal trust may suffice. For that, minimal readiness to render national strategy transparent may suffice. Hence, an advantage of democratic discourse and liberal values such as freedom of information is that this may destabilize undesirable erroneous equilibria and even prevent them in the first place. The prevalence of erroneous equilibria based on the assessments of the strategy of others as hostile renders them interesting—to game theorists, politicians and peace lovers alike. The moral from the discussion of the end-of-the-game problem and the start-of-the-game problem is obviously very important for international relations as it encourages efforts to prevent defection. This is particularly the case since threats to withdraw generosity, we remember,

are easier to implement and hence more credible than sanctions, not to mention the exercise of violence. Generosity is also more visible than a future use of force; hence, it is easier to dismiss conditional threat to use force than conditional threat to withdraw generosity, particularly if the generosity is already active. The all too possible oversight of incentive for cooperation that may lead to war is an additional advantage of conditional threat to withdraw generosity over threats of violence. Quite generally, as a deterrent, the threat of aggression is more dangerous than threats to cease generosity, since the undesired but possible response to it poses a bigger threat to peace.

As Kreps et al. show, a little hope may move the Nash Equilibrium of a repeated game from mutual defect to cooperation. Hope helps dramatically and even removes the start-of-the-game problem. The first player may cooperate in order to allow others to cooperate in the hope to build trust; extreme mistrust goes the opposite way. The problem then is, what would persuade distrustful players to choose trust as their initial moves?

Although trust is very important, since a little trust improves dramatically the result in the repeated prisoner's dilemma, trust-developing steps are not included in the presentation of the options that characterize this game. (By itself, cooperation bespeaks trust. Regrettably, game theoreticians hardly notice this.) A repeated game in which it is possible to take trust building steps rather than cooperation is not a repeated prisoner's dilemma game. If so, then establishing an option of trust-developing steps suffices as incentive to prevent playing the repeated prisoner's dilemma game. Hence, an assertion that some given steps are undesirable for players of the repeated prisoner's dilemma does not entail the assertion that these steps are undesirable for nations under international tensions.

So much for cases of the usefulness of trust in facing the situation of the prisoner's dilemma game, be it one-time or repeated. The same reasoning holds for the situation of the stag-hunt game. Even in the repeated stag hunt game, there may be a Nash equilibrium of mutual defection. Aumann and Sorin [15] said:

Intuitively, if the interests are not common, the players have a conflict of interest in agreeing on which efficient outcome to reach. In a game with common interests, there is no such conflict of interest; there is a unique point-the single efficient outcome- that is best for all. Nevertheless, even in those games, with no conflict of interest at all, the conditions that necessarily lead to cooperation are quite circumscribed. In a game without common interests, one might prefer to call an efficient point a "compromise." But in a game with common interests there is no issue of compromise, it presents the quest for cooperation in its purest form; and even there, doubts and mistrust and suspicion get in the way and make cooperation difficult to achieve. Indeed, this may happen even when the preferences are common- when the payoffs are identical at each square of the payoff matrix.

Of course, even in a repeated stag hunt, the player may spread the risk of investing in cooperation, so in the case of stag hunt with not enough trust the players can compromise about how make the first cooperative move, so we disagree with Aumann that in such a game there is no issue of compromise: actually in such a situation negotiation is effective, and the avoiding from negotiation is a big mistake since it

Table 3.1 The minimal dilemma

	Coop.	Def.
Coop.	A, A	C, B
Def.	B, C	C, C

is loosing of opportunity to attempt to achieve something that is very achievable by negotiation.

In sum, it is advisable to add to the standard game-theoretical statement that both mutual cooperation and mutual defection are stable norms, the observation that even a little trust leads to stable cooperation to the benefit of all players. The following game, *The Minimal Dilemma*, displays the advantage of trust more emphatically: if both players cooperate, they will both walk; if they both defect, they will receive the same penalty. Otherwise, the one who defects will receive a smaller penalty than the one who cooperates. Those then are the payoffs of the minimal dilemma game (Table 3.1).

At first glance, the best strategy for players of this game is very simple: it is rational for both players to cooperate. Indeed, this is a Nash equilibrium. It is not the sole solution, however: mutual defection is also a Nash equilibrium⁹ for it. (The game's matrix is symmetrical.) Now, since this game has two Nash equilibria, a minimal level of trust should suffice to prevent mutual defection. If hostile states play this game, then the successful injection of minimal trust should suffice for thwarting a war: a mere shift from absolute mistrust to minimal trust should suffice to prevent an impending war. Very few people have sufficient credibility to raise oppose the proposal that the nation should harbour absolute mistrust; yet this may be the means by which to stop an impending war. For, this is the way to change a Nash equilibrium for the better, and then even dramatically so. Societies that practice the normal freedom of speech can then scarcely experience the absolute mistrust that leads the national strategy to be always-defect and thus maintain a permanent threat of war. It is an unrealistic scenario in the minimal dilemma game and even in the repeated prisoner's dilemma game. This is the obviously significant advantage of the freedom of speech in political practice—at home and abroad—even when practiced sparingly.

Game theory reveals the big advantage of trust, even of minimal trust, in situations that display characteristics such as those of the repeated prisoner's dilemma game, of the stag-hunt game, and emphatically of the minimal dilemma game. Hence, the sedate search for ways to build trust is always rational. The first step for any player should be to study opponents—at home and abroad—in order to find arguments for building trust. It is thus advantageous to develop trust for strangers. The educational system is the best means for achieving it at home and the expression of a desire for good relations between states is the easiest means for achieving it abroad. The post-World-War-II situation in Western Europe exemplifies it in international relations.

⁹ Cooperation is here a dominant strategy in the weak sense: players who adopt the strategy of cooperation will get at least what they get from any other strategy regardless of what the opponent will do, and at times they will get from this strategy even more than from any alternative to it.

It was a case of profound hostility between the French and the German nations, overcome by the expressed desire of the French and the German states to cooperate. What policy is best for achieving this situation is a question beyond the scope of game theory: it is limited to societies that cultivate some norm of trust, illustrating how trust operates with social benefits—at home and abroad. Its benefit, however, is easy to obstruct by any decision that keeps society closed. An easy obstructive proposal is demonizing the other.

All this belongs to game theory, even though game theoreticians overlook it all too often. In retrospect, it is so obvious that it can do it on its own, with no reference to game theory. The theory is enlightening here nonetheless, in its support for one claim that is not very obvious. It can even surprise many experts. It is this: in any repeated game, including even the repeated prisoner's dilemma game, even a small degree of expectation that the opponent does not adopt the strategy of always-defect makes it much more worthwhile for a player to prefer the tit-for-tat strategy to the always-defect strategy. Even a small number of people sufficiently conspicuous in a given society can render its strategy cooperative; a handful of people may change situations dramatically for better and for worse. This is also true for the finite repetitions of the prisoner's dilemma: a small likelihood that the opponent will cooperate in the last step suffices to improve the result of the game dramatically.

That a small group of creative people may suffice for the promotion of cooperation significantly is also no news. What game theory suggests, and surprisingly, is that creativity or any other peculiarity is not essential for the group to succeed; what is essential for success in averting war is that these people be conspicuous and not fully untrusted (for any reason whatsoever). They will then be able to try to start spreading some measure of trust. Any conduct that displays trust then should generate some incentive for others to do the same. Of course, long before game theory appeared on the scene, there was agreement that trust needs mutuality and mutuality needs honesty. (This is why it is so important in Israel to criticize publicly the popular idea that peace there is unlikely as there is no one on the other side to negotiate peace with.) Similarly, there is no need for game theory to realize that some societies display honesty as the default choice, and that members of other societies envy them, yet they do not know how to achieve this desirable situation. Finally, this explains why dictators try very hard to purge even very small disloyal groups. Game theory clarifies the picture and explains the mechanism by which it spreads: game theory suggests that persistence in the exposure of trust may bring about an equilibrium beneficial to all. A small increase in the practice of honesty in a society helps the rise of the conviction that there is at least a small probability of increase in the incidence of cooperation in it. Similarly, any conspicuous indulgence towards mendacity spreads distrust and defection. This is not surprising. What is surprising, especially for those who envy nations that have trusting Nash equilibria, is the transition from undesirable Nash equilibria to desirable ones: few who behave trustingly may cause an avalanche of trust sufficiently big to effect a transition.

Some people cooperate even when the only game in town is a stag hunt game, even though they know that the norm for this game is to defect. Why do they behave this way? Our reply is this. People viewed as playing such a game view the situation

not as a stag-hunt game or as any other coordinated game; the goal of such people is not coordination; they choose to play an altogether different game. Consider the game of supporting or resisting a war. W. H. Auden has called such a person “The Unknown Citizen” and described him thus:

When there was peace, he was for peace: when there was war, he went.

Auden explained here both peace and war are in equilibrium due to conformity: in peace the citizens prefer peace to war; in war, the citizens prefer war to peace. The game that unknown citizens play is that of following the norm: if it is war, they expect to achieve more from supporting it than from resisting it; and the same holds if it is peace; and in this game, the rational strategy is indeed to conform, to follow the norm. Society can come to a Nash equilibrium in which everyone supports war although everyone prefers that everyone support peace. It is thus possible that society will be in a bad equilibrium of supporting war although everyone in society will benefit from shifting from the equilibrium of supporting war to the equilibrium of supporting peace, and even when everyone understands this. This equilibrium is unstable: non-conformist citizens may disrupt it by supporting peace even when the norm is to support war. Given that they are rational, this means that they play a different game. They do so because they see a matrix that others fail to see: they play another game, a game in which the goal is not to be coordinated with others. When sufficiently many citizens decide not to play the coordination game, there is a hope for a transition of public opinion towards peace. This resembles the situation of the “White Flight” model of Schelling [16, 17]: one person can change a whole society. Consider this extreme example: everyone in society resists war unless there is at least one other person who supports peace, if there is at least one other person who supports peace, then everyone supports peace. In this case, there is an equilibrium of supporting war by everyone. However, in this case it is sufficient that one person, maybe a newcomer,¹⁰ adopts a strategy of supporting peace in order that everyone will support peace. We nevertheless suggest that the non-conformist plays a different game: what distinguishes one game from another is the payoffs it involves. These need not be monetary, material, or selfish ones; they are determined, *inter alia*, by individual preferences. Non-conformists have other priorities than the “unknown citizen.” (This is a revealed preference; the choice A when B is available at the same price is the revealed preference for A over B). Von Neumann and Morgenstern [18] said, “The game is simply the totality of the rules which describe it”. This assertion displays an oversight of the role of the preferences of the players. For, when the players are in love with each other, the prisoner’s dilemma game becomes another game altogether; it may easily become the stag hunt game or a game that displays a greater readiness to cooperate. A sufficiently significant change of preferences may change the game under play. Hence, game theorists who assume that players cannot choose the game they play assume not only that they cannot choose the rules of the

¹⁰ The effort of Abraham to save Sodom (*Genesis*, 18) failed because one newcomer—Lot—could not sway the town; it needed five righteous people to sway the town, but these were not found.

game, but also that they cannot change their preferences. This is an example of a mistake that we propose to correct.

3.1.1.1 About Information

Let us return to the idea of minimal change. Ellingsen and Östling [19] have suggested that allowing communication between players makes the preference for truthfulness invite cooperation. This is conspicuous in situations characterized by a variant of the stag-hunt game: one with open communication channels between players. That communication here pertinent is easy to see by comparing this game with the variant of the repeated prisoner's dilemma game in which no information about past performances is available to players (so that it cannot influence future decisions), obviously, the result will remain mutual defection. It is beneficial to both players to prevent such situations. This invites institutions that promote freedom of information. Pioneer information theoretician Ross [20] has already suggested that improved highway manners will reduce accidents and that communicability between drivers will do that. At the time, there were hardly any means for doing that. Now it is feasible, and game theory strongly supports it. Here the obvious dependence of unscrupulous passers-by on the ignorance of their prey is a major factor in any reasonable game-theoretical characterization of their conduct.

Moreover, mutual cooperation is a possible result of the repeated prisoner's dilemma iff the moves are visible during the game—at least partially. Without reputation,¹¹ the players cannot make the necessary difference between the repeated and the one-time game, and then defection remains the dominant strategy. This is so since in this case each player knows that their actions will not influence the actions of the opponent. In that case, always-defect is a dominant strategy.

The picture will be sharper, we hope, as the result of the analysis of a variant of the repeated prisoner's dilemma game in which one and only one player sees the actions of the other. Unobservable action cannot influence the actions of the opponent, so that in this particular game only a dominant strategy can guide them; that strategy will therefore be always-defect. The best response of the observable player then is to do the same (not as a dominant strategy). Let us now change the game a little: add a minimal likelihood that the actions of the first player will be observable by the other. In this case, if the second player adopts a strategy of cooperating until the conduct of the first, partly observable player appears to the second player as uncooperative, and the game is long enough, then the second player will have incentive to cooperate.¹² If the partly observable first player adopts a strategy such as tit-for-tat, and the opponent adopts the cautious strategy, both players will have no incentive to change

¹¹ This explains the Hollywood adage: "There is no such thing as bad publicity".

¹² We assume that the players' time discount is negligible. Of course, it may be significant. The degree of the minimal information needed in order to enable cooperation is function of the time discount, the length of the game and how much there is a payoff difference between the second best and the third best as well as between the third best and the worst. Higher discount demands more freedom of information to fend it off, namely, more liberalism.

their strategies. The minimal information thus accrued can improve the situation dramatically, but still not as well as full information does. In international relations, one of the advantages of transparency is that it significantly prevents the incentive to punish. This is important since any detection of defection can be an error, and in the case of minimal information, the cost of error in detection will be much bigger. (Remember the migrating geese that appeared on the radar of the US nuclear defence system: monitors read it as a possible massive nuclear attack, but fortunately corrected their error fast enough.)

Compare then the game with a minimal expectation that the moves of any player will be visible with a game in which no move is visible. Significantly, the availability of even minimal information tends to change the result dramatically. If any move has a minimal probability to be visible and the game is long enough, then the preferred strategy for each player may be to cooperate at least until the conduct of the opponent appears as uncooperative. If the game is long enough, then mutual adoption of such strategy will be a Nash equilibrium and will change the result dramatically from full defection to full cooperation. This is why even though criminal law is rarely applied, its application deters.¹³ This deliberation has important corollaries also regarding war and peace. The liberal values of freedom of information and of free speech help spread cooperation and thus prevent wars and terrorist activities. Some judges consider it wise to balance those values against some security interests. This consideration rests on the tacit assumption that the liberal values and the value of security are in competition with each other or at least indifferent to each other. In truth, liberal values evidently improve security. This is one reason why in democracies citizens have better security than in other political systems, even though dictator regimes invest much more in preparing themselves against a surprise attack. (Remember Pearl Harbour.)

This challenges the sharp and clear distinction between a one-time game and repeated one. When the repeated game will be quite unobservable, it will be no more than a sum of one-time games. Also, when the one-time game is public, then players may be concerned with their social reputation. The implicit assumption is that the recognition of reputation in the calculation of the payoff; alternatively, it is the recognition of the inability of the one-time game to significantly influence the reputation of its players. In the move from the mathematical abstract game to the real-life game, it is almost always possible for new players to join the game: the people who may watch it already change its rules as an inevitable though unintended consequence.

¹³ In his 1905 *Major Barbara*, Preface, Some Conclusions, Bernard Shaw said that the marginality of the system of imposition of the law of the land makes it clear that its abolition would make no difference to public life. This sounds common sense but it is not. He was in gross error.

3.1.1.2 The Benefit of the Doubt

Another mechanism useful for the improvement of trust is granting the opponent the right to enjoy the benefit of doubt. Bendor et al. [21] ran a tournament of a variant of repeated prisoner's dilemma with noise: they allowed for a small likelihood that one party would mistakenly read the conduct of the other as due to the adoption of the strategy to cooperate or to defect. In case the game is long, at times this will happen. In this tournament the strategy that they called generous won, while tit-for-tat received the eight place. The generous strategy was to cooperate fully unless the other one was below a standard of cooperation and then to reduce the level of cooperation accordingly. This strategy allows the opponent to enjoy the benefit of doubt. Since there is a noise, this strategy has the advantage of not falling into a cycle of revenge, which is the risk incurred when the tit-for-tat strategy is adopted. The Talmud offers a similar solution to the problem, how to prevent noise from leading to a cycle of revenge: "judge every person favourably" (*Talmud, Aboth, 1:6*). Maimonides explained: "A person's character is unknown to you You saw that he performed a deed or made a statement that ... could be considered good, but could also be considered bad. Judge the person favourably, and do not think ill of him". Game theory promotes this strategy as conducive to self-interest akin to the case of the tournament run by Bendor et al. This is an alternative to *Pax Romana* and a preferable one at that.

What Bendor et al. called a generous strategy is a different kind of generosity than the one that we discuss here. Let us compare the two. They spoke about generosity in the sense of not punishing the other side when in doubt; punish them only if they repeat their uncooperative behaviour sufficiently frequently. By contrast, we spoke about generosity in the sense of granting others more than they are entitled to. Also, we suggest the use of conditional generosity as an incentive with no penalty. This is the counsel of the *Talmud* (*Bava Mestiza 30b*):

R. Johanan taught, 'Jerusalem was destroyed because its inhabitants judged according to the law.' Should they rather have judged made arbitrarily? No; they judged strictly in accord with the law, instead of acting generously.

This is the counsel to avoid insisting on one's rights. Game theory may present this insistence as a good strategy; nevertheless, let us observe, whenever possible, conditional generosity is the best policy. (Otherwise, honesty is.)

3.1.1.3 Antitrust

Cooperation is not always socially beneficial. Already Adam [22] has noted this. ("People of the same trade seldom meet together, even for merriment and diversion, but the conversation ends in a conspiracy against the public"). Game theory recognizes this: the very possibility of cooperation in the repeated prisoner's dilemma game that is in the interest of both players already conflicts with the social interest. Thus, the wish to reduce undesirable trust between sellers has led to the legislation of

antitrust laws. Here the difference is clear between the one-time prisoner's dilemma and the repeated one. In the one-time case, the result is competition between sellers, but this is possibly not open to scientific examination, since, by a most prevalent convention, empirical science treats only repeatable data. The unrepeated game can be scientific nevertheless, in the sense that it is repeatable in a different sense: it is performable by different sets of players with no information of previous experiences and if its result turns out to be repeatable, then it is scientific. It takes little familiarity with sociology to realize that the game so construed will be repeatable only when the players share some cultural characteristics that are easier to recognize than to describe. Yet to be scientific the description must qualify the description by specifying the society in which we suppose it holds and be ready to test and improve these. Also, the question of the advisability of playing this game depends on the society within which the question comes up. Thus, since in the repeated game the mutual tit-for-tat strategy will sooner-or-later reach a Nash equilibrium that is socially undesirable as it neutralizes competition, in modern society this is a strong argument for the maintenance of laws intended to guarantee competition.

This holds for many possible Nash equilibria; regrettably, the antitrust laws that should prevent them all fail to do that, merely because of lapses of legislators. This is, indeed, the great social and political value of game theory: it draws attention to important overlooked cases that conflict with the public interest. Some of the important overlooked games are these: I-do-not-cut-prices-until-my-competitor-does; I-will-not-inform-the-seller-until-my-competitor-does; I-will-discriminate-as-long-as-my-competitor-does; and so on. They all share a very simple characteristic: they reach Nash equilibria even in the *absence* of communication or coordination.

Aumann [23] said that the repetition of the game may replace the enforcement of the agreements. We add: the repeating of the game may replace even the agreement! In the case of trade, the repeat players may behave as if they come to a forcible collusion agreement, even if there is no enforcement mechanism and even not an agreement!

This should encourage regulation and the dissemination of information regarding the marketplace even with no collusion in sight. It also explains why evidence that prices that many firms charge are much higher than the competitive ones, definitely do not suffice as proof of the presence of price coordination: the spontaneous order may lead firms to act as if they coordinated even though they have never attempted to coordinate. Contrary to the philosophy that the spontaneous order maximizes the welfare of society, game theory teaches that it sometimes leads to the maximization of a particular group in a way that contradicts the social interest. Game theory explains why price coordination may take place even with no criminal intent, so that it is wiser to try to improve the competitiveness of a market without trying to ascribe criminal intent (and thus without seeking an object for punishment). The utopianism of the "free marketplace" economists leads jurists to blame innocent people that by their criminal behaviour they extorted the marketplace. This is a private case for the warning of Popper (1945) that utopian visions lead to blaming innocent people for failure. The insight that free marketplace may lead to unintentional "cartel" discourages criminal regulation, but encourages civil regulation. Moreover, fortunately, the

kind of regulation required to prevent these socially undesirable cases is uncontroversial: it is the kind of intervention agreeable to mainstream economists (of the Chicago or the neo-classical persuasion). They object to fiscal intervention, alleging that it dampens competition and enhances bureaucracy, thus comprising a cure worse than the disease it comes to cure. They also tend to object to truth-in-advertising laws on the pretext that the market mechanism imposes honesty more efficiently than the law does. Yet they all allow for laws that impose the obligation to honour contracts and to pay debts, even though the market mechanism does that too. Game theory may help clarify the difference between proposals that the mainstream economists approve of and those that they reject. This will also weed out any mistake on such matters that they may commit. Clearly, some cases, like the ones mentioned in the opening of this paragraph, are of dampened competition due to the absence of information. The literature on economics presents this absence as a kind of friction. Economists should then differentiate between cases of friction that are negligible and other cases, just as Galileo's law of gravity does, which law mainstream-economists repeatedly refer to in this context, as it distinguishes between the fall of a metal ball and a feather.

3.1.1.4 Concluding Remarks

The moral from game theory goes further. The philosophy of the mainstream school of economics is individualism (or methodological individualism). It views societies as aggregates of individuals.¹⁴ The view of the nation as an aggregate led to the view of political leaders as mere representatives, and this deprives them of their role as leaders and as initiators of policies. True, they can still voice opinions and find support from their constituents, but this still does not address their duty to lead and to innovate when it is helpful and solve urgent problems. This is a hiatus that Paul Lazarsfeld and Elihu Katz [24] tried to fill with their theory of opinion-leaders. They claim that even gossipmongers may help shape the people's voice, especially by the use of the relatively newly fashioned mass media. They did improve the situation, but not well enough. Nor is it easy to cater for a privileged position of leaders within the democratic framework. Game theory, especially the prisoner's dilemma game and its variants, may pave the way: leaders help improve democracy by showing initiative, especially in the matter of building trust, which was found beneficial but problematic long before the appearance of game theory: trust is useful once it is there, but how to build it still is a mystery. At least it seems a clear case when it rests on national legislation meant to block the appearance of situations that share characteristics with the prisoner's dilemma game.

Let us now point out another problem with the tit-for-tat strategy. Let us propose the Turbo Prisoner's dilemma: this is a repeated prisoner's dilemma with one difference: not every round the play is on the same sum of money. Once in, say, 100 rounds,

¹⁴ Individualism is both a theory and a rule of method. As a rule, its adoption is independent of the facts of the matter that are of metaphysical interest but are (allegedly or in truth) irrelevant in many empirical social studies.

the game is 100 times the usual sum (the big round). If a player adopts a strategy of tit-for-tat, then their opponent will betray them in the big round. This is a refutation of the tit for tat strategy: it cannot be effective when the game is on changed sums.¹⁵ The tit-for-tat strategy cannot protect from betrayal in a time of crisis: when people most need help they will not get it. One of the advantages of the stag hunt game over the prisoner's dilemma game is that in the turbo stag hunt game, mutual tit-for-tat is a Nash equilibrium, while in the prisoner's dilemma it is not a Nash equilibrium. Thus, the peace in the stag hunt game is more stable. This is also another advantage of love: when the partners love each other sufficiently they will play stag hunt games instead of prisoner's dilemma games. Their cooperation will be stable for the benefit of both even in the big rounds, such as a big crisis that always appears during life.

References

1. Etzioni, A.: *The Hard Way to Peace: A New Strategy* (1962)
2. Zuckmayer, C.: *A Part of Myself* (1970)
3. Agassi, J.: The philosophy of trust. In: Alon, I., Bar-Tal, D. (eds.) *The Role of Trust in Conflict Resolution: The Israeli-Palestinian Case and Beyond*, pp. 3–14 (2017)
4. Finke, M.: *Carl Zuckmayer's Germany* (1990)
5. Agassi, J.: Discrimination, statistical. In: *International Encyclopedia of the Social Sciences*. Macmillan, New York (2008)
6. Arrow, K.J.: A difficulty in the concept of social welfare. *J. Polit. Econ.* **58**(4), 328–346 (1950)
7. Nash, J.F.: *Non-Cooperative Games. A Dissertation* (1950)
8. Arrow, K.J.: The theory of risk aversion. In: *Essays in the Theory of Risk-Bearing*, pp. 90–120 (1971)
9. Kreps, D., Milgrom, P., Roberts, J., Wilson, R.: Rational cooperation in the finitely repeated prisoner's dilemma. *J. Econ. Theor.* **27**, 245–252 (1982)
10. Kreps, D., Wilson, R.: Reputation and imperfect information. *J. Econ. Theor.* **27**, 253–279 (1982)
11. Neyman, A.: Bounded complexity justifies cooperation in the finitely repeated prisoner's dilemma. *Econ. Lett.* **19**(3), 227–229 (1985)
12. Neyman, A.: Cooperation in repeated games when the number of stages is not commonly known. *Econometrica* **67**(1), 45–64 (1999)
13. Aumann, R.J.: Irrationality in Game Theory, in *Economic Analysis of Markets and Games (Essays in Honor of Frank Hahn)*, edited by P. Dasgupta, D. Gale, O. Hart, and E. Maskin, pp. 214–227. MIT Press, Cambridge and London (1992)

¹⁵ See also this criticism of Shai Dothan: “Tit-for-tat is a strategy of immediate and proportional responses. Game theorists showed that this strategy often leads to fruitful cooperation. Indeed, many legal regimes resemble a tit-for-tat strategy and benefit from its ability to avoid unnecessary conflicts. But in situations of uncertainty—when actors cannot be sure about the actions of their adversaries—a tit-for-tat strategy would destroy cooperation and lead to continuous clashes. Because tit-for-tat responds immediately, a single mistake about the intentions of the adversary can lead to retaliation and start an endless string of counter-strikes. When uncertainty prevails, a strategy of many-tits-for-many-tats is optimal. Actors applying this strategy study the actions of their adversary over multiple rounds without issuing an immediate response. Only when the actor is convinced that the adversary intentionally defects, the actor will issue a disproportionately forceful response.” Dothan, Shai, *When Immediate Responses Fail* (April 19, 2018). *Vanderbilt Journal of Transnational Law*, Vol. 51, No. 1075, 2018; University of Copenhagen Faculty of Law Research Paper No. 2018-62. Available at SSRN: <https://ssrn.com/abstract=3165499>”.

14. Fudenberg, D., Levine, D.K.: Self-confirming equilibrium. *Econometrica* **61**(3), 523–545 (1993)
15. Aumann, R.J., Sorin, S.: Cooperation and bounded recall. *Games and Economic Behavior* **1**(1), 5–39 (1989)
16. Schelling, T.C.: Models of segregation. *Am. Econ. Rev.* **59**(2), 488–493 (1969)
17. Schelling, T.C.: Dynamic models of segregation. *J. Math. Sociol.* **1**(2), 143–186 (1971)
18. Von Neumann, J., Morgenstern, O.: *Theory of Games and Economic Behaviour* (1944)
19. Ellingsen, T., Östling, R.: When does communication improve coordination? *Am. Econ. Rev.* **100**, 1695–1724 (2010)
20. Ross Ashby, W.: *An Introduction to Cybernetics* (1956)
21. Bendor, J., Kramer, R.M., Stout, S.: When in doubt ... cooperation in a noisy prisoner's dilemma. *J. Conflict Resolut.* **35**(4), 691–719 (1991)
22. Smith, A.: *An Inquiry into the Nature and Causes of the Wealth of Nations* (1776)
23. Aumann, R.J.: War and peace. *Proceedings of the National Academy of Sciences* **103**(46), 17075–17078 (2006)
24. Katz, E., Lazarsfeld, P.F.: *Personal Influence: The Part Played by People in the Flow of Communications* (1955)

Chapter 4

Game Theory for International Accords



Realpolitik is the claim that agreements in international relations are worthless since there is no institution to enforce them. Game theoretician Robert J. Aumann suggests in his 2006 Nobel lecture that “the fundamental insight is that repetition is like an enforcement mechanism.”¹ The application of this insight to international relations allows for the improvement of their applicability and it, thus, refutes Realpolitik.

Early game theory appeared as an alternative to the social sciences. However, it is better anchored within social science—as a useful tool. This renders game-theoretical recommendations irenic. Aumann argues that there is no a priori reason to expect that the agreement to cooperate in the one-time stage hung game should have practical results.² We argue that when the norm is to respect agreements, agreements improve cooperation even in one-time stag hunt game. It goes well with the proposal to consider game theory part-and-parcel of social science: how does playing in a given game depend on the culture within which it takes place.

4.1 The Political Aspect of Game Theory

A common topic of discussion within game theory is *the prisoner’s dilemma* and its relevance to cooperation because its rules lead to conduct that reinforce conflict. When political scientists, jurists, or biologists apply game theory to the analysis of cooperation, they usually refer to this specific game. Of course, many other games pertain to cooperation. It is not easy to find out what game describes a situation sufficiently well in the field. It is easier to find out what game is advantageous to play under what circumstances. Such matters are better open to critical discussion and empirical tests.

Before presenting *the prisoner’s dilemma*, let us present another, simpler game, *the movies dilemma*, a variant of *the prisoner’s dilemma* often present in film. Here it is (Table 4.1).

¹ Aumann [1].

² Aumann [2].

Table 4.1 The movies dilemma

	Coop.	Def.
Coop.	A, A	C, B
Def.	B, C	B, B
	Cooperate	Defect
Cooperate	Freedom, freedom	Penalty, reduced penalty
Defect	Reduced penalty, penalty	Reduced penalty, reduced penalty

In this game, mutual cooperation is best for both players. To achieve mutual cooperation they have to trust each other sufficiently; if they mistrust one another, then they will come to mutual defection³; one defection leads to the worst outcome. Thus, if both players expect the other to either cooperate or defect, then their very expectations will make it true.⁴

In *the movies dilemma*, the information that one player has about the decision of the opponent plays a crucial role. Therefore, in variants of this game that allow the police to manipulate players through misinformation, it may lead one player to expect the other to defect. In that case, the expectation is self-fulfilling. Hence, manipulation is unnecessary. It suffices for the police to convince the players that the police will manage to convince one player that the opponent will expect the other player to expect the opponent to lose the trust of the one player.

In contrast, in *the prisoner's dilemma* game, it is worthwhile for each player to defect regardless of what the opponent does. This is the whole of the specification of that game. In the literature, it usually comes with a standard illustration that depicts a situation with four options: no penalty and penalties of three levels: lenient, severe, and medium—lenient penalty for the illegal possession of arms, severe penalty for having used them illegally, and the reduction of the severe penalty that leaves it still harsher than the lenient one.⁵ Consider two persons detained for possession of illegal weapons near a bank in which an armed robbery just took place. The police have strong enough evidence to charge them with the lenient penalty, but not enough evidence to charge them with the severe penalty, so the police try to encourage them to testify against each other. To achieve this, the police isolate them and propose a plea -bargain to each of them. The options that the game offers are these: if they both defect, they will both receive medium penalty; if they cooperate with each other and

³ We use terms such as defection because they are common in the game's theoretical literature, but not because of their moral content. For example, a firm that does not join a cartel defects in the game's theoretical language, although it should not be denounced.

⁴ This game appears in movies in diverse variants. For example, one prisoner may seemingly betray the other, but without losing the other's trust. This variant of the game may end with the trust rewarded, and it may result with the trusting party alone receiving full penalty, thus, leading to a new game of revenge. In all variants of the movies dilemma, the information that one player has about the decision of the other player plays a crucial role.

⁵ Oskamp and Perlman [3].

Table 4.2 The prisoner’s dilemma

	Coop.	Def.
Coop.	B, B	D, A
Def.	A, D	C, C

keep silent then they will both receive the lenient penalty. There are four levels of possible results, from 1 to 4 (Table 4.2).

Thus, the wish to maximize individual payoff imposes on each player in *the prisoner’s dilemma* game the betrayal of the other regardless of the strategy of the other.⁶ A strategy like the one described here is not the only one available. It is dominant in the sense that in all permissible situations a player will gain from it more than from any alternative strategy; therefore, in this game a player cannot gain anything from the information about the opponent.⁷ Hence, in *the prisoner’s dilemma* game, rationality precludes the socially optimal result: it leads to the socially worst result. This is why it is intriguing; the unpleasant aspect of the situation in *the prisoner’s dilemma* is that the distrust inherent in it is irreparable, since it imposes a result not improvable by soliciting trust.⁸

In some similar games, raising the level of trust might improve matters. The most common illustration for this is the variant of *the prisoner’s dilemma* known as *the stag-hunt game*⁹ (what makes game theory interesting is that it offers many variants of this game with different results; a little change in the game may, at times, lead to a completely different result). In it, cooperation brings the best payoff for each of them; the unilateral betrayal of one meets the defector the second-best payoff and the other the worst payoff, and mutual betrayal gives both the third-best payoff. For this, again, four possible outcomes are required. This is illustrated by two hunters who choose simultaneously whether to hunt a stag or rabbits. They succeed only if they both go for a stag, and each player achieves the best result—the stag. A player who goes for a stag alone is met with absolute failure. A player who goes for a rabbit alone wins all the rabbits, which is the second-best result, while both going for the rabbits

⁶ This idea of strategy is as old as game theory. According to the definition of Von Neumann and Morgenstern set forth in 1944, a strategy is a player’s plan, which specifies what choices to make in every possible situation, for all possible information available at the moment decision is called for. The strategy conforms to the pattern of information that the rules of the game prescribe. Thus, a strategy is a comprehensive policy, a plan for action in every possible situation that the rules of the game allow. Obviously, then, the project of Von Neumann and Morgenstern is utopian. As Kenneth Arrow has noted, such a strategy is impossible even for chess—a problem-situation much simpler than some real-life ones. Von Neumann and Morgenstern postulated that comprehensive strategies are always parts of games. This limits the applicability of game theory to the very simplest games, thus, limiting severely the intellectual challenge of game theory. Sometimes it is surpassingly possible to write some strategies. The standard examples are the always defect in the repeated prisoner’s dilemma and the tit-for-tat in the same game. Neumann and Morgenstern [4].

⁷ This is the equivalent to Savage’s “sure thing principle.” In the early stages of game theory, it was called “the sure thing strategy.”

⁸ This may explain the futility in some situations of the good will of peace activists who do not try to act politically, specifically in a way that changes the game.

⁹ McAdams [5].

Table 4.3 The stag-hunt

	Coop.	Def.
Coop.	A, A	D, B
Def.	B, D	C, C

mutually gives every player half of the rabbits—the third-best result. Therefore, it is best for both to go for the stag. For the one who goes for the rabbits, it is better if the other does not, namely, that the opponent goes for the stag (and loses), thus, enabling the one to hunt rabbits unimpeded. Consider then four levels of success, from 1 to 4 (Table 4.3).

Obviously, the absence of trust prevents the achievement of the optimal solution in this game, while if the players trust each other enough, they will achieve it. The important difference between the two games is not in the stories, but in the matrices for it is possible to translate the story of the stag-hunt game to the terms of the prisoner’s dilemma game, and it will remain the stag-hunt game. For example, if the two suspects from the prisoner’s dilemma game keep silent, they will both walk; if they both sing, they will both receive the usual penalty; and if only one sings, then only that one will receive a lenient penalty, and the other will receive a heavy penalty. Hence, the matrix determines the game, not its illustration.

The most important difference between the unrepeatable prisoner’s dilemma and the unrepeatable stag-hunt is that in the former game defection is the dominant strategy—each rational player will defect in any case—whereas in the latter the defection (or its avoidance) depends on the assessment of the interdependent strategies of players. Whereas the one game offers no hope for cooperation, the other offers recognition of the option of raising the incentive for cooperation by raising trust. Hence, it is more important to avoid situations that impose the prisoner’s dilemma game rather than the stag-hunt game.¹⁰ Although both games describe conflict situations, the lesson for social science is that in some conflict situations action can improve actors’ situations all around even without eliminating the conflict.

Thus, the difference between variants of a game may be significant. The decision about which variant describes a given political situation already determines attitudes towards it. Thus, bellicose game theoreticians set the game one way, and the irenic ones set it the other way. This is Mario Bunge’s criticism of game theory: it encourages arbitrariness.¹¹ The description of a real-life situation as a game will, thus, be less arbitrary if it includes options—whenever these are possible—for players to choose what game to play, with whom, and with what payoffs. This decision as to what game to play—this super game—describes some situations better than the games prescribed in standard game-theoretical texts.¹² This requires the recognition that at times some players are able to choose what game to play next.

¹⁰ See Agassi and Meidan [6].

¹¹ See Bunge [7].

¹² See id. at 176–80.

This is also the choice available to scholars who wish to use game theory in order to analyse given situations: they may (and possibly should) ask what games are available to players and what game is better for a player to play. This will prescribe for scholars the decision as to the choice of game to analyse—the most important in the field. They may then help players or social planners improve their lots by offering good advice. For example, in the sphere of litigation, it is more important for students of jurisprudence to analyse the *asymmetric* litigation game than the *symmetric* one, even if the symmetric games are more frequent.¹³ Only the asymmetric game may hide unacceptable consequences for the weaker party. The legal system may allow for situations in which weak litigants cannot realize their rights or at least it is not worthy for them. Legislators, judges, and attorneys for the weak litigants should try to prevent these situations as the initial (super) game. This is a worthy moral for the “law and economics” movement that aims to assess which legal rules are economically efficient. The analysis of the symmetric game—where options are the same for each side—is elegant, easy, natural, and relatively easy to apply, but it is not the most important game in town. Legal theory will benefit more from research that will reduce the number of unavoidable injustices of the system, and these are the asymmetric cases where financially comfortable litigants have many more options, including those who are less risk-averse due to their richness than ones who happen to be financially constrained.¹⁴ This may lead the weak parties to forego the use of all the legal advantages that they have and settle for much less than what the law entitles them. This is also the case when one party is a one-time player, and the other party is a repeat player¹⁵ (ironically, the literature considers this case not a part of “law and economics” but a part of “law and society”; obviously, it is both). Any move intended to compensate the less well-off litigant is a revision that will lead jurists to prevent games that end up in patent injustice. This is not limited to any specific society; the Bible mentions asymmetric litigation: “seek judgment, relieve the oppressed, judge the fatherless, plead for the widow.”¹⁶

Admittedly, asymmetric games are usually mathematically less elegant, but they are socially more important, at least from the humanist perspective. Unlike the prisoner’s dilemma, many situations of war and peace comprise asymmetric games. In many cases of violence, the strong party sees the game as asymmetric but presents it as symmetric in efforts to fend off the police, the courts, or public opinion. Even kids who are bullies in school do that when facing school authorities. Under attack, then, it is often useful to change the game by making a credible threat to involve the

¹³ For example, Weiss analysed the appeal game as an asymmetric one, while Shavell analysed the appeal game as a symmetric one. See Weiss [8]. Shavell noted that his model is not valid in a case of heterogeneous litigants, and, nevertheless, derives general policy recommendations from this model. The difference is not only that one analyses this game and the other analyses another game: the important question is what game should be analysed in the theory of litigation. What game should we see when we recommend rules of litigation? See Shavell [9].

¹⁴ See Weiss [10], at 1.

¹⁵ See Galanter [11].

¹⁶ *Isaiah* 1:17.

police, the courts, and public opinion. Making a conflict visible may even render an asymmetric game symmetric and thereby reduce violence dramatically.

4.2 A Comparison Between Our Approach and the Related Literature

Aumann [12] claims:

incentive . . . has to be there, and that is what is represented by the prisoner's dilemma in very stark, obvious language . . . Absolutely, you must create incentives for stopping CO₂. There is one very simple way to do it. Just tax the emissions. You could impose a much higher tax on gasoline. And there are other ways to tax emissions. Do not overtax them, but tax them at the true cost of these emissions. Absolutely, you have to give incentives. Not by fear: that is not going to work. What is going to work is giving people incentives. Precisely game engineering.¹⁷

We assume our readers are familiar with this, especially since incentives can appear in different places and grow at different paces depending on extant social and political conditions. Incentives can be chosen as part of the game, such as in the case that a player chooses a conditional strategy in the prisoner's dilemma, and they can be chosen in order to prevent a particular kind of games. Let us sharpen that in the example Aumann described, the social planner actually supplies an incentive in order to prevent an undesirable game, so it is actually a super-game.

Similarly, Aumann and Shapley show the need for social science in order to explain the stability of the repeated prisoner's dilemma—as due to the cooperation between players imposed by the rule that requires penalty for those who do not punish:

it . . . should be noted . . . that not only are defections from the cooperative sequence punished, but also defections from any punishing sequence are punished. A player who 'should' punish and does not do so will himself be punished. This is what provides the motivation for the punisher actually to carry out the penalty, and so keeps [the equilibrium].¹⁸

To this we add its converse: the same rules can destabilize the prisoner's dilemma itself and even eliminate it almost totally.

As to the context of any game, Aumann and Drèzee [14] observe this:

Formally, a game is defined by its strategy sets and payoff functions. But in real life, many other parameters are relevant; there is a lot more going on. Situations that substantively are vastly different may nevertheless correspond to precisely the same strategic game. For example, in a parliamentary democracy with three parties, the winning coalitions are the same whether the parties each hold a third of the seats in parliament, or, say, 49%, 39%, and 12%, respectively. But the political situations are quite different. The difference lies in the attitudes of the players; in their expectations

¹⁷ Aumann [12].

¹⁸ Aumann and Shapley [13].

about each other; in custom; and in history, though the rules of the game do not distinguish between the two situations.¹⁹

Let us comment on this: in Aumann's example (or even in a more extremist case of seats divided to 49, 49, 2%), traditional game theory may deem the three political parties in possession of equal power, since no party can establish a winning coalition by itself, and each party can establish a winning coalition with every other party.²⁰ Clearly, this is a mistake. Nevertheless, game theory is right in considering the small party in this case as having much more power than the number of its seats suggest and in its explanation of this fact; but, game theory ignores the constraint on the power of the small party that social norms of fairness impose. Game theory also ignores the incentives that this situation provides to change the situation radically. Thus, members of the big parties may defect and establish small parties or the majority may change the voting system. This invites interesting questions. How does the prevalent view of fairness influence the situation? What is the right view of fairness? How should it influence the situation? These questions and their likes pull us out of the mathematical world of game theory and lead us to apply social science. This illustrates the fruitfulness of traditional game theory as well as its limitation. Hence, to be fruitful, game theory should become part and parcel of social science. Otherwise, game theory may generate more mistakes than it can prevent.

In the conclusion of their paper, Aumann and Drèzee add this: "The fundamental object of study in game theory should be the game situation *G* rather than its underlying game *G*," while in the paper itself they define game situation as "a game played in a specific context."²¹

Young as game theory is, it already has a tradition. That tradition rests on its initial aim that was tacit. The aim was, we say, to replace the explanatory model of the social sciences. (Indeed, one of the early names of game theory was "social physics".) Von Neumann and Morgenstern said of its applications that they are of two kinds:

"On the one hand to games in the proper sense, on the other hand to economic and sociological problems as well We hope to establish satisfactorily . . . that the typical problems of economic behaviour become strictly identical with the mathematical notions of suitable games of strategy" For economic and social problems, the games fulfil—or should fulfil—the same function, which various geometrical-mathematical models have successfully performed in the physical sciences.²²

The just cited 2008 paper of Aumann and Drèzee is possibly a challenge to the tradition of Von Neumann and Morgenstern, a step-in effort to revise it. In line with this we try to anchor the theory—whether as is or in a revised version—within traditional social science. To that end, we draw attention to the difference between Aumann²³ [2], Aumann and Drèzee [14]. Aumann [2] claimed—quite rightly—that

¹⁹ Aumann and Drèzee [14].

²⁰ See id.

²¹ Id. at 72, 82.

²² Von Neumann and Morgenstern, *supra* note 6, at 2.

²³ Aumann, *supra* note 2.

as such, agreement to play the stag-hunt game in mutual cooperation is not self-enforcing.²⁴ He added that the agreement to cooperate while playing the stag-hunt game does not bring about any improvement.²⁵ This we deem somewhat incorrect since it is an oversight of the agreement that may change the mutual expectations of players that the result of the game depends on. Aumann's argument is this: both players will gladly agree to cooperate, whether or not they later keep their word while playing; hence, their explicit agreement conveys no information:

To say that a game is non-cooperative means that there is no external mechanism available for the enforcement of agreements Incentives can be changed by changing either the payoffs or the information of the players.²⁶

Of course, one may see the custom of keeping promises as irrational in any one-time game. This is a mistake. Expectations regarding cooperation that rest on agreement are too common to dismiss. Also, it will be beneficial for any specific society as well as for the international community to reform the culture in a manner that generates expectations to cooperate. That reform would render the reliance on promises eminently rational. As such, agreements tend to raise expectations; they improve the likelihood of achieving cooperation in the one-time stag hunt game and even in the repeated prisoner's dilemma game. This has a significant effect also for international relations, where institution to enforce contracts are still rather ineffective. This is in agreement with Aumann: "In the international relations literature, the game has been called the 'security dilemma.'"²⁷ Contrary to Aumann [2], however, we argue that international agreements in stag-hunt situations improve the disposition to cooperate and that therefore game theory rejects *Realpolitik* in international relations (*Realpolitik*, to repeat, is the recommendation to consider all agreements altogether worthless²⁸).

Aumann is quite right in asserting that there is no a priori reason to expect agreement to cooperate to lead to cooperation.²⁹ The very need to come to agreement may already signal potential mistrust and, thus, mistrust and doubt as to the expectation that promises lead to cooperation. Thus, Aumann's assertion that there is no a priori reason to expect agreement to lead to cooperation requires completion; at times, but only at times, there is a posteriori reason for that.³⁰ This then is an argument for the proposal to consider game theory, part and parcel of social science. How a given player will behave in a given game, thus, depends on the culture within which the game takes place. Hence, the conclusion from the rules of the game to the conduct of its players depends on tacit suppositions that represent the social conditions under which they play the game. These are better specified explicitly. The rules of the game

²⁴ Id.

²⁵ Id.

²⁶ Id.

²⁷ Id.

²⁸ Aumann, *supra* note 2.

²⁹ Aumann, *supra* note 2, at 619–20.

³⁰ See *id.*

called game theory should be altered to include this demand. This will lead to the proliferation of variants of many games that have, thus far, already been considered exhaustively.

For example, in the traditional wording of the stag-hunt game, the description of the set of alternatives is too sketchy: the option of agreement is missing without notice. Therefore, when one mentions it, one implicitly indicates that the game is not a closed system; it is, then, not mathematics; at best, it is social science. Considered pure mathematics, it does not have a unique solution: the conclusion that agreement will lead to improvement is questionable and depends on the expectation the agreement creates. In this regard, we agree with Aumann.

One may conclude from the above discussion that it is better to play the variant of stag-hunt with the option of preliminary communication than the stag-hunt without the option, and that these are indeed two different games. In the stag-hunt game with an option of preliminary communication, words are not merely cheap talk, but, they are in the one-time prisoner's dilemma game with an option of preliminary communication. To be precise, we should not ignore the variant of prisoner's dilemma played publicly with unenforceable agreements to cooperate: in this variant of the game, players will respect their agreement to cooperate in cultures in which the refusal to honour one's commitment will damage one's reputation considerably.

In Aumann's Nobel lecture we read, "the fundamental insight is that repetition is like an enforcement mechanism."³¹ This insight of Aumann is a clear refutation of *Realpolitik* that assumes that since there is no institution to enforce agreements in international relations, those agreements are worthless. Aumann's insight explains why covenants without sword waving can serve as much more than mere words: they add significant strength to much needed security. What we said contradicts Watkins assertion,³² that game theory endorses the claim of Hobbes: "covenants, without the sword, are but words, and of no strength to secure a man at all." We argue that game theory leads to the contrary conclusion: that covenants may prevent war even without sword waving, more in line with the observation of Hobbes.³³

Game theory conflicts with the *Realpolitik* idea that international agreements are not worth the paper on which they are written.³⁴ Game theory similarly conflicts with the *Realpolitik* idea that the rule of law does not matter since it can do no more

³¹ Aumann, *supra* note 1, at 354.

³² Watkins [15].

³³ Hobbes [16]: "In contracts that consist of such mutual trust, as that nothing be by either party performed for the present, when the contract is between such as are not compellable, he that performeth first, considering the disposition of men to take advantage of everything for their benefit, doth but betray himself thereby to the covetousness, or other passion of him with whom he contracteth. And therefore such covenants are of none effect. For there is no reason why the one should perform first, if the other be likely not to perform afterward. And whether he be likely or not, he that doubteth, shall be judge himself . . . But when there shall be such power coercive over both the parties, as shall deprive them of their private judgments in this point; then may such covenants be effectual; seeing he that performeth first shall have no reasonable cause to doubt of the performance of the other that may be compelled thereunto."

³⁴ See Ringmar [17].

than reflect and legitimize extant balances of forces active between the nations with no ability to change them.³⁵ This is the social philosophy of Hegel that is popular today among the legal realist movement.³⁶ Fortunately, this view meets with a very simple refutation: a new enforceable law can prevent, or at least reduce, situations of prisoner's dilemma, which is agreeable to all parties involved, so such a law has a great likelihood of changing an undesirable Nash equilibrium in many games.³⁷

4.3 Additional Morals to Learn from Aumann's Nobel Lecture (2005)

Our main moral from Aumann's Nobel Lecture is that game theory refutes Realpolitik. Let us offer two additional morals from Aumann's Nobel lecture. The first corresponds with his conclusion of his analysis of a particular repeated game:

What is maintaining the equilibrium in these games is the threat of punishment. If you like, call it 'MAD'—mutually assured destruction, the motto of the cold war.³⁸

In the game, he analysed it is indeed feasible to implement the advice to punish the party that plays the repeated prisoner's dilemma with a hostile strategy. It may nevertheless be infeasible in international relations, for example, in cases where punishment leads to a response from a third player such as an empire or an umpire (it will not be a repeated prisoner's dilemma, but a mere variant of it). In an effort to achieve a result of cooperation in the game, a player may be ready to punish the opponent severely. Other parties may then block the whole game, even in cases in which mutual cooperation is achievable with relative ease. Even the option of lenient penalty may be politically and scarcely feasible then. Therefore, an empire may prevent the game and sometimes lead one player to always cooperate and the other to always defect. Let us propose these two games that may be enforced by the empire: a repeated unilateral stag-hunt and a repeated unilateral prisoner's dilemma. Therefore, it is a super game; the empire may force the states to play one of these games; in other situations, the teacher may force the pupils to play one of these games. In these games, one player can choose between cooperation and defection, and the second player has only an option of cooperation. The payoffs of the possible results of these games are such that the payoffs of these results in the prisoners' dilemma or stag-hunt. Actually, the empire deletes one of the lines in the matrix of the game and by this makes it a new matrix—a new game.

This will be the matrix of the unilateral prisoner's dilemma (Table 4.4).

This will be the matrix of the unilateral stag-hunt (Table 4.5).

³⁵ Id. at 91.

³⁶ See id. at 101–02.

³⁷ A game is in a Nash equilibrium only if no player has incentive to change strategy unilaterally. See Nash [18].

³⁸ Aumann, *supra* note 1, at 354.

Table 4.4 The unilateral prisoner's dilemma

	Coop.	Def.
Coop.	A, B	B, A

Table 4.5 The unilateral stag-hunt

	Coop.	Def.
Coop.	A, A	B, B

One of the advantages of the variant of a repeated stag-hunt with an empire (or with an umpire) whose task is to force one player to avoid punishing the other player, to enforce the repeated unilateral stag-hunt, on such a variant of a repeated prisoner's dilemma, is this: in the repeated unilateral stag-hunt, the players will reach mutual cooperation, while in the repeated unilateral prisoner's dilemma they will reach the result in which one player will always defect and the other will always cooperate. While mutual cooperation is a possible result (as well as mutual defection) in the repeated prisoner's dilemma, the only possible result in the repeated unilateral prisoner's dilemma is that one player will always defect (this is their dominant strategy) and the other player will always cooperate. Hence, international intervention will be more desirable if it prevents the repeated prisoners' dilemma than if it prevents one side unilaterally from defecting in the repeated prisoner's dilemma. Furthermore, if a state believes that the empire prevents them from defecting in a repeated prisoner's dilemma, the state should prevent this game when possible.

Notice that although in a prisoner's dilemma game the response to always-defect by always-defecting is reasonable and is possibly the best winning strategy, it still poses a possible penalty. Similarly, raising the reward for mutual cooperation or for being betrayed unilaterally may make tit-for-tat the reasonable strategy even in the prisoner's dilemma. This is so since the risk of the tit-for-tat strategy that incurs is reasonable: a player who adopts it takes a risk of losing in the first round, but he gains the opportunity to achieve the payoff of mutual cooperation, an opportunity that is not achievable by the always-defect strategy. The rational choice between these two options then depends, not only on the expectation that the opponent will play tit-for-tat, but also on the time discount and on the distance between the different payoffs (this fully accords with the complaint of Bunge [7] that game theoreticians do not consider sufficiently critically the numbers that they write as examples for payoffs).³⁹

The second moral from Aumann's theory is sober. The mutual cooperation in the repeated prisoner's dilemma depends on mutual threat, sometimes a threat to use force or to punish. Therefore, a change of the rules of the game that stabilizes mutual cooperation is beneficial even when its players choose mutual cooperation as the status quo. This is a challenge to the observation of Von Neumann and Morgenstern that any "game is simply the totality of the rules which describes it": they obviously

³⁹ Bunge, *supra* note 11, at 178.

overlooked the possibility of changing the rules of a game.⁴⁰ Constitutions often include some formal rules for change, and every constitution is open to a revolution.⁴¹ This is so since even if the players achieve a Nash equilibrium of cooperation; the equilibrium may not be stable for some changes. Furthermore, there are equilibria of cooperation that rest on mutual threats, and there are those that rest on mutual trust; from a social science point of view, the latter is more stable and, thus, more desirable.

A physical system is in an equilibrium when the net force on each body in it is zero. It is stable if a small temporary deviation from it does not destroy it. It is unstable if it does (the equilibrium is indifferent if this deviation leads to another equilibrium). Moreover, equilibrium is relative to the forces in question: a system can be stable regarding only one set of extant forces. A game is in a Nash equilibrium if, and only if, no player has incentive to change strategy unilaterally. However, not all Nash equilibria are stable. Consider not only strategy change but also changes in the rules. Some equilibria remain stable even after such a change, but not after a change in the mutual expectations. Thus, stability is a relative matter.

One great advantage of the repeated stag-hunt game over the repeated prisoner's dilemma game is that only in the repeated stag-hunt game does each player always mutually cooperate, resulting in a Nash equilibrium. Thus, pacifist players will gain most from preferring to play stag-hunt over playing prisoner's dilemma: a player committed to play "always cooperate" will achieve the best result in all interactions, even where the received norm is mutual defection. And then, remarkably, all parties to the game are better off when they move from an equilibrium of mutual cooperation in the repeated prisoner's dilemma game to an equilibrium of mutual cooperation in a repeated stag-hunt game.

One may question this observation by noticing that those two equilibria allot the same payoffs to both players: this suggests there is no advantage in the shift from the one game to the other. The preference of more stable equilibria over less stable ones will lead to the rejection of this suggestion. This generally holds true as long as the more stable equilibrium does not impose stagnation; otherwise, the objection to stagnation may change the preference. Game theory is understandably an idealization, and, thus, it is not sufficiently sensitive to account for the difference in degrees of stability of the repeated game; this is no reason to overlook this difference, however. It is generally a political mistake to overlook degrees of stability, and it seems game theory can hardly help here without first inviting some development or change. As it happens, this oversight is common. Politicians systematically propose to end a war by reinstating the *status quo* in hopes of avoiding the repetition of past failed efforts at stability. At times, this hope for better stability rests on better considerations of the balance of powers between warring states. Game theory in its current state is unable to critically examine such considerations, as it is not sensitive enough to compare degrees of stability. It even overlooks the price for the achievement and maintenance of mutual cooperation in games of the prisoner's dilemma. Parties

⁴⁰ Von Neumann and Morgenstern, *supra* note 6, at 49.

⁴¹ See generally Spiro [19].

to this sort of game may make aggressive threats, which are costly even when there is no intention to follow them up. And then, players have to weigh the cost of war against the cost of the equilibrium within which peace depends on the fragile tool of threats to fight back (this resembles the equilibrium of peace in the repeated prisoner's dilemma). Since the consideration of waging war is expensive, it is wiser, whenever possible, to change the situation to enable players to rely on trust, which is the transition from the prisoner's dilemma game to the stag-hunt game. This happened in Europe after World War II, it seems. For now, peace is recognized as the best option for every European Union country, even where an attack on a neighbour would lead to an immediate surrender. This situation is obviously the best goal for all international relations, as it achieves the most stable situation. In this situation, the peace will be stable, even if the two sides assess the outcome of a potential war as advantageous for themselves (even to the degree they are both convinced that they will definitively win the war). This is quite intriguing because in most other sorts of games this optimistic assessment of the results of wars usually leads to wars. Game theory, to repeat, does not succeed in accounting for the stability of the kind of game that leads to a Nash equilibrium of peace since no degree of stability is intentionally built as yet into the system of game theory.

We therefore recommend rendering game theory more sensitive to degrees of stability of its equilibria. This includes stability of the equilibrium when the rules are unstable or when players are misinformed, commit common mistakes, or change their preferences midgame.⁴² It also includes stability of the equilibrium when new players enter the game or when the available set of alternatives for current players change. The development should be more fruitful as a toolbox to achieve stable world peace.⁴³ The ideal of international relations would naturally be a solution of this kind, whenever possible. The hope, that we suggest will make it more viable, is that this situation is achievable by building widespread expectations for the application in international courts of strict laws against aggressive national leaders. At the very least, we should welcome efforts to minimize all incentives for political leaders to break international law or to ignore its summons or rulings. All this is easier said than done, of course. Our point, however, is that it is common sense and obvious from

⁴² Howard et al. discuss a meta-game for which prospective players may choose their emotions, preferences, and even rationality. Players' self-interest will influence these and make some of their threats and promises credible; they will then rationally promote their chosen preferences. Howard et al. say, "often (as a player) one would be better placed strategically if one's preferences (P) were replaced by other preferences (P'). With preferences P', one would be in a stronger position to pursue one's original preferences P. Fundamentally, this happens because players can make use of each other's preferences as a means to obtain their ends." Now, if in the former game the players can adopt such moves, they do not improve their situation in the central game but prevent the central game; they make it another game. This is so since objective rules and options do not suffice to determine the game, as payoff for players signify too. Oddly, Howard et al. dismiss this rather obvious consideration. Howard et al. [20], at 99, 100. *See also*, Howard [21], at 1.

⁴³ There are different sorts of equilibria in game theory, and they may be perceived to present different degrees of stability, but not in a way that will be fruitful for handling the problems we present here. We invite our readers to challenge us and correct our mistakes; we will be grateful for this.

the viewpoint of game theory, as it should be. The generally received observation is that no one wants game theory to make recommendations that conflict with the public interest. And it is almost a consensus that the public interest is to make peace a top priority in all cases except for intolerable situations like enslavement or destabilization that worsens the situation (as symbolized by the compromise that Britain accepted in Munich in 1938).⁴⁴ If there is a situation in which war is better than peace, this should be subject to critical discussion, together with all possible answers to the question, what compromise is tolerable. Can game theory in its current version help the search for a reasonable answer to such a discussion? The answer, it seems on its face, is present-day game theory is useless for that purpose. We have argued that this is not true: present-day game theory may help rethink how to mitigate situations that threaten peace, admittedly, when degrees of stability signify greatly this is the case. And then, we say, it need not be so since game theory can nevertheless help one rethink the extent of the desirability of raising the degree of stability of peace and, thus, the cost that it is worthwhile to meet that end. And, observe, Abraham Wald has shown the way.⁴⁵ Considering chains of games and sub-games will be a useful extension of current game theory.⁴⁶

We suggest then that the most significant achievement of game theory is not in the design or in the applications of games, but in the suggestions of what games are unwise to play. Here, we follow Popper [25], who said, politically, preventing pain or suffering has priority over creating pleasure. Obviously, in game theory, prevention is also much easier than application because every game requires some conditions for its very applicability, and these are never too clear and are seldom part of game theory proper. The games we consider unwise to play are obviously dangerous, as they may lead to war. The paradigm case here is chicken/brinkmanship. To our regret, game theoreticians are often more concerned with the best way to play them. Even if they are right, we prefer not to join them, but to recommend the proposal to avoid playing them when possible. At times, the game theoreticians in question stress that peaceful games fit some utopian situations so that in the meantime war is inevitable. We say, even if some war is inevitable, we should do our best to try to prevent every specific case of impending war, giving the good Lord the benefit of the doubt.

⁴⁴ See, *Munich Agreement*, Fr.-Ger.-Gr. Brit.-It., Sept. 29, 1938, The Avalon Project, Lillian Goldman Law Library, Yale Law School. One major problem in Munich agreement is that it shifted the anti-Nazi block from an equilibrium of a cooperation to a cooperation to every country to itself. The scarification of Czechoslovakia challenged the expectations that every country will cooperate in order to achieve international security.

⁴⁵ See Abraham Wald, Statistical Decision Functions Which Minimize the Maximum Risk, *Annals of Mathematics*, 46 *Annals Mathematics*, Second Series, Apr. 1945, at 265. See also Wald [22]. Wald [23].

⁴⁶ See Solan and Vieille [24], at 265. Solan and Vieille discuss the system in which players have the choice between quitting and continuing to play. They impose on games limitations that increase their mathematical elegance. Alas, these limitations lose the empirical character of games that gamblers play and of games that are important in social studies.

4.4 Conclusion

In the one-time stag hunt game agreements improve the likelihood to achieve cooperation if the norm is to respect agreements. This is so then agreements create expectations that tend to fulfil themselves.

Here then is our major corollary to game theory: the tools for achieving cooperation are incentives that generate strong and significant expectations: in brief, hope. The incentives may be supplied by the legal system and by the norms and customs of civil society. The expectations may be products of institutions created to raise trust and join the educational or the diplomatic system. Surprisingly, a little success in trust-building may have a huge, dramatic, and positive impact on situations like the repeated prisoner's dilemma. Is this moral from game theory true? This is an empirical question not discussed here. That it deserves such discussions is obvious from the huge success of every educator who tried to reach neglected youths. Still, it is important to notice that the theory suggests that trust is superior to defection as the default option, thus, opening a venue to its empirical tests.

We recommend adding hope to the incentives and expectations of standard economic theory. Of course, appropriate incentives may generate hope, but they may also generate despair—intentionally or not. People can expect the best (that sounds hopeful), and they can expect the worst. Yet the logic of the ascription of expectations to rational agents differs from that of hope, since, unlike expectation theory, the theory of hope requires the will to live as more basic than any expectation, rational or not. As it happens, game theory evolved during the Cold War under the strong influence of economic theory and expectations theory. The theory of hope awaits proper development. We suggest that this step will also promote peace.

References

1. Aumann, R.: War and Peace. In: Prix Nobel 2005. The Nobel Foundation, Stockholm (2006)
2. Aumann, R.J.: Nash equilibria are not self-enforcing. In: Gabszewicz, J.J., Richard, J.-F., Wolsey, L. (eds.) *Economic Decision-Making: Games, Econometrics, and Optimization: Contributions in Honour of Jacques H. Drèze*, 201–206 (1990)
3. Oskamp, S., Perlman, D.: Factors affecting co-operation in the prisoner's dilemma. *J. Conflict Resol.* **9**, 29–31 (1965)
4. Neumann, J., Morgenstern, O.: *Theory of Games and Economic Behaviour* (1944). <https://ebookcentral.proquest.com/lib/lawsc/reader.action?docID=1092486&ppg=2>
5. McAdams, R.H.: Beyond the prisoner's dilemma: coordination, game theory and the law. *S. Calif. L. Rev.* **82**, 13–15 (2008)
6. Agassi, J., Meidan, A.: *Philosophy from a Skeptical Perspective*, 96. Cambridge University Press (2008)
7. Bunge, M.: *Social Science Under Debate: A Philosophical Perspective*, 180. University of Toronto Press (1998) (eBook). <https://ebookcentral.proquest.com/lib/southcarolina/detail.action?docID=4671968>
8. Weiss, U.: The Regressive effect of appealability. *SSRN Electron. J.* **1** (2011). <https://doi.org/10.2139/ssrn.1688877>
9. Shavell, S.: The appeals process and adjudicator incentives. *J. Legal Stud.* **35**, 1 (2006)

10. Weiss, U.: The Regressive Effect of Legal Uncertainty. Tel Aviv University, L. Fac. Papers (2005)
11. Galanter, M.: Why the “haves” come out ahead: speculations on the limits of legal change. *L. Soc. Rev.* **9**, 95 (1974)
12. Aumann, R.J.: Game engineering. In: Discussion Paper: Center for the Study of Rationality No. 518 (2009)
13. Aumann, R.J., Shapley, L.S.: Long-term competition—a game-theoretic analysis. In: Megiddo, N. (ed.) *Essays in Game Theory*, 1–15 (1994)
14. Aumann, R.J., Drèze, J.H.: Rational expectations in games. *Am. Econ Rev.* **98**(1), 72–86 (2008)
15. Watkins, J.: Imperfect rationality. In: Borger, R., Cioffi, F. (eds.) *Explanation in the Behavioral Sciences*, 202–203. Cambridge University Press (1970)
16. Hobbes, T.: The Elements of Law Natural and Politic. In: Tönnies, F. (ed.), 78 (1969)
17. Ringmar, E.: The relevance of international law: a Hegelian interpretation of a peculiar seventeenth-century preoccupation. *Rev. Int. Stud.* **21**(1), 87 (1995)
18. Nash, J.: Non-cooperative games. *Ann. Math.* **54**(S2, 2), 286 (1951)
19. Spiro, H.J.: Constitution. *Encyclopedia Britannica* (Feb 5, 2020). <https://www.britannica.com/topic/constitution-politics-and-law>
20. Howard, N., et al.: Manifesto for a theory of drama and irrational choice. *J. Operational Res. Soc.* **44** (1993)
21. Howard, N.: The present and future of metagame analysis. *Eur. J. Oper. Res.* **32**(1) (1987)
22. Wald, A.: *Statistical Decision Functions* (1950)
23. Wolfowitz, J.: Abraham Wald, 1902–1950. *Ann. Math. Stat.* **23**, 1–13 (1952)
24. Solan, E., Vieille, N.: Quitting games. *Math. Oper. Res.* **26** (2001)
25. Popper, Karl R.: *The open society and its enemies* (1945)

Chapter 5

Game Theory and Social Science



The place of game theory in contemporary scholarship is problematic. Although its inventors have presented it by the names “Theory of Games and Economic Behaviour” it is as related to economics as to sociology, politology, and even peace studies. It is not clear at all how what it adds to these fields integrates in them. Discussions of games begin with descriptions of them, not descriptions of who plays them and why. If we know about any interaction between people, what they expect of it, what rules they follow, and how their assessments of each other’s possible move influence their decisions, then there is hardly any difficulty to present it as a game in the format of game theory. We may have little difficulty to assume that people interact for some purposes and that their assessments of each other’s moves may influence their own decisions. (Even though these assumptions are not always true, they are true often enough to justify the study of such cases.) Still, why should we assume that the rules of any game are given? Perhaps when discussing the economic behaviour of entrepreneurs we may admit that they often take the rules for their conduct as given. But when discussing interactions between delegations that negotiate peace, for a different kind of example, such an assumption is scarcely ever tenable. The same goes for legislation. Yet these days game theoretical discussions often spill over to matters of legislation and of peace making.

5.1 Game Theory and the Social Science I

.... as far as the propositions of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality. Einstein [1, 2]

5.2 Preliminaries

John Nash said,¹ that the theory of games is a matter of convention; it is hard to find an adequate definition of it, which is not surprising: we have had mathematics for more than 2000 years and we still do not have an adequate definition of it. Without contesting this, let us suggest the following tentatively. Game theory concerns the general principles of optimal individual management of conflict and of cooperation in given situations. It aims to describe them within the framework in one scheme or format. For, rather than a study of a particular situation, game theory comprises the search for the common general principles that guide many sorts of interactions, including war and peace, trade, litigation, courting.² All of game-theoretical studies, including those of love and of war, use the same simple scheme.³ In particular, the game theoretical insight applies to the study of both love and war that at times agreement to exclude options that are generally undesirable [4] is better for all players concerned.

Oskar Morgenstern and John von Neumann launched game theory; the most important founding father of game theory is Nash, who has rendered game theory non-trivially applicable to difficult problems in the social sciences.

Morgenstern and Neumann distinguished there between games and economic behaviour, saying,

this book contains an exposition and various applications of a mathematical theory of games... The applications are of two kinds: On the one hand to games in the proper sense, on the other hand to economic and sociological problems which, as we hope to show, are best approached from this direction... Our major interest is, of course, in the economic and sociological direction. Here One may approach only the simplest questions.

This leaves it unclear whether the applications are parts of the theory or not. Is the theory mathematical or social? Our answer: pure game theory is mathematical; applied game theory is a part of social science. Pure game theory concerns questions of the kind, given a particular set of assumptions, what are the possible results of the interaction and what set of strategies may be stable in a repeated game given a particular set of assumptions? What strategy, then, what plan of action, is recommendable for each player? Another central question within game theory is, what are the possible results of a given game, on the assumption that the players act rationally? The study of mechanism design includes the use of game theory, given a particular

¹ Private conversation with Dr. Uri Weiss in 2008 at Lindau.

² By extension, game theory also applies to interactions between animals and even between genes. We will ignore this here.

³ Aumann ([3], second paragraph):

Up to now all the effort has been put into resolving specific conflicts: India-Pakistan, North-South Ireland, various African wars, Balkan wars, Russia-Chechnya, Israel-Arab, etc., etc. I'd like to suggest that we should shift emphasis and study war in general.

set of assumptions, to design means for the achievement of desirable goals. Maskin [5] said in his Nobel lecture:

We begin by identifying our desired outcome or social goal. We then ask whether or not an appropriate institution (mechanism) could be designed to attain that goal. If the answer is yes, then we want to know what form that mechanism might take.

One of the most surprising facts about game theory is that it usually limits completeness with no loss of generality to two players who have to choose between a few options, so that for each two players' decision there is a given payoff. The results of this presentation are easily generalizable to games with many moves: already well before game theory was invented, Ernst Zermelo has proven, the game of chess can have a complete presentation as a game with each player making one move and winning or reaching a draw.⁴ Von Neumann and Morgenstern also proved that a game with many players can be turned into two-player games. Within game theory, then, the usual way to present a game is by a two-by-two matrix: each player can choose between two actions, and the table presents the payoffs that the different combinations of actions of both actors bring about, thereby giving the possible interactions between players as given options. Highly simplistic as this is, it yields interesting results even for the simple cases of decisions of players, if they interact strongly with their opponents. Surprisingly, in some games the strategies of players do not depend on their mutual expectations, as is, for example, in the game called (a one-time) prisoner's dilemma.⁵ The greater surprise is that although the games are contrived and the conditions they describe are highly artificial, they can help improve some interactions in some situations, and these are real and even common.

Game theory offers two ways to look at all this: it considers differently a game played once and it played repeatedly. For, obviously, under some conditions, the two cases differ: the unrepeatd game is the one that transient merchants play. They decide differently from ones who stay put—as only the latter have their reputations

⁴ Aumann [6].

⁵ Prisoner's dilemma: suppose the police arrest two individuals for possession of illegal weapons near a bank immediately after an armed robbery took place there. The police have strong enough evidence to charge them with the minor infringement that incurs a lenient penalty, but not enough evidence to charge them with the severe infringement that incurs a severe penalty. To achieve that the police isolate them and propose each of them a plea-bargain. The options that the game offers are then as follows. If they both betray each other, they will both receive a medium penalty; if they cooperate with each other and keep silent, then they will both receive a lenient penalty. If only one betrays the other, then that one will walk, and the other will receive the severe penalty. The outcomes then are A (freedom), B (lenient penalty), C (medium penalty) and D (severe penalty):

	Cooperate	Defect
Cooperate	B, B	D, A
Defect	A, D	C, C

to consider. Thus, the cause of the significant difference is not the repetition itself but the capacity of players to gain reputation plus the incentive for them to gain it.

Considered a branch of (applied) mathematics, pure game theory says nothing about reality.⁶ Applied game theory as a part of social science concerns real behaviour—of individuals, of business firms, or of social institutions, especially states—as diverse as decisions to purchase and to declare war.⁷ Let us tabulate this:

	Mathematics	Social science
Pure game theory	V	
Applied game theory		V

Game theory offers possible hypotheses—models—regarding rules of conduct in given situations as some abstract games. It concerns rules for the choice of options within these models. At times, these are surprising. Reasonable players may reject a model as a description of the games that they happen to be playing, and then they may reject the conclusions from it; similarly, rejecting the conclusions from the description, they will have to reject the model from which these follow. Also, they may change their minds as a result of learning from experience that their choices lead to results that they dislike, and so they may reconsider their ejection of the model. In that case, game theory may help them to improve their behaviour in specific situations; they may then also improve their views on what rules (or set of possible actions or expectations or preferences) lead to desirable outcomes. More significantly, the same considerations show that game theory is useful in its ability to recommend what games to avoid playing. People may thus learn from game theory to improve their conduct.⁸ This includes social planners and people in some specific social or political roles. Recommendations that rest on a specific model of a game are sufficiently interesting to put them to empirical test. Well-designed Empirical tests are enlightening and their performance is a game, Karl Popper has observed a decade before the official birth of game theory [8, §11]. Let us describe it.

⁶ Our view of pure economics differs from that of Pareto and Priuli [7]. They have claimed,

It has been called pure economics, through analogy with other sciences which draw many consequences from one or very few principles by deduction.

They adopted a platonic view of principles as self-evident. We adopt the view of Einstein and of Popper [8] of all principles that involve reality as conjectural.

⁷ By extension, the individual players may be animals. At times, game theory applies even to the analysis of the selection of genes, and then it is the study of genes, or more accurately alleles, as if they possess strategies of sorts.

⁸ Authors of mainstream texts in game theory dismiss this. For, it seems, they do not consider declining playing a game a part of abstract game theory, even though that theory does not preclude the game of choosing one or another game from a given set. A trivial case of this is the game, to play or not to play a given game. The peculiarity of this game is that it is possible to view its outcome only partly determinate. The limitation of abstract game theory to fully determinate outcomes, however, renders it inapplicable (Knight [9], 220: “No social machinery of ‘sanctions’ will prevent the game from breaking up in a quarrel”).

It may be unclear what game is being played or even what game is being examined. When players conclude from experience that they are playing a specific game, they may be in error: the game they are playing may be different.⁹ This is particularly true for players familiar enough with the rules of a game to play it, but without knowing all of its rules. This creates an ambiguity, and ambiguity raises a difficulty about testing game-theoretical models. It allows different readings of the outcome of a game; when players disagree about it, they may seek help, say, of the law-courts. This is a different game, then. When one clearly loses a game, the situation is different. Generally, in the case of a difference between predicted and experienced outcomes, in the case of a refutation, at least a part of the model on which the prediction rests is mistaken. This is so regardless of whether that part is an important part of it or not. A refutation is particularly enlightening in the case of a refutation of some hypotheses about impossibility, as this opens the door to new possibilities. Game theory has already played such a productive role.

The views offered here differ from those found in the standard literature on game theory. We begin with small differences—concerning style. We join those whose matrices offer no numerical values (“cardinal payoffs”) but only comparative ones (“ordinal payoffs”). Detailed descriptions of the options in matrices the usual way is redundant and admittedly so. It is useful to omit any redundant item, unless it serves explicitly as a mere example. Adding a formal item may be arbitrary and serve no purpose, or, worse, some unspecified purpose (since it then comprises a hidden agenda). It is customary to add to any presentation of a formal apparatus some discussion intended to show that it is not arbitrary, namely, that it serves the purpose of the text at hand. When necessary, this background information undergoes critical discussion in the hope to improve the picture. Otherwise, it goes to the popular literature on the topic. All this hardly ever happens in game theory. Over half-a-century old by now, it has no explicit received informal background information. The preliminaries to the theory in its standard or introductory or popular literatures are much too scant. This makes it hard to sift the grain from the chaff. As game theory uses sufficiently many undefined terms, and not enough background information, it puzzles new readers. As a part of mathematics, pure game theory forgoes the usual social scientific assumptions of applied game theory; and as a part of game theory applied game theory omits these assumptions too. The result is then bound to be puzzling. Yet the observation that the presentation of a game rests on some implicit assumptions is almost always absent. The sense of puzzlement wears off, but not the ambiguity that generates it. It is then hard to judge what is the default option among game theoreticians, not only for want of a survey on the matter but, and chiefly, because of the confusion on the matter that prevails in that group of researchers.

This determines our strategy, which is rather unusual: we distinguish sharply between mathematical and social game theories and we indicate what background information determines the character of the discussion at hand.

⁹ Anthropology is full of such examples. Indeed, the reason anthropologists go to lie in the societies that they study is that they do not trust the descriptions of its members of their own customs.

The background information for game theory and critical discussions of it can profitably reduce the suspicion directed against it. We attempt to present here some guidelines for its conduct and to use them in our informal presentation of our arguments. The first guideline is that the overuse of formal arguments is not advantageous, as it intimidates needlessly; every increase of formality should be advantageous, and this should be explicitly shown: every added use of formal argument that is advantageous should enter with its rationale: the advantage of introducing it is better spelled out. This should raise the clarity that should serve a specific purpose. It should show how a hypothesis explains a phenomenon, for example, or how it undermines a significant hypothesis. This should facilitate critical discussion, as clear and explicit arguments usually do.

The very introduction of game theory had an initial rationale that was never sufficiently spelled out, and therefore it also hardly ever underwent critical assessment. This we try to do here, and we encourage our readers to offer criticism of our view and/or an alternative to it. In addition to the rationale for game theory in general, some specific game theoretical observations invite explanation by way of supplying background information: game theoreticians often offer political observations, particularly some that pertain to international relations, in which they claim—explicitly or implicitly—that game theory renders them persuasive due to its—real or alleged—scientific character. Our wish, by contradistinction, is not to persuade but to boost critical thinking. We find the informal character of our presentation useful for the critical examination of some of the political claims of some game theoreticians, since the motive behind this paper is an effort to turn irenic the too often pugnacious application of game theory to politics. To that end we jettison the excess formalism that may add to the prestige of some arguments but not to their force or clarity. This concerns the scientific status of game theory: when a theory becomes highly formal, it may claim the status of a mathematical truth that is beyond reasonable doubt; yet no matter how doubtless a theory is, its applicability is always in doubt. Thus, the high status of classical geometry stands even after Einstein replaced it with another geometry (differential geometry); whether and how classical geometry is still applicable is a question that every discovery of a new possible application of it reopens afresh. The question that engages us here is of this ilk: where and how is game theory (socially and politically) applicable, hopefully with valuable new results? Moreover, how can it alter to gain wider applicability and more useful for the cause of peace?

For example, in the sphere of litigation, it is more important for students of jurisprudence to analyse the *asymmetric* litigation game—between a strong and a weak litigant—than the *symmetric* one, even on the supposition that the symmetric games are more frequent. For, only the asymmetric game may hide unacceptable consequences for the weaker party. The legal system may allow for situations in which weak litigants cannot realize their rights or at least it is not worthy for them; legislators, judges and attorneys for the weak, should try to prevent these situations as the initial (super) game. This is a worthy moral for the “law and economics” movement that aims to assess which legal rules are economically efficient. The analysis of symmetric games—where the options are the same for each side—is elegant, easy, natural and relatively easy to apply; but it is not the most important game in

town. Legal theory will benefit more from researches that will reduce the number of unavoidable injustices of the system, and these are the asymmetric cases, where financially comfortable litigants have many more options, including those who are less risk-averse due to their richness (Weiss 2005) than ones who happen to be financially constrained. This may lead the weak parties to forego the use of all the legal advantages that they have and settle for much less than what the law entitles them. This is also the case when one party is a one-time player, and the other party is a repeat player (Galanter 1974). (Ironically, the literature considers this case not a part of “law and economics” but a part of “law and society”; obviously, it is both). Any move intended to compensate the less well-off litigant is a revision that will lead jurists to prevent games that end up in patent injustice.¹⁰ This is not limited to any specific society: already the Bible mentions asymmetric litigation: “seek judgment, relieve the oppressed, judge the fatherless, plead for the widow” (*Isaiah*, 1:17).

Admittedly, asymmetric games are usually mathematically the less elegant, but they are socially more important, at least from the humanist perspective. Unlike the prisoner’s dilemma, many situations of war and peace comprise asymmetric games. In many cases of violence, the strong party sees the game as asymmetric but presents it as symmetric in efforts to fend off the police, the courts or public opinion. Even kids who are bullies in school do that when facing school authorities. Under attack, then, it is often useful to change the game by making a credible threat to involve the police/the courts/public opinion. Even making a conflict visible may render an asymmetric game symmetric and thereby reduce violence dramatically.

5.3 Part II

We will begin by repeating some things we said in the chapter “Game theory for International Accords”. Formerly their goal was to make the point that game theory refutes Realpolitik, and now their goal is to discuss how to make game theory. Formerly, the methodological discussion was the instrument, and now the goal. Now, we use the discussion about game theory and realpolitik as an example to our thesis that game theory should be part and parcel of social science.

Aumann and Dreze [3] observe this:

Formally, a game is defined by its strategy sets and payoff functions. But in real life, many other parameters are relevant; there is a lot more going on. Situations that substantively are vastly different may nevertheless correspond to precisely the same strategic game.

Young as game theory is, it already has a tradition. That tradition rests on its initial aim. That aim was tacit. We suggest it was to replace the mode of explanation

¹⁰ For example, Weiss [10] analyzed the appeal game as an asymmetric one, while Steven Shavell as a symmetric one. Shavell [4, 11] noted that his model is not valid in a case of heterogeneous litigants, and nevertheless derives general policy recommendations from this model. The difference is not only that one analyzes this game, and the other analyzes another game. The important question is what kind of game represents best what kind of litigation?

received in the social sciences. (One of the names of game theory in its early days was “social physics”.) Its inventors, Oskar Morgenstern and John von Neumann, said at the time ([12], p. 2),

We hope to establish satisfactorily... that the typical problems of economic behaviour become strictly identical with the mathematical notions of suitable games of strategy... For economic and social problems, the games fulfil—or should fulfil—the same function which various geometrico-mathematical models have successfully performed in the physical sciences.

One may see the paper of Aumann and Dreze just cited as a welcome challenge to that tradition or as a step towards revising it in efforts to anchor the theory—in its current version or in some variant—within traditional social science. We go further in that direction: we draw our readers’ attention to a contradiction between Aumann [13] and Aumann and Dreze [14]. First Aumann [13] noted—rightly—that agreement between players of the stag-hunt game¹¹ is not self-enforcing. He added there that hence such an agreement to cooperate leads to no improvement: “the agreement has no effect one way or the other... An agreement to play it does not improve its chances further”. This we consider an error. Aumann argues thus: both players will gladly agree to cooperate, whether or not they later keep their word; hence, their agreement conveys no information. This way Aumann ignores the significant difference regarding the expectation of cooperation, namely, the difference between cultures in which promises create expectations and those in which they do not. Of course, one might dismiss keeping promises voluntarily as irrational. This is a mistake. All too often agreement creates expectation of cooperation; this is too common to be dismissed with no discussion. It will be obviously beneficial for any specific society as well as for the international community to develop a culture that transforms agreement to cooperate into expectation to cooperate, since that would eminently render rational any behaviour that conforms to it.

This is a general disagreement that we have with Aumann. In the same paper he says,

To say that a game is non-cooperative means that there is no external mechanism for the enforcement of agreements. Thus when the time comes to choose an action, the players are

¹¹ In the stag hunt game two hunters choose simultaneously whether to hunt a stag or rabbits, when a successful stag-hunt requires two hunters whereas going for rabbits one hunter is assured of success. It is then best for both if both go for the stag; but otherwise it is wiser to go for rabbits. Going for rabbits, one hunter prefers the other to go for the stag. Consider then four levels of success, from A to D.

Stag hunt

	Cooperate	Defect
Cooperate	A, A	D, B
Defect	B, D	C, C

assumed to act on basis of the existing incentives. Therefore, an agreement is effective only if it changes the incentives that obtain in the absence of the agreement.

Incentives can be changed by changing either the payoffs or the information of the players.

In disagreement with this we say, agreement may be effective whenever it raises expectations. Moreover, Aumann has claimed in his Nobel lecture (2006), [15] “Economics is all about incentives”. Incentives, we add, obviously depend on expectations and on preferences. Hence, economics, like game theory, has to notice these cases too. Not that incentives, expectations and preferences suffice: they also interact with legislation, social planning, and individual aspirations. As Aumann has noted (2006), agreements may change expectations and thus improve the likelihood of achieving effective cooperation even in the repeated prisoner’s dilemma game: “The fundamental insight is that repetition is like an enforcement mechanism”. This observation of Aumann is a clear refutation of the *Realpolitik* thesis that without institution to enforce agreements (in international relations), they are worthless. In agreement with this observation of Aumann we reject *Realpolitik*.

This rejection signifies for international relations, where institutions for the enforcement of contracts are still scarce and hardly effective. Contrary to Aumann [13], however, we suggest that international agreements in stag hunt situations do improve the likelihood of achieving cooperation: game theory does not lead to *Realpolitik* in international relations; and this is propitious, since not all international agreements are worthless.¹² Watkins [16] says that game theory endorses *Realpolitik* in the spirit of Hobbes who said: “covenants, without the sword, are but words, and of no strength to secure a man at all”.¹³ We argue that game theory refutes this. We suggest that game theory leads to Hobbes’ clear discussion and full expression of the idea that trust is a part of political life proper when he spoke¹⁴ of the cost of the acquisition of trust and friendship as factors that should make the strong avoid relying on force alone as the default option. Although at times trust is not operative in international relations (or in business relations), it is at times a significant factor in the maintenance of international peace (and even in the readiness to honour one’s contacts).

Aumann [13] may have provided the best defence of *Realpolitik* in his purely mathematical discussion of games: there is no a priori reason to expect that agreement to cooperate will lead to expectation of cooperation even in the stag hunt game, in which mutual cooperation yields the best result all round. It is possible to go Aumann’s way further and suggest that the very need to come to agreement already signals mistrust. This argument, however, is a poor defence of *Realpolitik*; rather, it is a further argument for our contention that game theory should be part-and-parcel of social science since—quite generally—the way people play a game depends on their culture, as Aumann and Dreze have noted. Hence, in a discussion of a game, even as a part of pure mathematics, it is advisable to specify the (social) conditions

¹² This is a self-fulfilling prophecy: if the prediction is credible that a currency will lose its value, then its broadcast will cause its downfall.

¹³ Thomas Hobbes, *Leviathan*, 1661, Chap. 17.

¹⁴ Thomas Hobbes, *The Elements of Law Natural and Politic*, 1640; Part I, Chap. 15, Sect. 10.

under which a game is played before going into its ramifications. Otherwise the game is underdetermined, and then it can be determined in different ways. The traditional discussions of the stag hunt game do not specify sufficiently the set of alternatives, particularly the option of agreement and the expectations that it may raise. Every mention of it, then, is implicitly a declaration that the game is not fully determined. Such discussions are not only mathematical; they also belong to social science. Considered as pure mathematics, they do not yield the unique answers that tradition ascribes to them, and to fully determine them, additional postulates are required. Anchoring game theory in social science, however, renders these postulates hypotheses about the conditions within which a game is played. This achieves three major beneficial effects.

We see here a major beneficial effect of anchoring game theory in social science. It invites many new questions and tools to think about diverse options, thus drawing attention to the variety of situations within which a game occurs; this opens the door for fruitful controversies about the situations in which a game is played. These may at times be settled empirically: which games do people play, where and when? Are there important cases that students of game theory should notice? In public policy discussions, what are the public goals, and what are the cheapest means to achieve them? How can the public change preferences and expectations? How can society prevent socially undesirable games? The promotion of placing such questions high on the national political agenda will, we contend, much help democratization and thus peacefulness.

Our criticism of current game theoretical discussions follows those of [16] and of [17]. Yet, whereas their aim is to detract from game theory, we claim that game theory is too narrow, and we hope to see an improvement of it—by making it part-and-parcel of social science, particularly by asking what game is played in the political arena or what game is better avoided. Our goal is to improve its profitable applicability. Watkins has said, any decision-schema employed is but a caricature of some images of theoretical preference—a crude and barely articulated schema, with very few of options ever noticed, much less their implications. Bunge [18] has said,

The game-theoretic models of international relations are not just simplistic: they are also quite arbitrary. So much so that, whereas one political scientist will model an international crisis as a prisoner's dilemma, another may model the same crisis as a game of chicken (brinkmanship)... If the choice of game is so arbitrary, what is the point of discussing any game.

Bunge [18] is right in his identification of the problem; his dismissal of the field, however, is in oversight of its potential. Already Keynes was aware of this, as his description¹⁵ of economics science in his letter to Roy Harrod¹⁶ illustrates:

¹⁵ John Maynard Keynes, letter to Roy Harrod, 4 July 1938; *Collected Writings*, 1973, vol. 14, 296.

¹⁶ We recommend adding the following argument of Keynes to game theory: "if orthodox economics is at fault, the error is to be found not in the superstructure, which has been erected with great care for logical consistency, but in a lack of clearness and of generality in the premises" (*Collected Writings*, Vol. 7, xxi).

Economics is a science of thinking in terms of models joined to the art of choosing models which are relevant to the contemporary world.

In the same letter Keynes wrote:

It seems to me that economics is a branch of logic.¹⁷

We disagree: a branch of logic cannot include the choice of the game/model to describe reality. Even Keynes was confused on this and he contradicted himself and was unclear as to whether the choice of the model is part of economics science or of its application. In his 1936 *The General Theory of Employment, Interest, and Money* he wrote [19] ,

I shall argue that the postulates of classical theory are applicable to a special case only and not to the general case... Moreover, the characteristics of the special case assumed by the classical theory happen not to be those of the economic society in which we actually live, with the result that its teaching is misleading and disastrous if we attempt to apply it to the facts of experience.

This view of economics as a science clashes with the view of it as a branch of logic; the view of it as a part of game theory may agree with the view of it as a part of logic. In any case, we prefer the third option, though Keynes has granted it hardly more than a passing observation.

We also have to refer to Boland [20], who said:

explanation is not a matter of logic alone but also involves ad hoc the proper use of our reversible models— namely the inclusion of extra ad hoc rules in addition to the logic of the mathematized economic models... solvability if properly specified leads to uninformative economic models—models which cannot say anything of significance about the ‘real world’.

The view of game theory proposed by Rubinstein [21, 22] is different:

Game theory has a sexy name, but it is actually no more than a collection of concepts and formal models about rational human behaviour in strategic situations—that is, situations in which the considerations of a rational player depend on how he assumes other players will behave.

Our discussion refuted him. Game theory is more than a collection of concepts and formal models about rational human behaviour in strategic situations; it is also the discussion of what is the applicable game. One may say that Rubinstein described only the pure game theory, but it is not true, since pure game theory does not include models about rational human behaviour; there are no humans, but only players in pure game theory. Actually Rubinstein [22, 23] contradicts Rubinstein [21, 22]:

Similarly, I think that testing an economic model should be focused on its assumptions, rather than its predictions. On this point, I am in agreement with Economics Rules: ‘... what matters to the empirical relevance of a model is the realism of its critical assumptions’.

¹⁷ At about the same time Ludwig von Mises held a similar view. He discussed it in much greater detail. See Murray N. Rothbard, Preface to the 1985 edition of his *Theory and History*.

Discussions of empirical questions (such as, which game is played?) take place in diverse legal and economic situations; yet it is always done incidentally, not sufficiently clearly, not to say without awareness of the great difference in its status as compared with the bulk of the literature on game theory.

Bunge's criticism continued thus:

One root of this arbitrariness lies in the most applications of game theory... How does one assign numerical values, wheatear absolute or relative, to the entries of the matrix?

We agree. Thus, the present paper does not use numerical values.

A pioneer game theoretician who wrote about game theory of institutions and empirical question was Elinor Ostrom [24]. She claimed:

the application of empirical studies to the policy world leads one to stress the importance of fitting institutional rules to a specific social-ecological setting. 'one-size-fits-all' policies are not effective.

Displeasure with game theory for its insufficient attention to empirical questions will not disappear when standard game theory literature will take account of standard economic literature. For, that literature admits preferences as given—as exogenous parameters. This keeps individual decisions out of the universe of discourse of economics. Unlike traditional economic theory, game theory allows for a Nash equilibrium in a coordination game while leaving open the question as to whether this equilibrium is desirable or not. Also, consider discussing the question, how is it possible to move from an undesirable Nash equilibrium to a desirable one; this discussion involves diverse possible preferences.

Or consider the fact that players may choose preferences and then change their minds. Game theory dismisses the case in which the strategy of one player changes the preferences of the other despite the great importance of such cases, especially in games of peace and war. For, hawkish or cruel strategy may lead the opponent to hate, whereas conditional generosity may succeed and thus lead the opponent to develop friendly preferences. These two strategies may be described as tit-for-tat and thus tacitly expand game theory. At times, as when considering fashions, this must enter considerations [25]. This is obviously true not only regarding individual choice of priorities but also for social choice—by the creation of a custom or a fashion or by legislation. Even if a purpose like happiness is given, then goals that serve it, such as maximizing profits, should be open for discussion and alteration: we do advise some people to act generously rather than in a profit-minded stance. (The major thrust of Adam Smith's *Wealth of Nations* is for governments to be generous by cancelling tariffs, although it is a major source of income of theirs in order to raise the wealth of their nations.)

What game theoreticians usually call “decision-making” is not the process of decision making and not the part of the game where the initial preferences or values to payoff are determined. Nor is it what economists consider decision-making. The exception is the neglected maximin model of Wald [26, 27]. He did not present decisions as given, but provided tools for reaching intelligent decisions. Allowing his readers to decide what is the maximal outcome of a possible decision and what is

its minimal outcome, once given that it is a correct decision and once given that it is not. (This approach is very much in accord with common-sense, as is the advice of Bertrand Russell to decision-makers to find the worst possible result of a policy that they consider and whether they can live with it; he advised them to seriously consider the option of not adopting a policy whose worst outcome they cannot endure.) Von Neumann and Morgenstern made the assumption that precludes all decision problems. They said,

Let us for the moment accept the picture of an individual whose system of preferences is all-embracing and complete, namely who for any two objects or rather for any two imagined events, possesses a clear intuition of preference. More precisely we expect him, for any two alternative events which are put before him as possibilities, to be able to tell which of the two he prefers. It is a very natural extension of this picture to permit such an individual to compare not only events, but even combinations of events with stated probabilities.

A branch of science that recommends what to conclude, given some priorities, may be fruitful. It is advisable then to remember that it operates under a very severe restriction. The mere readiness to apply game theory should be restricted to cases that will not demand new decisions. Otherwise, this readiness will block the capacity to decide—by the very oversight of the need to have decided beforehand that the readiness to apply game theory creates. There is always a need to decide beforehand: at the very least, a normal situation requires a decision whether to play or not to play. Hence, the function of game theory and of decision theory should be clarified and kept transparent. (The main advantage of the decision theory of Wald is that it keeps this function transparent.) This holds particularly for decision-making on matters of international relations. In games of war and peace, significant decisions depend on weighing the value of the possible achievement due to victory relative to the price of war. Thus far this is not yet a part of the game theoretical discussion in peace and war but as it is very much a part of responsible national politics, taking it into account may yield useful results, thus disproving the claims that it is barren. Regrettably, discussions in the game theoretical literature do not pay many significant cases the game-theoretical considerations that they deserve.

Wald's model allows for a player stopping to play for a while, and engage in an additional game, a game of seeking information that might help decide how to play the initial game. Thus it is a game within a game and, more than that, rather than prescribe payoffs, as game theory regularly does (and as Bunge rightly complains about the arbitrariness that it regularly involves), it lets players try to make a realistic assessment of payoffs as parts of decision processes under consideration. Wald has taken account of the obvious fact that at times a rational player purchases information, thus breaking away from the idealization of standard economic models that take all relevant information as freely available. The question remains, how does a market function when the sale of information is taken into account? This question is outside our concern. The fact that economists are reluctant to discuss Wald's theory for want of an answer to it is an ostrich policy. (This label denotes an irrational policy.) In Wald's model players make conjectures and guess the payoffs of the results of the diverse options they have, once on the assumption that their conjecture is true and once that it is false. They then decide on what strategies to adopt: minimize loss

and/or maximize gain. Within the game-theoretical literature, the game that comes closest to Wald's decision-making model is the Gale-Shapley [28] matching-game, since in this game they do not choose only how to achieve their goal, but particularly what they wish. Before the game every unmarried man and every unmarried woman rank their preferences for potential spouses. Men propose to the women of their choices. A woman may postpone a decision; but one woman may keep on hold no more than one proposal. She is not available for another proposal until she decides (if she has a complete set of ranked preferences that is unchangeable, this limitation is costless for her). A woman who decides to accept a proposal drops out of the game together with her man. Shapley and Gale are not clear as to what this means; it is unclear whether in the game that they describe divorce is permissible or not. This is very frustrating as they discuss the stability of marriage under the conditions of the game as they describe it. Worse, usually the literature describes this game as a part of cooperative game theory, a theory that deals with games that lead to enforceable contracts. Some commentators present this game as a major achievement, although its rules are very unclear. It is clear though that a man's proposal keeps him out of the game until his proposal is rejected. The weakest aspect of the Shapley-Gale matching-game is this. In any particular society in which the game is played, it suffices that some players revise their preferences in order to destabilize the whole system. The same holds when one sufficiently attractive person joins such a society. There is also a question: what happens if some women will not obey the mechanism but will make their proposal? Applying the Wald decision-making model leaves open for assessment the question, what action will destabilize what stable society, and it allows players to assess this in advance at one payoff if their assessments are right and another if not; and this is so even if players do not know what is the likelihood that their assessments are right. Finally, clearly, improving the lot of women by allowing some of them to propose destabilizes the system most. And the empirical question remains: how stable the marriage market is, how does its level of stability rise and fall, and what is the lowest level of stability of the marriage market a society can suffer before it destabilizes as a whole. Moreover, since the application of Wald's theory can take into account the players' preferences of a stable market, and particularly the incentives that their society give them to preserve the market stable, one may try to apply similar considerations to matching the classical economic model with Wald's model and attempt to assess the contribution of friction to stability. (It is agreed that friction in the mortgage market has caused the 2008 market instability.)

Another major beneficial effect that anchoring game theory in social science achieves is the diversity of interpretations that it invites within diverse social contexts of any game and of any particular solution to any problem that it raises. Consider the concept of Nash equilibrium that is possibly the most central concept in current game theory. It is an equilibrium of strategies; before presenting a definition for it, we need to clarify the concept of strategy. Consider first the pioneering book of von Neumann and Morgenstern [12]. A strategy, they say, is a player's plan that determine all the choices available in the game in every possible situation that the rules of the game permit, for every possible information that the player may possess at that moment in conformity with the pattern of information that the rules of the game provide for

the player for that case. We may translate all this to the context of the social sciences thus: a strategy is a policy regarding a given game; it is a plan for what to do in every possible situation of the game. This presentation of their definition suffices to show how utopian their project is. There is no chess player in the world who has a strategy according to their definition, and it is impossible even to write such a strategy, as is clear from any advanced text about chess: all the strategies that they describe are extremely partial and they involve the question, how does one approach the situation and choose wisely the strategy that generates that partial strategy. Computers win the game with people as they can calculate strategies a bit more completely. (As Ernst Zermelo has proven, the game is complete—either one side has a winning strategy or it is a draw—but thus far only in principle.)

A repeated game is in Nash equilibrium when and only when the strategy of one player maximizes that player's pay-off as long as the strategy of the other player is unchanged. Thus, each player's strategy is optimal against that of the other. A repeated game is a Nash equilibrium, then, if and only if no player has incentive to change strategy unilaterally; hence, in a Nash equilibrium, the strategy of each player is the best strategy given the strategy of the other. Hence, it is the best possible response. Consider what Nash wrote in the abstract of his dissertation [29]:

The main mathematical result is the proof of the existence in any game of at least one equilibrium point.

Not quite: not every game has a Nash equilibrium, and not every Nash equilibrium is attained. In the words of Aumann and Dreze,

Even when there is just one Nash equilibrium, it is not at all clear that the players 'should' expect its payoff.

Nash equilibrium can serve as a stabilizing norm; it has a significant social meaning if and only if a norm is at all possible. Thus, Nash equilibrium has a significant social place if and only if it is a game playable in a social context; it may then be the game that prevails in a culture (it has "mass action": the public effect of the game depends on the frequency of players and of playing within a given population): it is repeated sufficiently frequently to create popular expectations. The contribution of Nash is regrettably not popular in the social sciences despite its possible usefulness. Game theorists behave as if they prefer this usefulness to be inaccessible to outsiders. For, this is the outcome of the preference of game theoreticians to concentrate on the two-player one-time variant of any games they discuss: these variants are of little use for students of social problems.

Hence, the ability to apply the theory of Nash equilibrium to practical politics will improve by the subtle distinction between the view of it as game-theoretical and as social-scientific. Nash equilibrium is observable—only when it exists, of course. It is an equilibrium of strategies. At times people have no strategy and at times they have them but unawares, and then they can hardly see how they can improve them. Some observations about norms prescribe strategies, and they too are only partial. More than that: norms that prescribe Nash equilibria are never fully effective; their effectiveness may be ephemeral and it may be stable. This is very important as the best

and most significant case history illustrates: liberalism was a high ideal that people dismissed cynically, but this changed with the stupendous success of liberalism and the stability that it has brought in its wake. All this is obvious, especially formally, since norms are social and within the social sciences Nash equilibria are at times social and at times individual.

Let us apply the theory of Nash equilibrium to “The Emperor’s New Clothes” game. It is a coordination game: given that everyone shares a lie, the best interest of everyone to continue and share it; and then lying by everyone is a stable norm, even though telling the truth by everyone can be also a stable norm and a better one all-round. When one individual (with different preferences or with no information regarding expectations), the child, declares the truth, then this declaration may move others from a stable norm of lying to a stable norm of telling the truth; the switch may be practically instantaneous. The obvious game-theoretical moral from this story is that one deviant may be able to change dramatically the social Nash equilibrium; it may suffice to have one deviant to improve matters dramatically. Hence, it is hard to predict the result of such a game, since it is extremely difficult to know when one deviant will catch the public eye and manage to trigger a change. It may also explain why leaders of closed societies are so eager to prevent all deviation. It may also explain how a mass society can move from one dogma to another with a flick of an eye. It can explain quite a few different cases of stampede.

Rubinstein [21, 20] used to describe game theory as fables. The above case-study supports him. Alas, game theorists often take his description as an insult rather than as a compliment. The difference between the two is that game models are hopefully open to criticism, whereas legends are hardly ever more than merely thought-provoking. The claim that a particular model / game represents a real life situation may be open to criticism since in a model / game the parameters are more defined, specified and transparent. Game theory suggests equivalences with much more specified nuances than one may propose by story-telling. The difference between the matrix of the prisoner’s dilemma and the matrix of the stag hunt, for example, is not something that we have in stories—not even in the specific stories that describe the games at hand.

Let us now propose the following challenge to Nash Theory.

Nash equilibrium is an equilibrium of strategies. A strategy is a plan of action what to do in every possible situation, namely it is a plan of action what to do (in the possible future) given the (possible) past. The game is in a Nash equilibrium iff the strategy of each player is the best response to the strategies of the others. The application of Nash equilibrium is based on a tacit assumption that every player knows the strategies of the others. However, game theory, and particularly Nash theory, dismisses that sometimes a good strategy is one that specifies what to do not only given the past, but also given the expected strategy of the others. It is particularly strange that Nash theory applies to situations in which everyone responds optimally to the strategy of the others, but the strategy cannot specify what to do given the expected strategy of the others. Let us take a well-known game, “the battle of the sexes”, to show the difference between our approach and the literature’s approach:

The battle of sexes

	Boxing	Ballet
Boxing	Best, second best	Worst, worst
Ballet	Worst, worst	Best, second best

If one player has no expectations regarding the strategy of the other, then in this game Nash theory is meaningless as social science. However, if a player has expectations regarding the strategy of the other player, why can the player not decide that they take a strategy of making exactly what the other player is expected to do? Players who wish to promise themselves the second best payoff will opt for this strategy. In the battle of sexes, it is a Nash equilibrium that one player adopts a strategy of imitating, namely their maximin strategy, and the other adopts a strategy of choosing the action that may give them their best, namely their maximax strategy. By this, we attempt to combine between Nash and Wald.

This critique is a development of Howard [30, 31, 28] who proposed that in the one-time prisoner's dilemma each player will take a strategy (he called it a Meta-Strategy) of cooperating given the other player cooperates, this solution was rejected by game theorists. A difference between him and us is that in the one-time 'prisoner's dilemma, a rational player should not consider the strategy of the other or the norm; their decision is independent of them. In other words, in the prisoner's dilemma there is a dominant strategy. Howard actually spoke about another game without declaring about. He spoke about a prisoner's dilemma as if each player can change their choice after they see what the other player did, and the game ends when no player wishes to change their choice. This is an interesting game, and we will call it the *nice prisoner's dilemma*, but it is not the prisoner's dilemma and Howard did not give a clue that he investigated this game. Howard actually changed the rule of the game and presented it as a change in the possible strategies.

Furthermore, can game theory write a strategy of "In Rome behave like the Romans", namely follow the norm?

Let us now take the Dilemma of Abraham. We refer to the book of Genesis (King James Version), Chap. 13:

6: "And the land was not able to bear them, that they might dwell together: for their substance was great, so that they could not dwell together."

7: And there was a strife between the herd men of Abram's cattle and the herd men of Lot's cattle: and the Canaanite and the Perizzite dwelled then in the land.

8: And Abram said unto Lot, Let there be no strife, I pray thee, between me and thee, and between my herd men and thy herd men; for we be brethren.

9: "Is not the whole land before thee? Separate thyself, I pray thee, from me: if thou wilt take the left hand, then I will go to the right; or if thou depart to the right hand, then I will go to the left".

The strategy of Abraham was to insure peace, to take the second best, in a game that is equivalent to the battle of sexes.

This then is the Dilemma of Abraham:

	Left	Right
Left	War, war	Peace and one kind of land, peace and another kind of land
Right	Peace and another kind of land, peace and one kind of land	War, war

In this game Abraham has a strategy that can insure him peace: taking the opposite action from the other player, Lot. If Abraham sees war as the worst result, then this strategy will insure him at least the second best. Anyway, if Abraham wishes to ensure peace, he should take the opposite action of Lot, so Abraham asked Lot to choose first. Abraham actually designed the game to be sequential, namely a one in which the second player chooses their move after they see what the other did.

We wonder whether game theory can write a strategy in which the choices of Abram depend on his expectations regarding the strategy of Lot. Our answer is yes, since in the definition of strategy there is nothing to prevent the strategy from being a function of the expected strategy of the other. In Nash equilibrium, the strategy of each player is the best response to the strategies of the others, so we wonder why the strategy cannot be such that a player's action in every particular situation will be a function of the strategy that they expect the other will take. For example, in the stag hunt game a good strategy will be to imitate the expected strategy of the others when the players know it, in other words "In Rome behave like the Romans", in other words cling to the norm.

Consider the Shakespearean strategy (or meta-strategy): "O, change thy thought, that I may change my mind!" (Sonnet X). Translated to current game theory it seems an efficient strategy in many games. Yet current game theory dismisses it out of hand. When both players adopt a strategy of always defect in the repeated prisoner's dilemma, the game is in a Nash equilibrium: changing strategy unilaterally benefits no player. Nevertheless, the adoption of the above Shakespearean strategy by one player may bring about a change of strategy of the other!

The third major beneficial effect of anchoring game theory in social science is increasing its flexibility and thus its applicability. The standard traditional game theory is that its models are applied to precisely defined situations. Some situations are sufficiently approximate to some of these models, but quite naturally, the vast majority are not. On this Aumann said it all (in his interview with Eric Van Damme):

What one needs for game theory to work, in the sense of making verifiable and falsifiable predictions, is that the situation be structured. ... Sometimes when people interview me for the newspapers in Israel, they ask questions like, can game theory predict whether the Oslo agreement will work or whether Saddam Hussein will stay in power. I always say, those situations are not sufficiently structured for me to give a useful answer. They are too amorphous. ... Now, if you don't have a structured situation, ... usually you can only say something qualitative.... you can have a theory that makes predictions on the basis of this formal structure, and you can check how often that theory works out, and you can design a system based on those parameters.

Aumann rightly observes that traditional game theory is applicable to structured situations, and that in other situations game theory can say little or no more than some qualitative comments. To this we add the recommendation to open game-theoretic discussions to considerations common in other social sciences by the free use of testable hypotheses and by playing the devil's advocates any way we can. The applications of game theory to cases of interaction of all sorts, social, political and legal, especially regarding recommendations to the political and social planners, as well as to individuals in their daily affairs, depends on opening it to empirical tests (when possible) and corrections: all policy recommendations and all predictions are uncertain. Here we may very well follow the general approach of Albert Einstein (This seems that von Neumann and Morgenstern were considerably influenced by Einstein's approach towards geometry). The cold war was very important in the establishment of game theory. Its students have developed tools to apply in the cold war (Aumann et al. [20], Preface). Game theorists then naturally thought about deterrence and incentives. They used the model or analogy of the game chicken in order to analyse the general situation and the policy of brinkmanship. They dismiss two important discussions, both led by Bertrand Russell. First, how can society develop preferences, expectations or beliefs that prevent this dangerous game? Second, how can we create institutions to prevent this dangerous game? Game theorists still do not ask, how can society encourage and even design healthy preferences? In contrary for them, Einstein [2] wrote in his letter to Freud:

I have specially in mind that small but determined group, active in every nation, composed of individuals who, indifferent to social considerations and restraints, regard warfare, the manufacture and sale of arms, simply as an occasion to advance their personal interests and enlarge their personal authority. But recognition of this obvious fact is merely the first step towards an appreciation of the actual state of affairs. Another question follows hard upon it: How is it possible for this small clique to bend the will of the majority, who stand to lose and suffer by a state of war, to the service of their ambitions? (In speaking of the majority, I do not exclude soldiers of every rank who have chosen war as their profession, in the belief that they are serving to defend the highest interests of their race, and that attack is often the best method of defence.) An obvious answer to this question would seem to be that the minority, the ruling class at present, has the schools and press, usually the Church as well, under its thumb. This enables it to organize and sway the emotions of the masses, and make its tool of them.

One may see that the analysis of Einstein is consisted of examining the incentives of the different players, but also the source of their preferences and the asymmetric structure of the situation; he explains why the asymmetric structure of the situation enables one group of players to design particular preferences of the other players against their own self-interest, which may be considered inconsistent preferences by the players.

We should therefore shelve the dream of von Neumann and Morgenstern, the dream of reducing the social sciences to game theory. Game theory is less general than the social sciences, since the social sciences recognize situations in which people have the choice of games to play: we often choose if and when and with whom to

play which game.¹⁸ Take, for example, the case of repeatable prisoner's dilemma: in some situations, a player can decide to stop playing, judging the other player as not cooperative. As the cost of adopting a grim strategy (one that reiterates the prisoner's dilemma) may be higher or lower than stopping playing, there are many options here. Similarly, as Abraham Wald has noted, a player may decide to take a break and play another game, one that concerns purchase of information relevant to the initial game. The literature on game theory is oblivious to all this and more, and so also to the social context in which it takes place. This is sad, since it is notorious that one who has just won has incentive to leave the table, contrary to the other players or to the house. Now consider the following game: married couples may play the-battle-of-sexes in a society with an effective right to divorce or in one without it. Their decisions to play or not to play in either case can be charted. So is the possibility of the decision to play or not to play being reversible or not. If it is, we may possibly speak of a repeated game, but this need not be so: if after each round the couple have the choice to quit, this option should be represented in the matrix that describes their game.

In the standard repeated prisoner's dilemma, game theory does not take into account the important option of apologizing and correcting one's error. The strategy of tit-for-tat precludes this option obviously, yet it does so only tacitly. If two players adopt the strategy of tit-for-tat and one of them makes a mistake, this might lead to a cycle of revenge (such as feuds) with increasing prices. This renders it very important to have the institutions of apology and forgiveness (ritualized peace projects). The application of game theory without taking this in account is thus possibly a serious distortion. (This is more interesting when we take into account the loss of face due to the admission of error, as that factor restricts the application of the option of ritualized peace projects to extreme cases.) Now the strategy of always cooperate in the repeated prisoner's dilemma is an incentive for the other player to choose the strategy of always defect; this is Aumann's justification for his recommendation (in his Nobel Lecture, 2006) to avoid the strategy of always cooperate in cases of international conflicts. This, we say, should alert us to see to it that the elimination of the always cooperate strategy should not lead to the elimination of other friendly strategies (including that of respect for international law) and that it should not block the way to efforts to establish mutual trust and thus cooperation. Deciding to add to always cooperate some incentives to the other player to avoid defection should anyway not lead to the choice of violent penalties but to softer sanctions. One is better off if one's potential enemy has what one can take with no effort in response to future defection. The rubberstamp examples here are curtailing finance support and blocking the other player's bank accounts in one's own territory. This shows that it may be rational for a state to be generous toward its neighbours; it shows that conditional generosity may be the best deterrence and that conditional generosity can be an excellent substitute to arming—a phenomenon that game theorists have analysed in great detail, yet while paying too little attention to substitutes. It still may be rational to punish, and in diverse manners. A player may inadvertently prevent

¹⁸ Arrow suggested privately, (to U. W.) that when players choose a game, this choice occurs in a super-game.

nonviolent resistance (including demonstration and diplomatic struggle) thus unintentionally reduces the opportunity-cost of terrorism, and thus directly encouraging terror.

We recommend that game theory become part-and-parcel of social science, but it should be expanded to all fields of economic science, including economic theory and macroeconomics. Recently, Shiller [11, 12] proposed to study the phenomena of recessions by investigating the narratives that may lead to them. Narratives, true or false, may lead to recessions if and when they design successfully the expectations of people and hence influence their economic behaviour, narratives, for example, may lead to huge decline in demands. In his paper Shiller referred to some works in the theory of literature that investigates the theory of narratives. He says,

We have to consider the possibility that sometimes the dominant reason why a recession is severe is related to the prevalence and vividness of certain stories, not the purely economic feedback or multipliers that economists love to model.

He continues, rather disappointingly,

The field of economics should be expanded to include serious quantitative study of changing popular narratives.

He concludes his paper thus:

Research in economics is already on its way to finding better quantitative methods to understand the impact of narratives on the economy.

We wonder why he insists on quantitative methods. If he is right, then a narrative can explain a recession. And then the theory of Nash equilibrium can serve as a key to understanding of the Phenomenon (Shiller spoke in his paper about expectation, but not via the theory of Nash). It will not be sufficient, since it only helps explain why a special narrative dominance is a possible equilibrium, and why it may lead to recession; but the explanation requires the assumption of the presence of that narrative. Keynes [31] did not use the word narrative or applied to the theories of Narrative, but he explained economic phenomena, such as hard working and saving, by what can be considered a narrative.

5.4 Conclusion

Game theory comprises pure game theory and applied game theory, which are a branch of practical mathematics and a branch of social science respectively. As applied to social science, game theory is part-and-parcel of social science. The first question to ask when applying it is, what game is played? The description of the game is a part of mathematics, but its application to a given situation is not; the conclusions from such exercises concern real life situations and so they are open to criticism. Admittedly, it is not always possible to learn from observations of people playing what game they play: descriptions of situations to which we may wish to

apply game theory are often unclear and incomplete. Deliberations on such matters render game theory most helpful to social science. We thus recommend the use of game theory particularly as means for studying and deciding questions of two kinds. First, what game is being played in a given specific situation? Second, what game is advisable for people in that situation to avoid playing, what game it is advisable for them to try to play, and how to act then? This is a reversal of the theory of information acquisition and efficient mechanism design that is the study of the question, which game is advisable to design in order to achieve specific desirable goals [5]. We see the current theory of efficient mechanism design as too utopian to be profitably applicable to political science or the study of legislation, we argue that a theory is needed that could serve as a part of social science as a tool for efficient design. We follow Karl Popper's anti-utopian attitude and adopt his recommendation to view applied social science as means for social engineering [32]:

The piecemeal engineer will, accordingly, adopt the method of searching for, and fighting against, the greatest and most urgent evils of society, rather than searching for, and fighting for, its greatest ultimate good.

In particular, following Popper, we seek (not the best game but) ways to prevent playing bad games.

References

1. Einstein, A.: Geometry and experience. In: Lecture Before the Prussian Academy of Sciences, January 27, 1921
2. Einstein, A., Freud, S.: Why War? The Correspondence Between Albert Einstein and Sigmund Freud (1933)
3. Aumann, R.J., Dreze, J.: Rational expectations in games. *Am. Econ. Rev.* **98**, 72–86 (2008)
4. Shavell S.: The appeals process and adjudicator incentives. *J. Legal Stud.* **35**(1) 1–29 (2006)
5. Maskin, E.S.: Mechanism design: how to implement social goals. *Am. Econ. Rev.* **98**(3), 567–576 (2008)
6. Aumann, R.J.: Lectures on Game Theory (PDF), p. 1. Westview Press, Boulder, CO. (1989)
7. Pareto, V., Priuli, F.: On the economic phenomenon: a reply to Benedetto Croce. *Giornale degli Economisti e Annali di Economia* **71**(2/3), 11–28 (2012)
8. Popper, K.R.: The Logic of Scientific Discovery. London, Hutchinson ([1935] 1959)
9. Knight, F.H.: Intellectual confusion on morals and economics. *Int. J. Ethics* **45**(2), 200–220 (1935)
10. Weiss, U., Zohar, Y.: Is the game of plea bargaining a game of extortion. In: Law, Society and Culture Series: Justice in the Legal System? Criminal Law and Criminal Procedure in Israel—Problems and Challenges (2018)
11. Shiller, R.J.: Narrative economics. *Am. Econ. Rev.* **107**, 967–1004 (2017)
12. Von Neumann, J., Morgenstern, O.: Theory of Games and Economic Behaviour. Princeton University Press, Princeton, NJ (1944)
13. Aumann, R.J.: Nash Equilibria are not Self-Enforcing. In: Gabszewicz et al. (eds.), 201–206 (1990)
14. Aumann, R.J., Maschler, M., Stearns, R.E.: Repeated Games with Incomplete Information. MIT Press, Cambridge MA (1995)
15. Aumann, R.J.: War and Peace. In: Grandin, K. (ed.), 350–358 (2006)

16. Weiss, U.: Rethinking Appeals. *Touro L. Rev.* 37, 1409 (2021)
17. Damme, E.V.: On the state of the art in game theory: an interview with Robert Aumann. In: Albers, W., et al. (eds.) *Understanding Strategic Interaction, Essays in Honor of Reinhard Selten*, 8–34 (1997)
18. Bunge, M.: *Social Science Under Debate* (1998)
19. Keynes, J.M.: The general theory of employment, money and interest. *Collected Writings* 7 (1936)
20. Boland, L.A.: Uninformative economic models. *Atlantic Econ. J.* 3, 27–32 (1975)
21. Rubinstein, A.: How game theory will solve the problems of the euro bloc and stop Iranian nukes. *Haaretz* (2013)
22. Rubinstein, A.: Comments on economic models, economics, and economists: remarks on economics rules by Dani Rodrik. *J. Econ. Liter.* 55(1), 162–172 (2017)
23. Schelling, T.C.: *The Strategy of Conflict*. Harvard University Press, Cambridge, MA (1960)
24. Ostrom, E.: Beyond markets and states: polycentric governance of complex economic systems. *Am. Econ. Rev.* 100(3), 641–672 (2010)
25. Agassi, J.: Beyond the static theory of tastes as exogenous. *Methodol. Sci.* 25, 99–118 (1992)
26. Wald, A.: Statistical decision functions which minimize the maximum risk. *Ann. Math.* 46, 265–280 (1945) (Second Series)
27. Watkins, J.: Imperfect Rationality. In: Borger, Cioffi (1975)
28. Gale, D., Shapley, L.S.: College admissions and the stability of marriage. *Amer. Math. Monthly* 69, 9–14 (1962)
29. Nash, J.F.: *Non-Cooperative Games. A Dissertation* (1950)
30. Howard, J.V.: Cooperation in the prisoner's dilemma. *Theor. Decis.* 24, 203–213 (1988)
31. Keynes, J.M.: *The Economic Consequences of the Peace*. George Weidenfeld & Nicolson, London (1919)
32. Popper, K.R.: *The Open Society and Its Enemies* (1945)
33. Krishna, V., Perry, M.: *Efficient Mechanism Design*. Unpublished Paper (1998)
34. Rousseau, J.-J.: *The Social Contract* (1763)
35. Howard, N.: *Paradoxes of Rationality*. MIT Press, Cambridge, MA (1971)
36. Rubinstein, A.: *Economic Fables*. Open Book Publishers (2002)

Chapter 6

The Game Theory of the European Union Versus the *Pax Romana*



Game theorists recommend the strategy of the *Pax Romana*: if you want peace, prepare for war. It is conditional aggressiveness. The better alternative is the conditional generosity that the European Union (EU) practices with great success.

These strategies may belong to the game known as the repeated prisoner's dilemma: peace (or mutual cooperation) rests on a threat to punish; to that end, players should maintain their threat. In the repeated prisoner's dilemma, the best response to the strategy of "always cooperate" is to always defect. Yet, these strategies may belong to the game known as the stag hunt. In it, the best response to the strategy of "always cooperate" is cooperating with the other player through each round of the game. The game played by the European Union, we contend, is nearer to the stag hunt game than to the prisoner's dilemma game. Every European Union country recently (rightly, of course) recognizes peace as best—and thus as better than an attack on a defenceless neighbour that would lead to an immediate victory.

6.1 Introduction: The Prisoner's Dilemma Versus the Stag Hunt

Below is a diagram of the prisoner's dilemma game. Consider two people detained for possession of illegal weapons near a bank in which an armed robbery just took place. The police have strong enough evidence to stick both with a lenient penalty, but not enough evidence to stick both with a severe penalty; so, the police encourage each of them to testify against the other. To achieve that, the police isolate them and propose to each of them individual plea-bargains. The options that the game offers are the following: if they both defect, they will both receive a medium penalty; if they cooperate with each other and keep silent, they will both receive a lenient penalty.

There are four possible results:

Prisoner's Dilemma

	Coop	Def
Coop	B, B	D, A
Def	A, D	C, C

Thus, the wish to maximize individual benefit imposes on each player in the prisoner's dilemma the temptation to betray the other, regardless of the other's strategy.¹ The strategy described here is not the only one available; it is dominant in the sense that in all permissible situations, a player will gain more than from any alternative strategy. Therefore, in this game, a player cannot gain anything from learning information about the strategy of the opponent.² Hence, in the prisoner's dilemma game, rationality precludes the socially optimal result: it leads to the most socially dissatisfying result.³ This is intriguing. The unpleasant aspect of the situation of the prisoner's dilemma—the distrust inherent in it—is irreparable, since it prescribes a result that cannot be improved by soliciting trust.⁴

Some similar games allow for improvements of outcomes through gaining the trust of other players. The most common illustration of this is the variant of the prisoner's dilemma game known as the “stag-hunt game.”⁵ Interestingly, many variants of

¹ This idea of strategy is as old as game theory. According to the definition of von Neumann and Morgenstern (1944), a strategy is a player's plan that prescribes choices for every possible situation given every possible set of relevant information. Thus, a strategy is a comprehensive policy, a plan for action in every possible situation that the rules of the game permit. Obviously, then, the project of von Neumann and Morgenstern is utopian. As Kenneth Arrow has noted, such a strategy is impossible even for chess, that poses problem-situations much simpler than most real-life ones. The limitation of Von Neumann and Morgenstern study to games with fully determined result limits severely the intellectual challenge of their theory. Surprisingly, the theory is nevertheless somewhat challenging. The standard examples for this are the strategies in the repeated prisoner's dilemma of always defect and the tit-for-tat. John von Neumann & Oskar Morgenstern, *Theory of Games and Economic Behaviour* 49 (1944).

² This is equivalent to what in the early stages of game theory was called “the sure thing strategy” and that Savage called “the sure-thing principle.” Leonard J. Savage, *The Foundation of Statistics* 21 (2d ed. 1972).

³ See, e.g., Robert J. Aumann, *Game Engineering*, in *Mathematical Programming and Game Theory for Decision Making* (S. K. Neogy et al. eds., 2008). See Steven Kuhn, *Prisoner's Dilemma*, *Stan. Encyclopedia Phil.* (2019), available at <https://plato.stanford.edu/archives/win2019/entries/prisoner-dilemma/>.

⁴ This may explain the futility in some situations of the goodwill of peace activists who do not try to act politically in order to change the rules of the game.

⁵ This game was proposed by Rousseau in a less precise language than is common in game theory:

In this manner, men may have insensibly acquired some gross ideas of mutual undertakings, and of the advantages of fulfilling them: that is, just so far as their present and apparent interest was concerned: for they were perfect strangers to foresight, and were so far from troubling themselves about the distant future, that they hardly thought of the morrow. If a deer was to be taken, every one saw that, in order to succeed, he must abide faithfully by his post: but if a hare happened to come

this game exist; a little change in the game may lead to very different results.⁶ In it, cooperation produces the optimal payoff for all players; the unilateral betrayal of one gives the defector the second-best payoff, and to the other player, the worst payoff. Mutual betrayal gives both individuals the third-best payoff. For this stag hunt game, again, there are four possible outcomes. The stag-hunt game is best illustrated by two hunters who choose simultaneously whether to hunt a stag or rabbits.⁷ If both hunters go for a stag, they succeed and each gains a part of the stag, which is the best result. On the other hand, a player who goes for a stag alone meets with an absolute failure, which is the worst result. A player who goes for the rabbits alone wins all the rabbits, which is the second-best result. Going for the rabbits together gives every player some rabbits, which is the third-best result. It is then best for both hunters if each go for the stag. When the first hunter goes for rabbits, it is better that the second hunter does not go for the rabbits, but instead goes for the stag (and loses), thus enabling the first hunter to hunt unimpeded. Consider the four levels of success, from 1 to 4:

	Coop	Def
Coop	A, A	D, B
Def	B, D	C, C

Obviously, the absence of trust prevents achievement of the optimal solution. However, if the players trust each other enough, they will each achieve the optimal result. The important difference between the prisoner’s dilemma and the stag-hunt

within the reach of any one of them, it is not to be doubted that he pursued it without scruple, and, having seized his prey, cared very little, if by so doing he caused his companions to miss theirs.

See Jean-Jacques Rousseau, *Discourse on Inequality*, in *The Social Contract and Discourses* 209–10 (G. D. H. Cole, trans., 1923).

By using the table Game theory clarifies what the priority of each player is, and what is exactly the set of options of each player has. However, one may see that Rousseau has advantage by discussing the context: it is a game, in which the players do not think about their reputations, they play as if they are strangers who do not think about tomorrow. This led Rousseau to propose the following recommendation:

It is easy to understand that such intercourse would not require a language much more refined than that of rooks or monkeys, who associate together for much the same purpose. Inarticulate cries, plenty of gestures and some imitative sounds, must have been for a long time the universal language; and by the addition, in every country, of some conventional articulate sounds (of which, as I have already intimated, the first institution is not too easy to explain) particular languages were produced; but these were rude and imperfect, and nearly such as are now to be found among some savage nations.

See id. at 210.
We propose to combine between the socially scientific approach of Rousseau and the preciseness of the table developed by game theoreticians.

⁶ Economists have noted this interesting result first. See Lipsey and Lancaster [1].

⁷ See [2, 3].

does not lie in the stories, but rather in the matrices.⁸ This is because it is possible to translate the depiction of the stag-hunt game to the terms of the prisoner's dilemma, without changing the stag-hunt conceptually. For example, if the two suspects from the prisoner's dilemma keep silent, they will both walk. If they both sing, they will both receive the usual penalty. But if only one sings, then only that one will receive a lenient penalty, and the other will receive a heavy penalty.⁹

The most important difference between the prisoner's dilemma and the stag-hunt is this: in the prisoner's dilemma, defection is the dominant strategy—each rational player will defect in any case—whereas in the stag-hunt game, the defection (or its avoidance) depends on the assessment of the players' interdependent strategies. Whereas the prisoner's dilemma game offers no hope for cooperation, the stag hunt game offers the option of raising the incentive for cooperation through trust: if a player believes that the other will cooperate, the player will cooperate. Moreover, if player X believes that the player Y believes that X will cooperate, then the X will believe that Y plans to cooperate, and hence the X will also cooperate. Hence, it is more important to avoid situations that impose the prisoner's dilemma than those that impose the stag-hunt game.¹⁰ This is a useful lesson for the social sciences: some, but not all, cases of conflict allow for improvements all around, even while leaving the conflict as it is.

The difference between the variants of a game may be significant, since small changes in the rules of the game can make all the difference. Because of this, the decision about which variant describes a given political situation determines attitudes towards it, namely, the decision of the political player which game they play will determine how they will play the game: if they decide that they play a one-time prisoner's dilemma, they will defect for sure. Thus, bellicose game theoreticians set the game one way, we contend, and the irenic ones set it the other way.¹¹ This is Mario Bunge's¹² criticism of game theory: it encourages arbitrariness in scientific guise; one game theoretician may describe the international interaction as one type of

⁸ This may even be realistic, since in both options are available to the police, and they write the rules, namely, they choose what game that the prisoners will have to play, so it is reasonable that the police will impose on them the prisoner's dilemma game rather than the stag hunt game.

⁹ See Skyrms, *supra* note 9, at 32. They claimed:

The Stag Hunt does not have the same melodramatic quality as the Prisoner's Dilemma. It raises its own set of issues, which are at least as worthy of serious consideration. Let us focus, for the moment, on a two-person Stag Hunt for comparison to the familiar two-person Prisoner's Dilemma... Suppose that hunting hare has an expected payoff of 3, no matter what the other does. Hunting stag with another has an expected payoff of 4. Hunting Stag alone is doomed to failure and has a payoff of zero. It is clear that a pessimist, who always expects the worst, would hunt hare. But it is also true with these payoffs that a cautious player, who was so uncertain that he thought the other player was as likely to do one thing as another, would also hunt hare. That is not to say that rational players could not coordinate on the stag hunt equilibrium that gives them both better payoff, but it is to say that they need a measure of trust to do so.

Id.

¹⁰ Agassi and Meidan [4].

¹¹ See [5]. We took his thesis one small step further.

¹² Id.

game, and another game theoretician will describe the same international interaction as another type of game. Descriptions of real-life situations as games will be less arbitrary if they include options—whenever such options are possible—for players to choose what game to play, with whom, and with what payoffs. This decision as to what game to play, this “super-game,” describes some situations better than the games prescribed in standard game-theoretical texts. It is but our emphatic recognition that at times some players can choose what game to play—this is what standard game theory ignores and our Article wishes to correct. The paradigm case should then raise the question: should we start playing a “war game”?¹³

6.1.1 *The Repeated Version*

A game is in a Nash equilibrium if no player has incentive to change strategies unilaterally. Each player's strategy is then the best response for the strategy of the other.¹⁴ Nash¹⁵ limited his theory to games without communication between players and only with unilateral changes in the players' strategies. Thus, when players in the (indefinitely repeated) prisoner's dilemma adopt the strategy to always defect, neither has incentive to change strategy unilaterally. A friendly bilateral change, such as tit-for-tat, would benefit every player,¹⁶ so that by breaking the rule of unilateral change, they may come to an agreement to alter their strategies simultaneously. One

¹³ Russel claimed:

Since the nuclear stalemate became apparent, the Governments of East and West have adopted the policy which Mr. Dulles calls “brinkmanship”. This is a policy adapted from a sport which, I am told, is practiced by some youthful degenerates. This sport is called “Chicken!” It is played by choosing a long straight road with a white line down the middle and starting two very fast cars towards each other from opposite ends. Each car is expected to keep the wheels of one side on the white line. As they approach each other, mutual destruction becomes more and more imminent. If one of them swerves from the white line before the other, the other, as he passes, shouts “Chicken!”, and the one who has swerved becomes an object of contempt. As played by irresponsible boys, this game is considered decadent and immoral, though only the lives of the players are risked. But when the game is played by eminent statesmen, who risk not only their own lives but those of many hundreds of millions of human beings, it is thought on both sides that the statesmen on one side are displaying a high degree of wisdom and courage, and only the statesmen on the other side are reprehensible. This, of course, is absurd. Both are to blame for playing such an incredibly dangerous game. The game may be played without misfortune a few times, but sooner or later it will come to be felt that loss of face is more dreadful than nuclear annihilation. The moment will come when neither side can face the derisive cry of “Chicken!” from the other side. When that moment is come, the statesmen of both sides will plunge the world into destruction.

Russell [6]. The most important proposal of Russel was that we should prevent this risky chicken game. (What Russel claimed regarding one particular war game, should be claimed regarding other war games as well). The conclusion from his proposal for game theoreticians should be to seek for ways to prevent risky games, and this is the main correction that we propose to game theory, this is the right way to make game theory.

¹⁴ Nash and Games [7].

¹⁵ Id.

¹⁶ See Kuhn, *supra* note 5.

player's hope that his change of strategy will make the other follow suit should suffice as incentive to change strategies.

Consider the prisoner's dilemma repeated indefinitely with a fixed norm¹⁷ for cooperation and a fixed norm for defection. What conditions secure a Nash equilibrium in this game? Many Nash equilibria to this game are available.¹⁸ The two standard pairs of strategies that achieve the equilibria are mutual always-defect and mutual tit-for-tat.¹⁹ In this game, the mutual always-cooperate strategy is not in a Nash equilibrium²⁰ because the choice of this strategy comprises incentive for opponents to always defect.²¹ Therefore, the mutual always-cooperate does not work in a game with fixed norms.²² Let us emphasize: whereas mutual tit-for-tat strategies yield permanent mutual cooperation and are in a Nash equilibrium in this game, mutual always cooperate do not. When players choose this strategy, the best response of their opponents is to always defect! To encourage cooperation in this game, it is not sufficient that both players prefer mutual cooperation.²³ This is because it also depends on the following condition: each player should be ready to respond to defection with a sufficient degree of defection. If each player adopts, say, tit-for-tat, then each player issues a threat to the other without ever realizing it. This surprising insight has led prominent game theorists to a strange conclusion: the decision to punish

¹⁷ Aumann and Dreze proposed: "Nash equilibrium is of central importance in studying norms of strategic behaviour[.]" See [8].

¹⁸ See Ely and Välimäki [9].

¹⁹ The latter strategy invites the player to begin with cooperation, and to repeat in any other round of the game what the other did in the previous round.

²⁰ Game theory ignores the possibility that adopting the strategy of "always cooperate" may change the preferences of the other player and by this change the game. This possibility is at the heart of the famous novel *Les Misérables* by Victor Hugo (1862).

²¹ The best result for a player in the repeated prisoner's dilemma will be that the player will always defect, and that the other will always cooperate. If the other adopts a strategy (namely, a complete plan of actions) of "always cooperate" regardless to what the player will do, then the best response for this will be to play always cooperate. The strategy of "always cooperate" does not provide any incentive to respond by minimal cooperation in the repeated prisoner's dilemma.

²² Mutual always cooperate strategy is no Nash equilibrium since in this case every player has incentive to defect: the literature deems always defect the best response to always cooperate. We disagree; it is the best response only if players who adopt the always cooperate strategy do not change their strategy when their opponents defect. The literature dismisses this criticism on the strength of the observation that the last condition is fulfilled by definition: if the response to defection is any strategy other than always cooperate, then it is not the always cooperate strategy. Our response to this is as follows. This observation hides a tacit assumption: the choice of a strategy that each player makes is not open to replacement, since by definition every future replacement of the chosen strategy is a part of it. This tacit assumption contradicts the theory of Nash. He spoke of unilateral change of strategy. A change of strategy of a rational player depends not only on the opponent's implementation of a plan, but also on the opponent's change of plan. In real-life, every plan is open to change, especially as learning from experience. A rational player asks, does the way my opponent plays reflect a plan that is open for changes. This is an open problem in (the allegedly fully determined) game theory. It may be on the agenda of research in game theory.

²³ See [10].

opponents heavily enough, regardless of the price of this decision, renders this very implementation (namely, the punishing) unnecessary.²⁴

6.2 Against the Vision of the *Pax Romana*

The *Pax Romana* relied on well-advertised cruel punishment for rebellion. What Robert Aumann²⁵ said in his Nobel lecture regarding the Cold War is also valid mutatis mutandis to the *Pax Romana*, “[w]hat is maintaining the equilibrium in these games is the threat of punishment. If you like, call it ‘MAD’—mutually assured destruction, the motto of the cold war.”²⁶ Aumann’s lecture “War and Peace in the Middle East” praised the vision of *Pax Romana*: *Si vis pacem, para bellum*—if you want peace, prepare for war. We disagree. Assuming the default option that a political situation is a repeated prisoner’s dilemma (or any other games) is often a grave error. Rather than offering the best recommendations for players in a given game, in our opinion, it is obviously better to advise them against games such as prisoner’s dilemma (when it is possible) and to deliberate on the advisability of playing the game once the initial decision is made.

One way of changing the game is by changing preferences²⁷: the choice of humanist and peaceful values may prevent many risky games.²⁸ For example, the choice of liberal values may prevent a prisoner’s dilemma game between police and demonstrators. It is well known that when liberalism prevents punishment, vigilantes find it intolerable.²⁹ Yet, they are in error by their own light; their conduct does not reduce crime. The same holds for the hostility to some types of demonstrations, yet suppressing them notoriously incites violence. This leads to absurd justifications for killing demonstrators.³⁰ Some game theorists would consider some games, such as

²⁴ Schelling [11].

²⁵ Aumann [12].

²⁶ Id. at 17077.

²⁷ What distinguishes one game from another game is the matrix of payoff. The payoffs are a function of the feeling of the players. Thus, when the feelings are changed, the player may play an absolutely different game.

²⁸ Russel emphasized that in order to prevent wars society should develop friendly feeling and prevent hostile ones. Game theory can teach why he was right, and Russel can teach why the influencing on preferences should be a part of the (super) game. See Russell [13].

²⁹ Machiavelli claimed: “[I]f the populace be made the guardians of liberty, it is reasonable to suppose that they will take more care of it...” See Father Leslie J. Walker, *The Discourses of Niccolò Machiavelli* 220 (1992).

³⁰ This was the claim of the Israeli general attorney before the Israeli high court discussing the legality of shooting “central rioters”:

The starting point of the Respondents’ position is that these riots are taking place as part of the **armed conflict** existing between the Hamas terrorist organization and Israel—and therefore the legal framework that regulates the opening of fire is the **law of Armed Conflict**. In this context, they distinguished between fire that is opened and is regulated by the conduct of hostilities paradigm (for example, when the fire is opened as part of actual combat between Hamas and Israel), and fire

repeated prisoner's dilemma or the zero-sum game, sufficient justifications for real actions. We instead recommend questioning the wisdom of the choice to play any game, namely, the players should choose which games to play, and more importantly, which games not to play. It is obligatory to ask whether the very decision to play a given game is legitimate. If it is, then this should raise the question, is it wise to play?

Admittedly, a game in which unconditional cooperation comprises incentive for the opponent to defect is problematic. For, obviously most leading writers tacitly writerly admit, it renders the strategy of unconditional cooperation inadvisable. Conditional generosity, we claim, may very well be superior to it. In real life, where error is inevitable, *Pax Romana* is very risky. A mistake in reading the opponent's action may lead to war. Armament may lead to war in many other international games, such as the stag-hunt, as it offer incentives for increased aggressive conduct. The Romans did not consider this option, as they preferred always staying as ready for war as possible.³¹ The case of the prolonged tension between Israel and Palestine is similar: no side offers any proposal for peace negotiation, Israel prefers the acquisition of territories to peace. Had Israel respected the right of Palestinians to protest occupation, an agreement to end the present tensions may be significantly more likely.

6.3 In Favor of the Vision of the European Union

Since the very consideration of waging war is expensive,³² it is wiser to change the situation to enable players to rely on trust whenever possible. This amounts to the transition from the prisoner's dilemma-type game to the stag-hunt-type game. This happened in Europe after World War II.³³ Peace is now recognized as best for every

that is opened and regulated by the law enforcement paradigm. The events which are the subject of the petitions combine both... The Respondents further emphasized during the hearing that the Rules of Engagement permit firing towards the legs of a central rioter or of a central inciter, but are only carried out in the framework of the armed conflict that exists between Israel and the residents of the Gaza Strip, and only as a last resort, subject to strict requirements that derive from the principles of necessity and proportionality, and after all other means have been exhausted and failed.

See Judgment at 7–8, HCJ 3003/18 Yesh Din v. IDF Chief of General Staff (2019) (Isr.).

³¹ Publius Flavius Vegetius Renatus claimed: “He who wants victory, let him train soldiers diligently. He who wishes a successful outcome, let him fight with strategy, not at random. **No one dares challenge or harm one who he realizes** will win if he fights.” Publius Flavius Vegetius Renatus, *Vegetius: Epitome of Military Silence* (N.P Milner trans., Liverpool University Press 2d ed. 2001).

³² See [14], Russell, *supra* note 30, at 79–116.

³³ This is how the European Union leaders celebrated their 2012 Nobel Prize in their Nobel lecture: Of course, peace might have come to Europe without the Union. Maybe. We will never know. But it would never have been of the same quality. A lasting peace, not a frosty cease-fire. And to me, what makes it so special, is reconciliation...

To think of what France and Germany had gone through... and then take this step... Signing a Treaty of Friendship... Each time I hear these words—Freundschaft, Amitié—I am moved. They

member-state of the European Union, even if an attack on a neighbour would lead to an immediate surrender. In other words, the EU countries do not play a game in which peace is based on the threat to respond by aggressiveness to aggressiveness, and they do not play a game in which the best result for a EU country is that they invade another EU country and the other EU country will cooperate with them. This situation is obviously the best goal for all international relations, as it achieves the most stability. In this situation, peace will be reasonably stable, especially in positions of strength. This is quite intriguing because in other games, this optimistic assessment of the results of war is what usually leads to wars: if both states believe that they will win the war for sure without significant losses, it will be very hard for them to come to peace, unless they prefer peace to war even when they are sure that they will win the war without significant losses.³⁴ Game theory, to repeat, does not account for the stability of the type of game that would result in a Nash equilibrium

are private words, not for treaties between nations. But the will not to let history repeat itself, to do something radically new, was so strong that new words had to be found.

...

But symbolic gestures alone cannot cement peace.

This is where the European Union's "secret weapon" comes into play: an unrivalled way of binding our interests so tightly that war becomes materially impossible. Through constant negotiations, on ever more topics, between ever more countries. And it's the golden rule of Jean Monnet: "Mieux vaut se disputer autour d'une table que sur un champ de bataille." ("Better fight around a table than on a battle-field.").

If I had to explain it to Alfred Nobel, I would say: not just a peace congress, a perpetual peace congress!

...

The Union has perfected the art of compromise. No drama... No drama of victory or defeat, but ensuring all countries emerge victorious from talks. And for this, boring politics is only a small price to pay...

See Herman Van Rompuy & José Manuel Durão Barroso, Nobel Lecture: From War to Peace: A European Tale (Dec. 10, 2012).

³⁴ Blainey claimed: "War is usually the outcome of a diplomatic crisis which cannot be solved because both sides have conflicting estimates of their bargaining power." See Blainey (1988); see also Slantchev and Tarar [15]. The authors claimed: "The mutual optimism explanation is perhaps one of the most venerated explanations for how war can occur." Id. We add: the choice of the game may prevent wars: extreme optimism will lead to war when the parties play the game in which they wish to maximize their territories regardless to international law, but will not lead to a war in a game such as the EU game, in which the countries do not prefer easy victory in war to peace.

of peace.³⁵ The option of a peaceful stability was ignored when game theory was invented during the Cold War.³⁶

Nevertheless, one of the most important questions in political studies remains: how it is possible to prevent wars and arms races? Wars and arm races may result from conditions for a game of prisoner's dilemma. Therefore, it may be wise to seek ways and means to prevent situations that invite playing this game, especially in international relations. Considered mathematically, it is always advantageous to add a neutral element to any set of objects³⁷; in the case of game theory, we claim, the neutral element is the choice not to play.

The prevention of prisoner's dilemma situations is possible. One example of this is legislating incentive for cooperation, including compliance with contracts. To do this in international relations is to grant international courts the means to enforce their decisions.³⁸ International institutions may generate repeated disincentives for aggression and generate collective security mechanisms, including prizes for international cooperation and memberships in prestigious elite clubs like the European Union. The European Union deters aggression against any of its members by establishing a commitment to protect every member from aggression.³⁹ This is a generalization

³⁵ Kohlberg and Mertens claimed:

The concept of equilibrium, as defined by Nash and Games [7], is central in the theory of noncooperative games. It reduces the set of all possible strategic choices by the players to a much smaller set of those choices that are stable in the sense that no player can increase his payoff by unilaterally changing his strategy. One might be tempted to conclude that Nash equilibria must actually be "strategically stable" (self-enforcing)... Since not all Nash equilibria are strategically stable, the natural question that arises is: which ones are?

See Kohlberg and Mertens [16]. We are interested in a more primitive meaning of stability: how much will the equilibrium be stable when the balance of powers, or the values, or the leaders are changed? In other words, we are interested in how much the (peaceful equilibrium) will be stable when the game is changed. Thus, we are particularly interested in degrees of stability.

³⁶ See John von Neumann: Life, Work, and Legacy, Inst. for Advanced Study, <https://www.ias.edu/von-neumann> (last visited June 11, 2021).

³⁷ Peter M. Neumann, Galois and his Groups, Newsletter (Eur. Mathematical Soc'y, Zurich, Switzerland) Dec. 2011, at 31–32, 34, 36.

³⁸ Two urgent problems involve international courts. One concerns partial enforcement: the court may not be able to bring war criminals to justice yet be able to prevent some states from granting asylum to war criminals. The Arab Spring, and particularly the war in Syria, challenges the institution of the International Criminal Court this way: some western states prevented the compromise that gives immunity for the Syrian dictator Assad, without having the power to bring him to justice or to deprive him from power. Second, establishing international courts with enforcement mechanisms may amount to the imposition of a universal distrust between nations. This is self-defeating, as is the intent to build an international institution that generates repeated disincentives for aggression. And distrust may happen every time a new law has loopholes that invite its violations with impunity. This is why we should be wary of new legislation, which is one of the theses of Friedrich von Hayek's *The Constitution of Liberty*. Friedrich A. von Hayek, *The Constitution of Liberty: The Definitive Edition* 279 (Ronald Hamowy ed., 2011).

³⁹ According to Article 42.7 of the Lisbon Treaty:

If a Member State is the victim of armed aggression on its territory, the other Member States shall have towards it an obligation of aid and assistance by all the means in their power, in accordance

of the traditional policy of seeking a balance of powers,⁴⁰ since the threat to expel an aggressor from an elite club, we claim, is a better means for preventing aggression, especially internationally. The opportunity for preventing international hostility encourages states to change the prisoner's dilemma game into the stag-hunt game.

This discussion is obviously incomplete: it is limited to the prevention of war with a neighbour but does not address the need to prevent war between neighbours. This is the need to devise disincentives for aggression, such as the aggression of Italy against Ethiopia before World War II, and of Iraq against Kuwait in August 1990. Besides this disincentive, no means is available other than changing national preference—the preferences for peace-loving political leaders and political parties.⁴¹ This seems to be the most impressive achievement of the European Union. Today, there is equilibrium within the European Union where the preference is for peace over war.⁴²

Another important question that this situation raises is: why is the preference for peace not prevalent everywhere? Once we know the answer to this, only then can we move to the next question: how can peaceful countries transfer their preference for peace to others? Moreover, one may ask, which of the two preferences is stronger, for peace or for victory. The question is then the dislike of being considered “non-loyal,” “chicken,” “submissive,” “suckers,” etc., or hating to be considered barbaric? When the situation is fluid, education promoting peace is most effective; otherwise, it is just similar to a Nash equilibrium (but not quite, as it depends sensitively on other, more delicate factors). A superficial impression suggests that education increases pride in loving peace.⁴³ If this impression is true, then peace-lovers should help raise the educational level in their societies. This amounts to the less obvious recommendation for economically advantaged countries to be generous and invest in the education of economically disadvantaged countries in order to preclude playing the prisoner's dilemma. Incentives for this recommendation are economic—peace is considerably

with Article 51 of the United Nations Charter. This shall not prejudice the specific character of the security and defence policy of certain Member States.

Treaty on European Union art. 42(7), Feb. 7, 1992, 2012 O.J. (C 326) 39.

⁴⁰ Kirchhof [17]. See generally Henry Kissinger, *Diplomacy* (1994).

⁴¹ Nicki Peter Petrikowski, Angela Merkel, Britannica, <https://www.britannica.com/biography/Angela-Merkel> (last visited May 25, 2021).

⁴² Students new to prisoner's dilemma often object: people do not like betraying friends. The usual answer to this is that the standard description of a game takes account of the feelings of players as a part of their systems of preferences. This reply is true, but facile. Indeed, mechanisms like love survived evolution not only because they help to achieve more in a particular game, but also because they prevent some harmful games. Couples in love will be much less prone to play the prisoner's dilemma game than couples not in love. This does not impinge on the game, but it does impinge on the choice of the game. More generally, only members of an open society can choose with whom to play the game of marriage. Love reduces the frequency of situations of prisoner's dilemma games. Evolutionary scholars such as Dawkins, seek mechanisms that enable mutual cooperation in the repeated prisoner's dilemma game. See generally Richard Dawkins, *The Selfish Gene* (1976). However, seeking mechanisms that prevent occasions for this game is more efficient by far.

⁴³ Madhavi Majmudar, Human values, educating the Whole Child for peace and being a citizen in Multi-ethnic Britain, Sathya Sai Educ. in Hum. Values (EHV), (May 22, 2002).

cheaper than war⁴⁴—and in line with the preference for proper conduct or at least for appearance of proper conduct. Similar to a low national crime rate, we claim, international peace is a Nash equilibrium that is often desired without being easy to achieve. Let us emphasize the parallel between national and international peaceful, law-abiding conduct.⁴⁵

Game theory, obviously, cannot replace social science. In our opinion, it is possible and we recommend that it should, help decide which policy to avoid in a particular game, and which policy to endorse. One may use game theory in order to recommend which policy to adopt in a particular game. However, in order to choose the right policy, we should know who plays which game under what conditions. Such decisions are outside the province of game theory. Indeed the canonical text on game theory of Von Neumann and Morgenstern opens with a given game.⁴⁶

Consider then the peace agreement between Israel and Egypt.⁴⁷ One part of it was the agreement of the United States to transfer a large sum of funds to Egypt.⁴⁸ The agreement still is a big success,⁴⁹ although analysis of its effects depends⁵⁰ on the future achievement of peace in the region. Until then, the choice to enforce peace by the threat to cut funds may still be a case of the repeated prisoner's dilemma. Obviously, the obligation to enforce international treaties is inferior to other mechanisms, such as threats to cease international aid from economically advantaged countries, since war is very costly, threats to respond with war may be dismissed.

By comparison, at least, the threat to stop generous support is much more credible, since it is cheaper. Furthermore, since social norms may block the prisoner's dilemma game, we recommend the establishment of social international norms which prevent situations that may invite playing the prisoner's dilemma in international relations. Sometimes global public opinion may suffice for discouraging play of the prisoner's

⁴⁴ See Edelstein, *supra* note 34, at 421.

⁴⁵ See Amrei Müller, Relationship between National and International Law, Public International Law, University of Oslo 14 (Oct. 14, 2013).

⁴⁶ Von Neumann & Morgenstern, *supra* note 3, at 48.

⁴⁷ See generally Treaty of Peace, Egypt-Isr., Mar. 26, 1979, 1136 U.N.T.S. 115.

⁴⁸ According to Clarke:

The unabashed political purposes of aid to Egypt were and remain: to reward Cairo for making and maintaining peace with Israel; to build mass support within Egypt for the peace treaty with Israel by using ESF, development assistance, and food aid to create a link between peace and a more open, prosperous society; and to secure a strategic relationship between Egypt and the United States.

See Clarke [18].

⁴⁹ Egypt affirms commitment to Israel peace treaty, Jerusalem Post (Aug. 24, 2012, 9:17 AM), <https://www.jpost.com/Middle-East/Egypt-affirms-commitment-to-Israel-peace-treaty>.

⁵⁰ How to Deal with Threats: 4 Negotiation Tips for Managing Conflict at the Bargaining Table, Harv. L. Sch. (Apr. 19, 2021), <https://www.pon.harvard.edu/daily/conflict-resolution/how-to-deal-with-threats/>.

dilemma game.⁵¹ Leading game theoreticians often make realist⁵² and aggressive recommendations in questions of war and peace.⁵³ They tend to belittle international agreements. Instead they recommend frightening the opponent by making credible military threats.⁵⁴ They explicitly or implicitly adopt the cruel vision of *Pax Romana*.⁵⁵ We examine options for applying game theory and come up with dramatically different recommendations: (1) we recommend the building of international institutions that aim at the prevention of war; (2) we argue that international agreements may, and at times do, prevent wars even when they are not enforceable; (3) we recommend conditional generosity as a way to prevent wars and convince potential enemies that there is no intent to attack. The adoption of such recommendations may turn hostility into friendship. Game theory is not necessary to accomplish this. The Talmud says, “Who is the hero of heroes?... One who can turn an enemy into his friend.”⁵⁶ What we find amazing is that game theoreticians who write books

⁵¹ Woodrow Wilson claimed: “And in order to safeguard the popular power so far as we could of this representative body, it is provided, you will notice, that when a subject is submitted, not to arbitration, but to discussion by the Executive Council, it can upon the initiative of either one of the parties to the dispute be drawn out of the Executive Council on the larger form of the general Body of Delegates, because throughout this instrument we are depending primarily and chiefly upon one great force, and this is the moral force of the public opinion of the world—the cleansing and clarifying and compelling influences of publicity—so that intrigues can no longer have their coverts, so that designs that are sinister can at any time be drawn into the open, so that those things that are destroyed by the light may be properly destroyed by the overwhelming light of the universal expression of condemnation of the world.” Woodrow Wilson, Address to Peace Conference: Article XXVI (Feb. 14, 1919).

⁵² John Watkins claimed that game theory endorses Hobbes’ assertion that “covenants, without the sword, are but words, and of no strength to secure a man at all.” See John Watkins, *Imperfect Rationality*, in *Explanation in the Behavioral Sciences* 207 (Robert Borger & Frank Cioffi eds., 1970). We argue that game theory should lead to the contrary conclusion, namely, to the conclusion that covenants may prevent war even without sword waving, that game theory refutes the Realpolitik approach. [19].

⁵³ See [20], see generally Aumann, *supra* note 27, at 5.

⁵⁴ Schelling, *supra* note 55, at 36; Aumann, *supra* note 27, at 17, 076–77.

⁵⁵ Robert Aumann said:

If Israel wants to live in peace with its neighbours, it’s actually doing everything wrong from the point of view of game theory! A very large component of game theory is about giving people incentives to do what you want them to do. So how does this work with peace? Well, study the “world champions of peace,” Switzerland. The Swiss have been at peace for close to 450 years. A year ago I was vacationing in Switzerland with my grandson and saw military jet planes overhead. My grandson asked me: “Why do the Swiss need fighter planes if they’ve been at peace for so long?” I responded that that’s exactly why! They have peace because they are strong. The runners-up to the Swiss are the Romans, who had a *Pax Romana* which lasted for about 230 years and who had a maxim: “If you want peace, prepare for war.” Yet while Israel does prepare for war, it’s not getting peace. That’s because while we may be preparing for war in hardware—investing in the tools of war such as tanks, missiles, ground forces and drones, we are failing to prepare for war in software—deep down in our hearts. To fully follow the Roman axiom, a country has to feel deep down that it is ready to fight. But our heart isn’t fully in it.

Yisrael Aumann, *Israel70* | Yisrael Aumann on gaming Israel’s future, *Fathom* (Mar. 2018), <https://fathomjournal.org/israel70-yisrael-aumann-on-gaming-israels-future/>.

⁵⁶ Babylonian Talmud, Avot d’Rabbi Natan 231.

about peace and war do not even raise the question of how it is possible to reduce hostility by changing game preferences.⁵⁷ We explain this as theoreticians' adoption of the *Pax Romana* as their real-life model. Our real example is the European Union. Hence, our present recommendation is much more realistic than the recommendation of Aumann. We argue that there is no contradiction between goodwill and being strategically adept.⁵⁸

One of our main recommendations then is to adopt conditional generosity instead of conditional aggression. As emphasized by Aumann, mutual always-cooperate is not a Nash equilibrium in the repeated prisoner's dilemma and a player should not play always-cooperate in the repeated prisoner's dilemma game.⁵⁹ These insights, however, are not the end of the discussion but the opening of a new one. Even if the member-states repeatedly play prisoner's dilemma in real-life situations, it does not mean that a state should be aggressive. Thus, a state can adopt conditional generosity instead of threats. This has many advantages: first, threats to withdraw generosity are more credible than threats to declare war, since it is obviously substantially cheaper to realize such threats than to realize threats of aggressiveness. Second, adopting conditional generosity may lead the opponent to develop peaceful preferences, while conditional aggressiveness may encourage aggressive preferences. Hence, conditional generosity can be an excellent substitute to war.

Our recommendation for conditional generosity follows John Maynard Keynes' proposal in *The Economic Consequences of the Peace*.

If the General Election of December, 1918, had been fought on lines of prudent generosity instead of imbecile greed, how much better the financial prospect of Europe might now be... I believe this to be an act of generosity for which Europe can fairly ask, provided Europe is making an honourable attempt in other directions, not to continue war, economic or otherwise, but to achieve the economic reconstitution of the whole Continent.⁶⁰

Later on, Keynes wrote,

Great Britain lives by commerce, and most Englishmen now need but little persuading that she will gain more in honor, prestige, and wealth by employing a prudent generosity to preserve the equilibrium of commerce and the well-being of Europe, than by attempting to exact a hateful and crushing tribute, whether from her victorious Allies or her defeated enemy.⁶¹

History proves him right.⁶² In game theory discourse about war and peace, his proposal does not receive the attention it deserves.

Furthermore, those days we can see how the EU uses the mechanism of conditional generosity in order to promote Democracy. The EU has suspended support to Hungary and Poland in order to encourage them to respect the principles of the rule of law.

⁵⁷ Schelling, *supra* note 55, at 4–5.

⁵⁸ Although making credible threats is difficult for most people, showing goodwill is not.

⁵⁹ Aumann, *supra* note 27, at 17076.

⁶⁰ Keynes [21].

⁶¹ Keynes [22].

⁶² Actually, Marshall Plan is a (too) late adoption of Keynes' program.

This mechanism is much more effective, friendly and credible than any aggressive mechanism to promote democracy. Since democracy promotes peace, this is another example of promoting peace by conditional generosity. It is still too early to know what the results will be, and the results will help us to examine the thesis of this book. So far, so good.

6.4 Conditional Generosity Versus Conditional Aggressiveness

Compare conditional aggressiveness with conditional generosity. When conditional generosity is possible and responsible, its adoption is more efficient means for promoting peace and security than threats, since threats invite preparations. Mainstream game theory recommends conditional aggressiveness.⁶³ Although this seems easier, because it is passive, conditional generosity is more practical as it is much easier to implement and much more credible than threats of violence.

Generosity is also more visible than a future use of force. Thus, it is easier to dismiss conditional threats to use force than conditional threats to withdraw generosity, particularly if the generosity is frequent. An additional advantage is the all-too-possible oversight of incentive for cooperation, which by its very meaning inevitably may lead to war. As a deterrent then, the threat of aggression is more dangerous than threats to cease generosity. For, the undesired but possible response to it poses a bigger threat to peace.

Another advantage of generosity is granting your opponent the right to enjoy the benefit of the doubt. Jonathan Bendor ran a tournament of a variant of repeated prisoner's dilemma with noise⁶⁴: they allowed for a small likelihood that one party would mistakenly read the conduct of the other, resulting in the adoption of the strategy to cooperate or to defect.⁶⁵ If the game is long, at times this will happen.⁶⁶ In the tournament, the strategy that was generous won, while tit-for-tat received eighth place.⁶⁷ The generous strategy was to cooperate fully unless the other one displayed a level of cooperation below the standard, and then to reduce the level of cooperation accordingly. This strategy allows the opponent to enjoy the benefit of the doubt.⁶⁸ Since there is noise, this strategy has the advantage of not falling into the cycle of revenge, which is the risk incurred when the tit-for-tat strategy is adopted. The Talmud offers a similar solution to the problem of how to prevent noise

⁶³ Schelling, *supra* note 55, at 187.

⁶⁴ In the standard version of the repeated prisoner's dilemma there is no option of mistakes, mainly the parties know what the other player did, there is no "noise" of mistakes in reading what the other player did.

⁶⁵ Bendor et al. [23].

⁶⁶ See generally *id.*

⁶⁷ *Id.* at 696.

⁶⁸ *Id.* at 696–97.

from leading to a cycle of revenge: “judge every person favorably.”⁶⁹ Maimonides explained,

A person’s character is unknown to you and you are not aware whether he is righteous or wicked. You saw that he performed a deed or made a statement that, according to a given set of circumstances, could be considered good, but could also be considered bad. Judge people favorably, and do not think ill of them.⁷⁰

In accordance with game theory, this is not only moral; it may promote self-interest akin to the case of the tournament run by Bendor.⁷¹ This is an alternative to *Pax Romana* and a preferable one at that.

The generous strategy that Bendor discusses differs from our preferred strategy. Bendor’s perspective on generosity was to not punish the other side if you are unsure of their lack of cooperation.⁷² Given that you may always make mistakes, Bendor also believed that punishing them should only be done if they repeat their uncooperative behaviour under a sufficient degree of certainty that they really did it.⁷³ By contrast, we spoke about generosity in the sense of giving the other more than they are entitled to, and, in cases where generosity is conditional, incentivizing the other without punishing them. Those two kinds of generosity contribute more than deemed obligatory. The Talmud says, “R. Johanan taught, ‘Jerusalem was destroyed because its inhabitants judged according to the law.’ Should they rather have judged made arbitrarily? No; they judged strictly in accord with the law, instead of acting generously.”⁷⁴ This is the counsel to avoid any insistence on one’s rights. Game theory may present this insistence as a good strategy; nevertheless, quite often generosity (rather than honesty) is the best policy.

6.5 A Game-Theoretical View of Brexit

The withdrawal of the United Kingdom (UK) from the European Union (EU), is known as the Brexit. It was a shock to both the European union and even to Britain, since it was unexpected even in Britain.⁷⁵ The Brexit displays a major difference between games of crisis in old Europe and those in new Europe: unlike the old shaping of Europe by war and threats of war, new Europe is shaped by negotiation and by threats to limit cooperation.⁷⁶ This is the advantage of the EU model over

⁶⁹ The Interpretation of the Maimonides 1:6.

⁷⁰ Id.

⁷¹ Bendor et al., *supra* note 67, at 691.

⁷² Id.

⁷³ Id.

⁷⁴ Babylon Talmud, Bava Metzia 30b.

⁷⁵ Steven Erlanger, Britain Votes to Leave E.U.; Cameron Plans to Step Down, *NY Times* (June 23, 2016), <https://www.nytimes.com/2016/06/25/world/europe/britain-brexiteuropean-union-referendum.html>.

⁷⁶ According to Schuman Declaration:

the *Pax Romana*. The wish to leave the Roman Empire led to war; the wish to quit the EU exclusive club may make it offer a new agreement.⁷⁷ The EU is an exclusive club that does not impose membership but provides positive incentives for being a member-state.⁷⁸ Thus, the EU is much less vulnerable when tribal feeling, namely, strong feeling of affiliation plus willingness to make sacrifices,⁷⁹ leads a country to quit the club. It is democracy that improves the capacities to interact with separatist groups.⁸⁰ The logic of the *Pax Romana* cannot deter groups that adopt the strategy of freedom-or-death and thus it encourages bloodshed. Because *Pax Romana* cannot deter groups from clinging to the freedom-or-death strategy, those countries are

The pooling of coal and steel production should immediately provide for the setting up of common foundations for economic development as a first step in the federation of Europe, and will change the destinies of those regions which have long been devoted to the manufacture of munitions of war, of which they have been the most constant victims. The solidarity in production thus established will make it plain that any war between France and Germany becomes not merely unthinkable, but materially impossible. The setting up of this powerful productive unit, open to all countries willing to take part and bound ultimately to provide all the member countries with the basic elements of industrial production on the same terms, will lay a true foundation for their economic unification. This production will be offered to the world as a whole without distinction or exception, with the aim of contributing to raising living standards and to promoting peaceful achievements.

Robert Schuman, French Foreign Minister, Declaration to French Foreign Ministry (May 9, 1950).

⁷⁷ See Valentin Kreiling et al., *Brexit: Negotiation Phases and Scenarios of a Drama in Three Acts* (Jacques Delors Inst., Policy Paper No. 182, 2017); [24].

⁷⁸ According to Article 50 of the Treaty on European Union:

1. Any Member State may decide to withdraw from the Union in accordance with its own constitutional requirements.
2. A Member State which decides to withdraw shall notify the European Council of its intention. In the light of the guidelines provided by the European Council, the Union shall negotiate and conclude an agreement with that State, setting out the arrangements for its withdrawal, taking account of the framework for its future relationship with the Union. That agreement shall be negotiated in accordance with Article 218(3) of the Treaty on the Functioning of the European Union. It shall be concluded on behalf of the Union by the Council, acting by a qualified majority, after obtaining the consent of the European Parliament.
3. The Treaties shall cease to apply to the State in question from the date of entry into force of the withdrawal agreement or, failing that, two years after the notification referred to in paragraph 2, unless the European Council, in agreement with the Member State concerned, unanimously decides to extend this period.
4. For the purposes of paragraphs 2 and 3, the member of the European Council or of the Council representing the withdrawing Member State shall not participate in the discussions of the European Council or Council or in decisions concerning it.
5. A qualified majority shall be defined in accordance with Article 238(3)(b) of the Treaty on the Functioning of the European Union.
6. If a State which has withdrawn from the Union asks to rejoin, its request shall be subject to the procedure referred to in Article 49.

Treaty on European Union art. 50, Feb. 7, 1992, 2012 O.J. (C 326) 43–44.

⁷⁹ Regarding tribal feeling, see Popper (2002).

⁸⁰ *Id.*

forced to yield or fight a total war.⁸¹ The Romans would play a total war with those who adopt the freedom-or-death strategy, whereas the EU would play the game of divorce with them. For, no party in this interaction will withdraw unless their goal will be absolutely met. To me *Pax Romana* strategy is clearly unreasonable when the other side can also adopt it. The liberal will not say: “if you wish to fight, let’s fight, when he has an option to leave the club without fighting.” The capacity to compromise, particularly, is one of the greatest advantages of the liberal over the aggressive. The liberal chooses to lose what is not worth fighting for, whereas for the aggressive, losing is not an option.

6.6 Conclusion

The considerations above may make some players switch from *Pax Romana* to the European Union game, as error is inevitable and *Pax Romana* is risky since a mistake in reading an opponent’s action may lead to undesired war. Since the very consideration of waging war is expensive, it is wiser to change the situation in order to enable players to rely on stable trust whenever possible. Stable trust, then, is obviously the best goal for international relations. It renders peace reasonable, especially for those in positions of strength. This is quite intriguing, since most other types of war games do not preclude the major cause of war, namely, the over-optimistic assessments of the result of waging a war. The Romans response to the freedom-or-death strategy, as it happened in Judea, is the strategy of managing a total war. The EU, however, would prefer playing the game of divorce. This is one of the greatest advantages of the liberal over the aggressive. The liberal chooses to lose what is not worth fighting for, whereas for the aggressive, losing is not an option.

References

1. Lipsey, R.G., Lancaster, K.: The general theory of second best. *Rev. of Econ. Stud.* **24**, 11–32 (1956)
2. Skyrms, B.: The stag hunt. In: *Proceedings and Addresses of the American Philosophical Association* vol. 75, 31 (2001)
3. Jervis, R.: Cooperation under the security dilemma. *World. Pol.* **30**, 167 (1978)
4. Agassi, J., Meidan, A.: *Philosophy from a Skeptical Perspective*, pp. 94–96 (2008)
5. Bunge, M.: *Social Science under Debate: A Philosophical Perspective*, p. 176 (1998)
6. Russell, B.: *Common Sense and Nuclear Warfare*, p. 19 (2001)
7. Nash, J., Games, N.-C.: *Ann. Math.* **54**, 286 (1951)
8. Aumann, R.J., Dreze, J.H.: Rational expectations in games. *Am. Econ. Rev.* **98**, 72–80 (2008)
9. Ely, J.C., Välimäki, J.: A robust folk theorem for the prisoner’s dilemma. *J. Econ. Theory* **102**, 84–87 (2002)
10. Aumann, R.J.: Game engineering at 11 (The Federmann Ctr. For the Study of Rationality, the Hebrew Univ., Discussion Paper Series, dp518, 2009)

⁸¹ Saint-Amour [25].

11. Schelling, T.C.: An essay on bargaining. *Am. Econ. Rev.* **46**, 281–297 (1956)
12. Aumann, R.J.: War and peace. *Procs. Nat'l Acad. Sci.* **103**, 17075 (2006)
13. Russell, B.: *Why Men Fight*, 1st edn, pp. 63–64 (2010)
14. Edelstein, M.: What price cold war? Military spending and private investment in the US, 1946–1979. *Cambridge J. Econ.* **14**, 421–22 (1990)
15. Slantchev, B.L., Tarar, A.: Mutual optimism as a rationalist explanation of war. *Am. J. Pol. Sci.* **55**, 135–146 (2011)
16. Kohlberg, E., Mertens, J.-F.: On the strategic stability of equilibria. *Econometrica* **54**, 1003 (1986)
17. Kirchhof, P.: The balance of powers between national and European institutions. *Eur. L.J.* **5**, 225, 230–36 (1999)
18. Clarke, D.L.: US security assistance to Egypt and Israel: politically untouchable? *Middle East J.* **51**, 200–202 (1997)
19. Weiss, U., Agassi, J.: Game theory for international accords. *S.C. J. In'l L. & Bus.* **16**, 1–13 (2020)
20. Schelling, T.C.: *The strategy of conflict* 6 (1980)
21. Keynes, J.M.: The economic consequences of the peace. **102**, 164 (1920)
22. Keynes, J.M.: A revision of the treaty 193–94 (1922)
23. Bendor, J., et al.: When in doubt... cooperation in a noisy prisoner's dilemma. *J. Conflict Resol.* **35**(691), 700–701 (1991)
24. Ott, U.F., Ghauri, P.N.: Brexit negotiations: from negotiation space to agreement zones. *J. Int'l Bus. Stud.* **50**, 137–139 (2019)
25. Saint-Amour, P.K.: On the partiality of total war. *Crit. Inq.* **40**, 420–425 (2014)

Chapter 7

Playing the Game of International Law



In the realist game of international negotiations, each state attempts to promote their interest regardless of international law. Thus, it is a negotiation in the shadow of the sword, i.e. a negotiation in which each side knows that if the parties do not achieve an agreement, the alternative may be a war, and thus the bargaining position of its party is function of their capacities in a case of war. Negotiation in the shadow of international law is an alternative to it: in this alternative the parties negotiate according to their international legal rights. It reduces injustice and incentives to armament and to terror. It thus promotes peace. A state can choose unilaterally to play the game of negotiations in accord with international law by merely respecting the rights of one's neighbours regardless to their waving swords, and by this have much more peace and generate incentives against terror and armament. This efficiently brings much more security and peace. A policy of respecting international law, combined with conditional generosity, is more efficient. The wish for peace should make a country encourage its neighbours to avoid armament. The best way to do so is to adopt a policy of unilateral respect for international law and conditional generosity towards one's neighbours. The international community should enforce, or at least encourage, negotiations in accord with international law.

7.1 Preface

What game of international dispute-resolution should be chosen by the planners and by the players of international relations? What should be the place of international courts in conflict resolutions? What is the best response to negotiation failure?

Peace negotiation is clearly better than war. Even a negotiation between robbers and their victims are notoriously better than murder. Of course, every submission to a robber encourages robberies; one of the advantages of international law is that it encourages replacing terror with compromise. In the language of the social contract theory: when a state plays as if it is a Hobbesian “natural state,” namely, a game

without any valid law in which “[h]omo homini lupus” (“a man is a wolf to another man”),¹ they will be robbed much more if they play as if it is a “political state.”² This is so, since from the point of view of the state that believes that international relations represent a Hobbesian “natural state,”³ every demand by the other side is a robbery, and there is no distinction between legitimate demands and illegitimate demands. We argue that while a state recognizes international law, the state plays a game of political state and thus is robbed much less. Thus, when a state recognizes international law, they declare their right not to be robbed.⁴ By this, they play a less dangerous game, a game that protects their citizens from terrorism. We will explain this argument in this paper.

There are many potential different games of international negotiation: one extreme game is that if negotiation fails, one country has the power to force the other to settle the conflict with a universal jurisdiction and a capacity to enforce their decision. When the states play the negotiation game, they play the game of negotiation in the shadow of the law. Another possible negotiation game is one in which each country attempts to maximize their benefits regardless of the law, and if negotiation fails, they will settle their conflict by war. When they negotiate, they play the game of negotiation in the shadow of the war.

The first game will be played in a world with a court with universal jurisdiction and an effective mechanism to enforce their decisions. A game of negotiation in the shadow of the law will also be played in a non-utopian world. It will be the case, if the two states respect enough international law. The two states may choose to litigate if they fail to reach agreement. When this is the case, we will see much fewer territorial disputes, and thus the solution of conflict by this mechanism is much less visible, namely, the illusion is that this mechanism is neglected.⁵

Moreover, a state may choose to respect international law regardless of the choice of the other state, and by this choose the game. Despite the unilateral acceptance of international law, international law may influence the two parties’ negotiation. This will be the case particularly, when a side that may achieve much more territory by sword than they are entitled by international law, will subject themselves to

¹ See [1] (De Waal claimed: “Homo homini lupus—“man is wolf to man”—is an ancient Roman proverb popularized by Thomas Hobbes.”).

² See [2]. Hobbes claimed, “And in all places, where men have lived by small Families, to robbe and spoyle one another, has been a Trade, and so farre from being reputed against the Law of Nature, that the greater spoylees they gained, the greater was their honour; and men observed no other Lawes therein, but the Lawes of Honour; that is, to abstain from cruelty, leaving to men their lives, and instruments of husbandry.” Id.

³ Smith [3] (claims Hobbes’s “analysis of the state of nature remains the defining feature of realist thought. His notion of the international state of nature as a state of war is shared by virtually everyone calling himself a realist.”).

⁴ Thomas Hobbes claimed that “before constitution of Sovereign Power (as hath already been shewn) all men had right to all things; which necessarily causeth Warre.” Thomas Hobbes, *The Project Gutenberg eBook of Leviathan*, GUTENBERG.ORG, <https://gutenberg.org/files/3207/3207-h/3207-h.htm> (last visited August 10, 2022).

⁵ This is similar to the friendship paradox: since people with more friends are more visible, people tend to think that others have more friends than they have. See Feld [4].

international law. Thus, it is much more important that the strong side will accept international law, since the strong side is the one who can take more territory than they are entitled by international law.

Games of international negotiation in the shadow of international law reduces injustice in international relations, and reduces terrorism, arming and wars. We recommend to any state that faces conflict to invite the other side publicly: let's negotiate, and if the negotiation fails, let's go to the international court of justice. The choice of a state not to rob even when they can rob without paying for, incentivizes the other side not to arm. This is also more important that the strong side, the side that may achieve by sword more than they are entitled by law, will be subject to international law. Yet, even the weak side can invite the strong side publicly for an international adjudication. For them, it is (almost) a no-lose strategy: they will gain if the strong side accepts their proposal, and they will gain even if the strong side does not accept their public proposal since by this the strong side will lose legitimacy to attack them and to justify it by raising a self-defense claim. When a weak side relinquishes transparency, they pay an enormous price (that usually they cannot see because of the lack of transparency).

In an ideal world, the international community will force the game of negotiation under the shadow of international law. However, it does not mean that partial universal jurisdiction is always better than jurisdiction that is based on the mutual consent of the states.⁶ The realists claim that we do not live in an ideal world, and hence international law does not matter.⁷ As such, there is no such thing as international law.⁸ We argue that, by a unilateral acceptance of international law, a state defends itself, that international law is a *sine qua non* that states will not rob and will not be robbed.

7.2 Introduction

Let us now discuss in the common language of international relations: what states should do if negotiation fails? There are states that, in this case, will go to war, and there are states that in this case will go to international adjudication.

How should international conflict be solved? What should a country that faces a conflict do? According to the traditional approach, the conflict should be solved at

⁶ See [5, 6].

⁷ See Gregory Shaffer, *Legal Realism and International Law* (U.C. Irvine School of Law, Research Paper No. 2018-55, 2021). They claimed that “[l]egal realism is not IR realism and should not be confused with it. IR realism views international law as epiphenomenal because state power, and not law, determines international relations outcomes.” *Id.*

⁸ See [7].

the negotiation table.⁹ This solution is probably better than war: “in peace sons bury their fathers, but in war fathers bury their sons.”¹⁰ However, what should be the case if negotiation fails? One possibility is that in this case the conflict will be solved through litigation.¹¹ This will turn the negotiation be a negotiation in the shadow of the law. Another possibility is to go to another negotiation if negotiation fails, and this raises the question, what to do if the additional negotiation fails. Infinite negotiation may lead to the freezing of the status quo, even if the status quo is a status quo of war. Another possibility is that the conflict will be settled by sword, if negotiation fails. This is the approach of Carl von Clausewitz who said that “[w]ar is nothing but a continuation of political intercourse with an admixture of other means”.¹²

It is possible to imagine what to do if negotiation fails: that the strong world powers will force a solution.¹³ An alternative is that the Security Council will force

⁹ Let us see some examples to this approach regarding the contemporary conflicts. Zelenski claimed that the war could only come to a conclusive halt “at the negotiating table.” *Zelenski: Only Diplomacy Can End Ukraine War*, BBC NEWS (May 21, 2022), <https://www.bbc.com/news/world-europe-61535353>. The possibility of going to arbitration has not been mentioned as an option. Regarding the conflict in Yemen, “[w]hat has been most frustrating during my time [...] has been the absence of comprehensive peace talks,” said Martin Griffiths, Special Envoy of the Secretary-General for Yemen, during his briefing to the Security Council, adding that he had emphasized time and again the primacy of a political process to negotiate the core political and security issues needed to end the war. The last time the Government of Yemen and Ansar Allah, or the Houthis, sat down to discuss the sticking issues was in Kuwait in 2016, he said, “[o]nly a negotiated political settlement can truly turn the tide in Yemen,” he said, arguing that a mediator is not responsible for the war nor for the peace, despite the common assumption to the contrary. Rather, the mediator’s privilege is to present to the parties the ways the war can end, he stressed.” *Negotiated Political Settlement Only Way to End War*, UNITED NATIONS (June 15, 2021), <https://press.un.org/en/2021/sc14552.doc.htm>. Furthermore, “[s]ome countries claim, more or less, that the ICC should not have jurisdiction over the West Bank, East Jerusalem and Gaza, since the conflict should be solved via negotiation. See generally Situation in Palestine, Case No. ICC-ICC-01/18, Public Document: Submissions Pursuant to Rule 103 (Uri Weiss) (Mar. 16, 2020), https://www.icc-cpi.int/sites/default/files/CourtRecords/CR2020_01105.PDF. See also Raphael Ahren, *Why the Palestinian Case at the Hague Took A Big Hit This Past Week*, THE TIMES OF ISRAEL (February 21, 2020 9:40 AM), <https://www.timesofisrael.com/why-the-palestinian-case-at-the-hague-took-a-big-hit-this-week/>.

¹⁰ HERODOTUS, THE HISTORIES, Book I, ch. 87, § 4.

¹¹ *The Palestine Mandate*, YALE L. SCHOOL LILLIAN GOLDMAN L. LIBRARY (2008), https://avalon.law.yale.edu/20th_century/palmanda.asp;

The Mandatory agrees that, if any dispute whatever should arise between the Mandatory and another Member of the League of Nations relating to the interpretation or the application of the provisions of the mandate, such dispute, if it cannot be settled by negotiation, shall be submitted to the Permanent Court of International Justice provided for by Article 14 of the Covenant of the League of Nations.

Id.

¹² See [8].

¹³ A historical example to a forced solution may be that the U.S. forced Japan to adopt their liberal constitution.

a solution,¹⁴ however the fact that the five permanent members have a veto power may prevent a resolution.¹⁵

How should the international community organize the world, such that conflict will be solved in a better way? What should be the jurisdictions of international courts? What policy toward international law states should take, even unilaterally?

7.3 Historical Background

For years, there was no effective legal mechanism for international law enforcement.¹⁶ For, the traditional doctrine of international law assigned a court jurisdiction only with the consent of both parties, the complainant state, and the claimant state. Further, one of the strong doctrines of international law was, and largely remains, the primacy of state sovereignty.¹⁷ States are equal and must respect each other's sovereignty. The recognition of immunity of foreign heads of state and its diplomats is recognized as a part of this respect.

¹⁴ We can illustrate this by the Security Council's Resolutions 134, 181, 392, and 418 regarding South Africa. The last one, i.e., resolution 418, imposed a mandatory arms embargo against South Africa. We can partially illustrate this by the Security Council's resolutions 242 and 228 regarding the Israeli-Arab conflict.

¹⁵ See U.N. Charter art. 27, ¶¶ 1-3. "Each member of the Security Council shall have one vote." *Id.* at ¶ 1. "Decisions of the Security Council on procedural matters shall be made by an affirmative vote of nine members." *Id.* at ¶ 2. "Decisions of the Security Council on all other matters shall be made by an affirmative vote of nine members including the concurring votes of the permanent members; provided that, in decisions under Chapter VI, and under paragraph 3 of Article 52, a party to a dispute shall abstain from voting." *Id.* at ¶ 3.

¹⁶ See [9].

[T]he law obtaining between nations is not positive law: for every positive law is set by a given sovereign to a person or persons in a state of subjection to its author... [T]he law obtaining between nations is law (improperly so called) set by general opinion. The duties which it imposes are enforced by moral sanctions: by fear on the part of nations, or by fear on the part of sovereigns, of provoking general hostility, and incurring its probable evils, in case they shall violate maxims generally received and respected.

Id. See also [10].

¹⁷ Schrijver (11).

In terms of traditional international law, internal sovereignty is not limited.¹⁸ This becomes absurd; when dictators (say Assad) massacre their people, it is an internal matter, but when their forces injure members of other nationalities (say Turkish soldiers), it becomes an international issue.¹⁹ Such situations have made Justice Antônio Augusto Cançado Trindade criticize the established state of affairs as a distortion of the original intent of the founders of international law.²⁰

Over the years, attempts to change the traditional approach in international law took place, including attempts to empower the international court with universal jurisdiction. The attempts were to introduce an international order that rests on principles of law, rather than on a precarious balance of power, such as the equilibrium that the Vienna Congress created.²¹ Henry Kissinger²² presents Woodrow Wilson as the American president who has foreshadowed this approach. In the Treaty of

¹⁸ Bartelson (12),

All the contributors to this volume seem more or less painfully aware of the tension that exists between the traditional view of sovereignty as an indivisible and discrete condition of possible statehood, and the actual dispersion of political power and legal authority to the sub- and supranational levels. They are also very aware of the fact that whenever the concept of sovereignty is simply redefined in order to be better attuned to this dispersion of authority, a series of paradoxes arise that must be resolved if those new constellations of power and authority are to be perceived as legitimate.

Id. at 467.

¹⁹ Delbrueck (13) (“An impressive body of international conventions providing for the protection of human rights in almost all spheres of social and political life has been built up during the past fifty years,’ but their enforcement is sadly lagging. Sovereignty of states -understood as their supreme authority and independence-is being identified as the major factor responsible for such a lamentable state of affairs with regard to the internationally controlled implementation of human rights.”).

²⁰ See [14], He argued:

The universal *jus gentium* of Vitoria, remindful of the importance of human solidarity, regulated, on the basis of principles of natural law and right reason (*recta ratio*), the relations between all peoples, respectful of their rights, the territories wherein they lived, and their contacts and freedom of movement (*jus communicationis*). Deriving its strength from principles of universal value, the *jus gentium* in the conception of Vitoria applied equally to all, the governed and the governors. On the basis of such conception the emerging international legal order purported to ensure the primacy of law over force, as reflected in Vitoria’s famous warning “*Imperator non est dominus totus orbis*. On his turn, Francisco Suárez, warning that no State sufficed to itself, started likewise from the fundamental unity of humankind (forming a *societas ac communicatio*), and began to move towards the autonomy of the law of nations; such autonomy was acknowledged by Hugo Grotius, who also admitted the unity of the humankind and emphasized above all the role of reason. In the work of A. Gentili, *jus gentium* was already regarded as the “common law of humankind”. Much later on, with the contribution of the works of Hugo Grotius and Christian Wolff, International Law was gradually to achieve its autonomy vis-à-vis the national legal orders.

Id.

²¹ See Kissinger [15].

²² Kissinger [16].

Versailles (1919),²³ compensation was set on the basis of guilt, unlike the previous world order, in which the winners simply forced the losers to pay compensation.²⁴

The attempt to secure “collective security” through international institutions failed between the two world wars.²⁵ The American president during the first world war, Woodrow Wilson, failed to lead his own country to become a member of the League of Nations.²⁶

The Treaty of Versailles failed to propose a plan that might be stable.²⁷ John Maynard Keynes proposed a much better plan; he wrote in his overlooked book, *The Economic Consequences of the Peace*:

If the General Election of December, 1918, had been fought on lines of prudent generosity instead of imbecile greed, how much better the financial prospect of Europe might now be . . . I believe this to be an act of generosity for which Europe can fairly ask, provided Europe is making an honorable attempt in other directions, not to continue war, economic or otherwise, but to achieve the economic reconstitution of the whole Continent.²⁸

Later on, Keynes wrote:

Great Britain lives by commerce, and most Englishmen now need but little persuading that she will gain more in honor, prestige, and wealth by employing a prudent generosity to preserve the equilibrium of commerce and the well-being of Europe, than by attempting to exact a hateful and crushing tribute, whether from her victorious Allies or her defeated enemy.²⁹

²³ *Treaty of Versailles*, Bevans [17].

²⁴ *Id.*

²⁵ See Ebegbulem [18] (“Another example of the failure of the League of Nations’ collective security is the Manchurian crisis when Japan occupied part of China. After the invasion, members of the League passed a resolution calling for Japan to withdraw or face severe penalties. Given that every nation on the League of Nations Council had veto power, Japan promptly vetoed the resolution, severely limiting the League of Nations’ ability to respond. After two years of deliberation, the League passed a resolution condemning the invasion without committing the League’s members to any action against it. The Japanese replied by quitting the League of Nations. A similar process occurred in 1935, when Italy invaded Ethiopia. Sanctions were passed, but Italy would have vetoed any stronger resolution. Additionally, Britain and France sought to court Italy’s government as a potential deterrent to Hitler, given that Mussolini was not in what would become the Axis Alliance of World War II. Thus, neither enforced any serious sanctions against the Italian government.”).

²⁶ Dorsey [19] (“In July 1919, Wilson pledged to establish an organization of free nations working in concert to “maintain the peaceful understandings of the world” through diplomacy and democracy, and not necessarily through military might. When Congress balked at American participation in the peace organization, one of the first of the modern rhetorical presidents embarked on his famous ‘whistle-stop’ tour, stumping across the middle and western United States to preach directly to the public about the issue. Wilson’s tour, however, played out as a Greek tragedy. His sermons about America’s moral responsibility failed to generate the much-anticipated support in any substantive way. Wilson collapsed from exhaustion before he had finished his speaking tour, suffered a stroke days later, and was rendered incapacitated for several months.”).

²⁷ See Kissinger, *supra* note 22, at 218.

²⁸ Keynes [20].

²⁹ Keynes [21].

As a replacement for effective enforcement measures (particularly since U.S. Congress resisted the proposal that the U.S. will become a member in the League of Nations), the new post-World War I world order was to be secured primarily through public opinion.³⁰ But public opinion had failed to reach a new, stable world order. Only after World War II, did a significant change in international law appear.³¹ Crimes that were once deemed an internal affair, are now considered a legal matter for the whole international community to engage in.³²

Half a century before World War II, Theodore Herzl argued that anti-Semitism is not only the Jews' problem, but also the problem of the countries in which it occurs.³³ Later, Martin Luther King adopted this idea.³⁴ In the words of the International Criminal Court's (hereinafter "ICC") President:

The vow requires the world to stand hard and resolute against the danger of anti-Semitism and all other kinds of racism and religious bigotry—which always carry in their logic the associated risk of atrocity crimes motivated by them. The ICC is a newfound global instrument through which the world can take that stand.³⁵

From the perspective of the ICC the vow of 'never again' is a shared responsibility regarding which the ICC stands ready to play its part. That part requires the ICC to put itself between

³⁰ Woodrow Wilson, President of the U.S., Address at the Third Plenary Session of the Peace Conference in Paris, France (February 14, 1919), available at <https://www.presidency.ucsb.edu/documents/address-the-third-plenary-session-the-peace-conference-paris-france>:

[y]ou will notice, that when a subject is submitted, not to arbitration, but to discussion by the executive council, it can upon the initiative of either one of the parties to the dispute be drawn out of the executive council onto the larger forum of the general body of delegates, because throughout this instrument we are depending primarily and chiefly upon one great force, and that is the moral force of the public opinion of the world—the cleansing and clarifying and compelling influences of publicity—so that intrigues can no longer have their coverts, so that designs that are sinister can at any time be drawn into the open, so that those things that are destroyed by the light may be properly destroyed by the overwhelming light of the universal expression of the condemnation of the world.

Id.

³¹ See [22], "The emergence of international criminal law is very special in post-World War II international law." Id. at 332.

³² Kofi A. Annan, *Two Concepts of Sovereignty*, THE ECONOMIST (September 18, 1999), available at <http://www.kentlaw.edu/faculty/bbrown/classes/HumanrsemFall2008/CourseDocs/12Twoconceptsofsovereignty-Kofi%20Annan.pdf> ("State sovereignty, in its most basic sense, is being redefined—not least by the forces of globalisation and international co-operation. States are now widely understood to be instruments at the service of their peoples, and not vice versa. At the same time individual sovereignty—by which I mean the fundamental freedom of each individual, enshrined in the charter of the UN and subsequent international treaties—has been enhanced by a renewed and spreading consciousness of individual rights. When we read the charter today, we are more than ever conscious that its aim is to protect individual human beings, not to protect those who abuse them.").

³³ Agassi [23].

³⁴ Id.

³⁵ *Reflections of the President of the ICC, Judge Chile Eboe-Osuji, on the 75th Anniversary of Auschwitz Liberation: 'Never Again' Must Not Be a Meaningless Mantra*, INT'L CRIM. CT. (Jan. 27, 2020), <https://www.icc-cpi.int/news/reflections-president-icc-judge-chile-ebae-osuji-75th-anniversary-auschwitz-liberation-never>.

the victims and the atrocities that the world had in mind when creating the ICC—even if this means brooking political attacks against the Court itself.³⁶

In both the Nuremberg and the Tokyo trials, special international tribunals judged German and Japanese suspects of war crimes.³⁷ This was criticized as “the justice of the victors,”³⁸ yet it prevailed.

Other changes also took place unplanned and with no debate in any international forum. Israel set a precedent for universal jurisdiction in its trial of Adolf Eichmann³⁹: a state’s authority to judge horrific crimes, even if not committed in its land, and not even against its citizens.⁴⁰ Another change was the trial of retired Chilean dictator Augusto Pinochet: a Spanish judge issued a warrant for his arrest while he was visiting England—for alleged crimes that he had committed in Chile during his reign there.⁴¹ Spain asked England to extradite him.⁴² The precedent set by the House of Lords is that the former head of state should be extradited in such a case,

³⁶ *Id.*

³⁷ Walkinshaw [24]:

[T]he charter of the Tokyo tribunal. As early as 1944, there was set up at Chungking the Far Eastern and Pacific Sub-Commission for War Crimes; and the arrest of war criminals began as soon as the first American ships came into Tokyo Bay. Some four months later, on January 19, 1946, General MacArthur issued an order establishing the International Military Tribunal for the Far East, and published there with its charter which conformed in essentials to the charter which has been attached to the London Agreement. The legal basis, however, of the one tribunal was different from that of the other. The tribunal of Nuremberg rested upon an international agreement, but one to which Germany never became a party. Its only signatories were Great Britain, the Soviet Union, France and the United States... The tribunal for the Far East, on the other hand, rested upon agreement with Japan. Paragraph 10 of the Potsdam Declaration stated: We do not intend that the Japanese shall be enslaved as a race or destroyed as a nation, but stern justice shall be meted out to all war criminals, including those who have visited cruelties upon our prisoners. The reply thereto of August 10, 1945, stated: The Japanese Government are ready to accept the terms enumerated in the joint declaration which was issued at Potsdam on July 26, 1945... Out of such authority, General MacArthur, acting not as an American officer but as Supreme Commander of the Allied Powers, set up the Military Tribunal at Tokyo. As found by the United States Supreme Court, it too was a purely international tribunal; it was no more a tribunal of the United States than that of Nuremberg.

Id.

³⁸ Peskin [25] (“For human rights advocates, the notion of “victor’s justice” has become increasingly distasteful in the decades since Nuremberg.”).

³⁹ See [26]. See also [27] (“The Eichmann trial may have been the first United Nations-era assertion of universal jurisdiction, and perhaps also the boldest one.”).

⁴⁰ O’keefe [28] (“In positive and slightly pedantic terms, universal jurisdiction can be defined as prescriptive jurisdiction over offences committed abroad by persons who at the time of commission are non-resident aliens, where such offences are not deemed to constitute threats to the fundamental interests of the prescribing state or, in appropriate cases, to give rise to effects within its territory.”).

⁴¹ Roht-Arriaza [29].

⁴² Sole [30].

even though he eventually escaped extradition on the excuse of a health condition.⁴³ This was important as it preceded the rejection of the excuse that as a head of state, he had immunity against the extradition.⁴⁴ In the 1990s, the Security Council—the legislative body in international law—established special criminal tribunals for judging war crimes committed on former Yugoslav land (“ICTY”) as well as on Rwandan land (“ICTR”).⁴⁵ The next stage is the ICC.

According to Rome Statute, the jurisdiction of the ICC depends on the consent of the states.⁴⁶ On one hand, if a state accepts the jurisdiction of the court, the court will have jurisdiction over it. On the other hand, when a state accepts its jurisdiction, then the ICC has jurisdiction to judge even war crimes that have been committed on its territory, even by foreign forces.⁴⁷ This means that if an invaded state accepts the jurisdiction of the ICC, then the soldiers of the invading state can be investigated and prosecuted although the latter has never accepted the jurisdiction. Furthermore, according to the Rome Statute,⁴⁸ a state can accept the ICC’s jurisdiction with respect to crimes that had been committed since the entry into force of the Rome Statute, which was on 1 July 2002.⁴⁹

7.4 Kissinger Versus Keynes in Game Theoretical Perspective

President Wilson had a very beautiful vision about international relations, but his program was not founded on institutions and incentives that would lead to its desirable

⁴³ See Roht-Arriaza, *supra* note 41, at 312-13.

⁴⁴ *Id.*

⁴⁵ Hola (31).

⁴⁶ In the case of Aggression, the default is that the consent of the two parties is demanded. Rome Statute of the International Criminal Court [hereinafter Rome Statute], Art. 15(4) (“The Court may, in accordance with article 12, exercise jurisdiction over a crime of aggression, arising from an act of aggression committed by a State Party, unless that State Party has previously declared that it does not accept such jurisdiction by lodging a declaration with the Registrar. The withdrawal of such a declaration may be effected at any time and shall be considered by the State Party within three years.”); Rome Statute, Art. 15(5) (“In respect of a State that is not a party to this Statute, the Court shall not exercise its jurisdiction over the crime of aggression when committed by that State’s nationals or on its territory.”).

⁴⁷ Rome Statute, Art. 12 (2), <https://www.icc-cpi.int/sites/default/files/RS-Eng.pdf>; “In the case of article 13, paragraph (a) or (c), the Court may exercise its jurisdiction if one or more of the following States are Parties to this Statute or have accepted the jurisdiction of the Court in accordance with paragraph 3: (a) The State on the territory of which the conduct in question occurred or, if the crime was committed on board a vessel or aircraft, the State of registration of that vessel or aircraft.” *Id.*

⁴⁸ United Nations [32].

⁴⁹ Rome Statute, Art. 11, <https://www.icc-cpi.int/sites/default/files/RS-Eng.pdf>; “If a State becomes a Party to this Statute after its entry into force, the Court may exercise its jurisdiction only with respect to crimes committed after the entry into force of this Statute for that State, unless that State has made a declaration under article 12, paragraph 3.” *Id.*

aims. The international order has been founded on moral values which he proposed was desirable but not stable. Let us define a new equilibrium that may help us to choose games that lead to peace: a game is in peace equilibrium, if and only if every player sees the strategy of respecting the peace as superior to any strategy of going to war or threatening in war if the status quo is not changed in their Favour. The problem with the Treaty of Versailles was that it did not establish a peace equilibrium.⁵⁰

John Maynard Keynes warred in real time from the danger of the Treaty of Versailles.⁵¹ Keynes even explained why people supported the Treaty of Versailles: since people did not say in the external circles what they said in the internal circles. In the game theoretical language, when people say in the inner circles what they do not say in the external circle, there may be one Nash equilibrium⁵² of supporting one plan in the external circle, while a Nash equilibrium of resisting the plan in the inner circle.⁵³ Actually, the game may be played twice with the same players: one time they declare their opinion publicly, and in the other game they tell their opinions in the inner circles, and we will get two dramatically different equilibria. It is the phenomenon of double talk. Double talk prevents the opportunity to get rid of mistakes: the criticism is said only in the internal circles and saying it in the external circles is considered to be a disloyal step, which incentivizes not to do it. This game may be prevented when enough people have courage to speak openly or when society does not punish those who speak freely in the external circles. Keynes himself was blamed to love Germans when he proposed the program that could prevent the Second World War.

⁵⁰ Hobsbawm (33) (arguing that “the Versailles settlement could not possibly be the basis of a stable peace. It was doomed from the start, and another war was practically certain.”).

⁵¹ Keynes [34].

⁵² See Nash [35] (a game is in Nash equilibrium if and only if no player can benefit from unilaterally changing their strategy).

⁵³ Keynes [36] (note that this is a reproduction of the original from 1921),

For there are, in the present times, two opinions; not, as in former ages, the true and the false, but the outside and the inside; the opinion of the public voiced by the politicians and the newspapers, and the opinion of the politicians, the journalists and the civil servants, upstairs and downstairs and behind–stairs, expressed in limited circles. In time of war it became a patriotic duty that the two opinions should be as different as possible; and some seem to think it so still... Those who live in the limited circles and share the inside opinion pay both too much and too little attention to the outside opinion; too much, because, ready in words and promises to concede to it everything, they regard open opposition as absurdly futile; too little, because they believe that these words and promises are so certainly destined to change in due season, that it is pedantic, tiresome, and inappropriate to analyze their literal meaning and exact consequences. They know all this nearly as well as the critic, who wastes, in their view, his time and his emotions in exciting himself too much over what, on his own showing, cannot possibly happen. Nevertheless, what is said before the world is, still, of deeper consequence than the subterranean breathings and well–informed whisperings, knowledge of which allows inside opinion to feel superior to outside opinion, even at the moment of bowing to it.

Id.

It should be said that there were attempts to correct the mistakes of the Treaty of Versailles. However, the international community prefers to be tough toward Germany in enforcing the obligations to pay repression and to cancel their monarchic character, and very flexible regarding Germany's obligation not to strengthen their army and war industry. This prevents a peace equilibrium, since it leads to a combination of hostile feeling, incentives to violate international law, and capacities to fight. Churchill preached to make the opposite and warned against GB's priorities regarding which German's obligation to enforce.⁵⁴ We will discuss later the mechanism established by the Locarno Treaty, which followed the Treaty of Versailles.

Henry Kissinger presented President Theodore Roosevelt as representing the opposite to Wilson.⁵⁵ The alternative approach of "balance of power,"⁵⁶ as advocated by President Theodore Roosevelt, is not just; and it may be destabilized when the balance of power is changed; and it also encourages arms races.⁵⁷ Moreover, if the world order is based on an aristocratic approach such that one state will oblige to help the attacked state, the stability of peace is dependent on the belief of the potential aggressor that the obliging state will fulfil their obligation to protect the attacked state. Even if the obliged state intends to fulfil their obligation, the potential aggressor may misread their intention, and their mistake may lead to war. It should be clarified that there is a big difference between the Realpolitik approach

⁵⁴ Winston S. Churchill, *The Gathering Storm (The Second World War)* 10–11 (1948);

The prejudice of the Americans against monarchy, which Mr. Lloyd George made no attempt to counter-act, had made it clear to the beaten Empire that it would have better treatment from the Allies as a republic than as a monarchy. Wise policy would have crowned and fortified the Weimar Republic with a constitutional sovereign in the person of an infant grandson of the Kaiser, under a Council of Regency. Instead, a gaping void was opened in the national life of the German people. All the strong elements, military and feudal, which might have rallied to a constitutional monarchy and for its sake respected and sustained the new democratic and Parliamentary processes were for the time being unhinged. The Weimar Republic, with all its liberal trappings and blessings, was regarded as an imposition of the enemy. It could not hold the loyalties or the imagination of the German people... Poincare, the strongest figure who succeeded Clemenceau, attempted to make an independent Rhineland under the patronage and control of France. This had no chance of success. He did not hesitate to try to enforce reparations on Germany by the invasion of the Ruhr. This certainly imposed compliance with the Treaties on Germany; but it was severely condemned by British and American opinion. As a result of the general financial and political disorganisation of Germany, together with reparation payments during the years 1919 to 1923, the mark rapidly collapsed. The rage aroused in Germany by the French occupation of the Ruhr led to a vast, reckless printing of paper notes with the deliberate object of destroying the whole basis of the currency. In the final stages of the inflation the mark stood at forty-three million millions to the pound sterling. The social and economic consequences of this inflation were deadly and far-reaching.

Id.

⁵⁵ Kissinger, *supra* note 22, at 29.

⁵⁶ Id.

⁵⁷ Id.

and the aristocratic balance of power approach, since *realpolitik* does not take obligation seriously, and thus does not take seriously defined alliances such as NATO. The balance of power approach proposes to stabilize the worlds by treaties, that makes it irrational to go to war. The *Realpolitik* does not take the treaties seriously, since they claim that treaties cannot lead one country to protect another country. They argue that one country will protect another country if and only if it is in their best interest regardless of the treaty, so a treaty cannot make any difference.⁵⁸ The aristocrat may see the “honour” as a sufficient mechanism to enforce a treaty. This is why Chamberlin relied on Hitler in the Munich Agreement⁵⁹; he thought that Hitler is a gentleman who keeps his words.⁶⁰ We say: game theory, and particularly the game theoretical distinction of one-time game from repeat game, teaches us that treaties are much more than papers; they change the incentives. However, game theory also teaches us that in order to have a peace equilibrium treaty may not be sufficient.

An example of the aristocratic way to organize the world was The Locarno Treaties.⁶¹ Germany, Great Britain, Belgium, Italy and France obliged not to attack each other, and that if one country invades the other without justification, the rest will protect the other.⁶² It should be noted that the Locarno Treaties did not include

⁵⁸ See Hobbes, *supra* note 2. The *Realpolitik* actually followed Hobbes who claimed, “Covenants, without the Sword, are but Words, and of no strength to secure a man at all. Therefore notwithstanding the Lawes of Nature, (which every one hath then kept, when he has the will to keep them, when he can do it safely,) if there be no Power erected, or not great enough for our security; every man will and may lawfully rely on his own strength and art, for caution against all other men.” Id.

⁵⁹ Ekman [37] (“Defending his policies against those who doubt Hitler’s word, Chamberlain... in a speech to Parliament explains that his personal contact with Hitler allows him to say that Hitler ‘means what he says.’”).

⁶⁰ Id. (“After his meeting with Hitler, Chamberlain writes to his sister... in spite of the hardness and ruthlessness I thought I saw in his face, I got the impression that here was a man who could be relied upon when he had given his word...”).

⁶¹ Treaty of Mutual Guarantee, art. 16, Oct. 16, 1925, available at <https://treaties.un.org/doc/Publication/UNTS/Volume%2054/volume-I-1292-English.pdf> (Treaty of Mutual Guarantee, done at Locarno, October 16, 1925, Final Protocol of the Locarno Conference of the same Date and Collective Note to Germany dated London, December 1, 1925, regarding Article 16 of the Covenant of the League of Nations).

⁶² See Treaty of Mutual Guarantee, *supra* note 64, at art. 4(3);

In case of a flagrant violation of Article 2 of the present Treaty or of a flagrant breach of Articles 42 or 43 of the Treaty of Versailles by one of the High Contracting Parties, each of the other Contracting Parties hereby undertakes immediately to come to the help of the Party against whom such a violation or breach has been directed as soon as the said Power has been able to satisfy itself that this violation constitutes an unprovoked act of aggression and that by reason either of the crossing of the frontier or of the outbreak of hostilities or of the assembly of armed forces in the demilitarised zone immediate action is necessary. Nevertheless, the Council of the League of Nations, which will be seized of the question in accordance with the first paragraph of this Article, will issue its findings, and the High Contracting Parties undertake to act in accordance with the recommendations of the Council, provided that they are concurred in by all the Members other than the representatives of the Parties which have engaged in hostilities.

Id.

a parallel obligation to protect the borders in eastern Europe. In the end, World War II erupted after Germany did not respect the borders regarding Eastern Europe. Germany even blamed France for violating the Locarno Treaty, while entering into a defined alliance with the U.S.S.R.⁶³

Locarno Treaties represents an aristocratic ethos that five countries will be honest regarding each other.⁶⁴ However, it is not enough that they will be honest regarding each other, but the honesty should be expanded to a general honesty, at least to a minimal general honesty. This example represents the instability of partial honesty (this is a proposal for a democratization of the aristocratic values). This example also illustrates the advantage of Keynes not only on the Treaty of Versailles, but also regarding Locarno Treaties.⁶⁵ Keynes proposed a solution based on generosity.⁶⁶ One of the advantages of generosity on honesty is that partial generosity may be enough where partial honesty is not enough, and every honesty or generosity is always partial. If states intend to be generous toward each other they will be at least honest, while if they intend to be honest, they may fail. In the Jewish law, some rabbies demanded more than they believe the Torah commanded “in order to keep a man far from transgression.”⁶⁷ Let us say: generosity keeps a state far from transgression; it is like taking a security range. Moreover, since there may be sincere disputes about what is fair, it is not enough that countries will decide to adopt a policy of honesty. This is particularly valid when there is no consented court to decide what honesty commands. Thus, contrary to Realpolitik, we propose that the solution to the absence of enforcement mechanisms in international law is the combination of conditional generosity and the choice to be subject to international law and to the international court regardless of the choice of the other side. We argue that it is in the best interest of each country to adopt such a policy since by this they choose better games. It is

⁶³ S.A.H (38).

⁶⁴ Lindley-French [39] (“a complex interplay between the traditional balance of power approach to security and the collective security, disarmament and international arbitration enshrined in the Treaty of Versailles resulted in strategic paralysis. The nadir of this failed strategic concept was the Treaty of Locarno in 1925 that, by endeavouring to keep all states happy at all times, simply prevented the creation of an effective security and defence mechanism.”).

⁶⁵ See Churchill, *supra* note 54, at 28;

The pact of Locarno was concerned only with peace in the West, and it was hoped that what was called an “Eastern Locarno” might be its successor. We should have been very glad if the danger of some future war between Germany and Russia could have been controlled in the same spirit and by similar measures as the possibility of war between Germany and France. Even the Germany of Stresemann was however disinclined to close the door on German claims in the East, or to accept the territorial treaty position about Poland, Danzig, the Corridor, and Upper Silesia. Soviet Russia brooded in her isolation behind the Cordon Sanitaire of anti-Bolshevik States. Although our efforts were continued, no progress was made in the East. I did not at any time close my mind to an attempt to give Germany greater satisfaction on her eastern frontier. But no opportunity arose during these brief years of hope.

Id.

⁶⁶ See Keynes [20].

⁶⁷ Mishnah Berakhot 1:1.

much cheaper to be conditionally generous than to prepare for war, and commitment to international law incentivizes the other side to prepare much less to a war against you, and that the policy of respecting international law should not be dependent on the choice of the other player. Unilateral acceptance of international law is sufficient in order to lead to a huge improvement in the security of the state.⁶⁸

Let us now combine the above-mentioned criticism of the policy toward Germany between the two world wars: the alternative of Keynes that presented a solution of conditional generosity. Instead of this, a solution of partial-honesty was chosen, i.e. a solution in which the security of five countries is guaranteed, but not the security of the other countries in Europe. The Treaty of Versailles did not establish equilibrium,

⁶⁸ Aumann should be praised for his proposal to use game theory in order to compare between the Isaiah game and the Roman game, and we praise him despite coming to different conclusions from this comparison. Before his Nobel lecture, Aumann gave a public pilot lecture in the Rationality Center, that sparked an extremely interesting (and critical) discussion. He claimed that his vision teaches that the vision of Isaiah cannot be an equilibrium, since according to this vision people do not prepare for wars. However, in such a case one player changes their strategy to prepare for war in order to occupy. Aumann was erred in his pilot lecture since according to this vision, there is an international court. Fortunately, in the prize lecture itself Aumann changed his mind and wrote:

We end with a passage from the prophet Isaiah (2, 2–4): “And it shall come to pass... that... many people shall go and say,... let us go up to the mountain of the Lord,... and He will teach us of His ways, and we will walk in His paths.... And He shall judge among the nations, and shall rebuke many people; and they shall beat their swords into ploughshares, and their spears into pruning hooks; nation shall not lift up sword against nation, neither shall they learn war any more.” Isaiah is saying that the nations can beat their swords into ploughshares when there is a central government—a Lord, recognized by all. In the absence of that, one can perhaps have peace—no nation lifting up its sword against another. But the swords must continue to be there—they cannot be beaten into ploughshares—and the nations must continue to learn war, in order not to fight!

Aumann (2006). It is a huge improvement, but Aumann erred in the choice of the game and in missing the option to play unilaterally the game of international law. The example of the EU challenges the thesis of Aumann, since in the EU it seems that there is an equilibrium in which no country will attempt to occupy the other country even if their victory is assured. Aumann ignores cases of countries that prefer not to occupy even when their victory is assured. See [40, 41]. Moreover, a state may adopt unilaterally a policy of respecting international law, and by this reducing dramatically the incentive to be armed against them. Instead of using the vision of Isaiah in order to study how to change the game in order to have more peace and a significant disarming, Aumann used the vision in order to explain why to arm when we do not play the game of Isaiah. The mistake of Aumann is first of all in the choice of the game: Aumann recommend to play the roman strategy, based on the argument that we do not play Isaiah game so a country should not play unilaterally the Isaiah game, instead of asking how to play a game that will be closer to the Isaiah game, in which an international law discourages arming. We argue that it may be done by countries' unilateral choice to respect international law. Unilateral acceptance is sufficient in order to lead to a huge improvement in the security of both sides, and when enough countries accept it, we may move from playing the game of old Europe to playing the game of the European Union. We praise Aumann for his comparison between the Jewish game of peace and the Roman game of peace, yet Aumann is erred that the Romans are right when we do not have a central government. We do not only have different recommendation from those of Aumann, but also a different methodology: Aumann adopts the tradition of Von Neumann and Morgenstern to take the game as given, while we first of all attempt to prevent the bad games, including by unilateral choice of the game.

since given the lack of enforcement mechanism the Germans did not see it in their best interest to respect the Treaty of Versailles, particularly since the Treaty of Versailles also created hostile feelings.⁶⁹ The policy of what to enforce and what not to enforce strengthened the incentive of Germany to go to war, since it incentivized Germany to develop their military industry. The solution of Locarno was insufficient in order to prevent wars; it represented partial honesty, since the eastern part of Europe was not protected effectively by the treaty, and in the end the war erupted after Germany invaded this part of Europe. The Treaty of Locarno may have misled Germany to believe that the Western European countries will contain their occupations in the Eastern Europe parts.

We propose that the right attitude is to ask how to establish a peace equilibrium that leads to minimal injustice. This attitude synthesizes the two alternatives: it tries to achieve the goal of minimizing global injustice but recognizes the need to create powers, namely, institutions, that make this goal possible, namely, that achieve peace equilibrium.

While Realpolitik is blind to justice in the name of stability, we say that there is no zero-sum game between justice and stability. Reducing injustice changes the preferences and even incentives in a way that may strengthen stability. Kissinger is right in his criticism against Treaty of Versailles, however Kissinger sees the Realpolitik as the right substitute to the Treaty of Versailles, while we see Keynes' plan as the right substitute to the Treaty of Versailles, namely, peace that is based not on a policy on generosity. Thus, we strongly disagree with Kissinger and Aumann (although our project studies a lot from both of them), and adopt Keynes; thus, we reject the models of Vienna Congress and the Pax Romana and support the model of the EU. Keynes proposed an aristocratic solution that is based on generosity, while Kissinger who admires the solution of Vienna's Congress supports conservative Prussic aristocracy.⁷⁰

⁶⁹ Der Spiegel, *Henry Kissinger Interview with Der Spiegel*, HENRYAKISSINGER.COM (July 6, 2009), <https://www.henryakissinger.com/interviews/henry-kissinger-interview-with-der-spiegel/>.

Any international system must have two key elements for it to work. One, it has to have a certain equilibrium of power that makes overthrowing the system difficult and costly. Secondly, it has to have a sense of legitimacy. That means that the majority of the states must believe that the settlement is essentially just. Versailles failed on both grounds. The Versailles meetings excluded the two largest continental powers: Germany and Russia. If one imagines that an international system had to be preserved against a disaffected defector, the possibility of achieving a balance of power within it was inherently weak. Therefore, it lacked both equilibrium and a sense of legitimacy.

Id.

⁷⁰ Kissinger [15] ("It is only natural that a period anxiously seeking to wrest peace from the threat of nuclear extinction should look nostalgically to the last great successful effort to settle international disputes by means of a diplomatic conference, the Congress of Vienna. Nothing is more tempting than to ascribe its achievements to the very process of negotiation, to diplomatic skill, and to 'willingness to come to an agreement'—and nothing is more dangerous. For the effectiveness of diplomacy depends on elements transcending it, in part on the domestic structure of the states comprising the international order, in part on their power relationship.").

Let us mention another better alternative to the the Realpolitik. In his “Sinews of peace” speech Churchill made this point:

If we adhere faithfully to the Charter of the United Nations and walk forward in sedate and sober strength seeking no one’s land or treasure, seeking to lay no arbitrary control upon the thoughts of men; if all British moral and material forces and convictions are joined with your own in fraternal association, the high-roads of the future will be clear, not only for us but for all, not only for our time, but for a century to come.⁷¹

By this he proposed to accept unilaterally international law. The strategy of Churchill to “*adhere faithfully to the Charter of the United Nations*”⁷² is his advantage on the strategy of the Pax Romana: “[i]f you want peace, prepare for war,” and on strategies that attempt to follow the Pax Romana, such this of Aumann.⁷³ This is how Thomas willing Balch characterized the relationship of the romans regarding international law, “[t]he Greeks made some attempts at arbitration among themselves, notably in an agreement between the Lacedaemonians and the Argives. But with the ‘barbarians’ who formed the rest of the world, the Greeks, apparently, would not arbitrate. For a long time the Romans as the masters of the world maintained peace by force of arms but not by arbitration.”⁷⁴ Contrary to the vision of the Pax

⁷¹ Winston Churchill, *The Sinews of Peace (Iron Curtain Speech)*, AMERICA’S NATIONAL CHURCHILL MUSEUM, [history.html#:~:text=On%20March%205%2C%201946%2C%20the,%22The%20Sinews%20of%20Peace.%22](#) (last visited August 12, 2022).

⁷² Id.

⁷³ See Yisrael Aumann, *Israel70: Yisrael Aumann on gaming Israel’s Future*, FATHOM (March 2018), <https://fathomjournal.org/israel70-yisrael-aumann-on-gaming-israels-future/>

Why do the Swiss need fighter planes if they’ve been at peace for so long?’ I responded that that’s exactly why! They have peace because they are strong. The runners-up to the Swiss are the Romans, who had a Pax Romana which lasted for about 230 years and who had a maxim: ‘If you want peace, prepare for war.’ Yet while Israel does prepare for war, it’s not getting peace. That’s because while we may be preparing for war in *hardware*—investing in the tools of war such as tanks, missiles, ground forces and drones, we are failing to prepare for war in *software*—deep down in our hearts. To fully follow the Roman axiom, a country has to feel deep down that it is ready to fight. But our heart isn’t fully in it.

⁷⁴ Balch [42].

Romana, that is glorified by Aumann,⁷⁵ Churchill recommends about being prepared for war, but also about respecting unilaterally international law.⁷⁶

Let us now compare what lesson Aumann and Churchill study from the absence of mechanism to enforce international law. Aumann claimed, in his Noel lecture,

Isaiah is saying that the nations can beat their swords into ploughshares when there is a central government—a Lord, recognized by all. In the absence of that, one can perhaps have peace—no nation lifting up its sword against another. But the swords must continue to be there—they cannot be beaten into ploughshares—and the nations must continue to learn war, in order not to fight!⁷⁷

Contrary to him, Churchill claimed:

I have, however, a definite and practical proposal to make for action. Courts and magistrates may be set up but they cannot function without sheriffs and constables. The United Nations Organisation must immediately begin to be equipped with an international armed force. In such a matter we can only go step by step, but we must begin now. I propose that each of the Powers and States should be invited to delegate a certain number of air squadrons to the service of the world organization . . . I wished to see this done after the First World War, and I devoutly trust it may be done forthwith.⁷⁸

Let us comment on the difference: Aumann takes the international game as given and recommends what strategy to take in this game, while Churchill recommends about changing the game to be more peaceful one.

Let us note also some other international relations' policies that should be rejected: the solution of George W. Bush (before September 11, 2001), to the fiasco of Israel and Palestine to achieve peace agreement, was "let them bleed."⁷⁹ In other words, Bush

⁷⁵ Steve Lind, *Nobel Advice: Israeli Strength and Peace, According to Prof. Yisrael Aumann*, JERUSALEM POST (July 28, 2018 13:35), <https://www.jpost.com/jerusalem-report/nobel-advice-israel-strength-and-peace-according-to-prof-aumann-563395>; Aumann explained his view in an interview:

There was the Pax Romana, which lasted well over 200 years. It kept the whole Western world at peace. How did they do it? Now, I don't like the Romans, OK? They destroyed the Temple and they were cruel people, but they kept the peace, and if you want peace, you have to look at what they did. The motto on my blackboard, "Si vis pacem, para bellum" means "If you want peace, prepare for war." That's a Roman proverb, OK, and people don't understand that. You know, I was at a conference of sorts of a medical unit of the IDF, and someone said, "We never come up with this. We don't have to deal with this because it never happens." But I say (he raises his voice), "You have to deal with it in order to keep it from happening!"

Id.

⁷⁶ He claimed: "From what I have seen of our Russian friends and Allies during the war, I am convinced that there is nothing they admire so much as strength, and there is nothing for which they have less respect than for weakness, especially military weakness." Id.

⁷⁷ Aumann, *supra* note 71, at 17078.

⁷⁸ Winston Churchill, *The Sinews of Peace (Iron Curtain Speech)*, AMERICA'S NATIONAL CHURCHILL MUSEUM, [history.html#:~:text=On%20March%205%2C%201946%2C%20the,%22The%20Sinews%20of%20Peace.%22](https://www.nationalchurchillmuseum.org/history/html#:~:text=On%20March%205%2C%201946%2C%20the,%22The%20Sinews%20of%20Peace.%22) (last visited August 12, 2022).

⁷⁹ See Lev Grinberg, *The Busharon Global War*, FPIF.ORG (July 8, 2002), https://fpif.org/the_busharon_global_war/. See also Aluf Benn, *Bush's Middle East Band-Aid*, SALON.COM (March 22, 2002 8:23 PM EST), https://www.salon.com/2002/03/22/peace_8/.

proposed the parties to fight and then to discover the balance of power between them. This solution illustrates the disadvantages of Realpolitik: sometimes the balance of power is unclear, and this may lead negotiations to fail without having an option of solution by adjudication. Meanwhile the parties may develop a more hostile feeling that makes the solution much more difficult; even if they corrected their mistakes regarding their balance of power before the last fight between them, it does not mean that they know what their current balance of power is. The country that wins the former war may be over optimistic regarding the result of the next war, which makes it more difficult to prevent the next war. Bush changed his policy after September 11, 2001, however his wars in the name of justice, democracy and human rights did not lead to democracy but to the raising of ISIS.⁸⁰ Bush was right that democratization may lead to much more security, however he was wrong in believing that the right way to spark democracy is by wars. It was much cheaper for the U.S. to promote democracy in the Middle East by Keynes' style solution: to invest in education, development and subsidizing peace agreements. The tragedy of rejecting the proposal of Keynes has repeated again and again, and we try to develop his theory and propose a combination of respecting international law and generosity.

7.5 From Negotiation to Litigation in Peace Processes

We argue, here, that a shift from a game of international negotiation in the shadow of the war (a realist negotiation) to a game of international negotiation in the shadow of the law will have three main effects: a distributive effect, an effect of reducing the incentive to arm and terrorize, and increasing the likelihood of peace.

First, this shift has a distributive effect. While in the negotiation mechanism, the settlement will be a function of force, in the litigation mechanism, it will be a function of law. Second, the shift from negotiation to litigation influences the incentives, particularly this shift reduces the incentive to pursue terrorism. Third, the shift from negotiation in the shadow of the war to a negotiation in the shadow of international law increases our likelihood to reach an agreement. In the negotiation mechanism there are possible obstacles ("market failures")⁸¹ in our way to achieve a settlement.

The shift from a negotiation in the shadow of the war to a negotiation in the shadow of international law may happen in two main ways: the first way is by establishing an international court with universal jurisdiction and an enforcement mechanism. According to the vision of the U.N. Charter:

⁸⁰ Hassan Hassan, *The True Origins of ISIS*, THE ATLANTIC (November 30, 2018), <https://www.theatlantic.com/ideas/archive/2018/11/isis-origins-anbari-zarqawi/577030/> ("Most historians of the Islamic State agree that the group emerged out of al-Qaeda in Iraq as a response to the U.S. invasion in 2003").

⁸¹ See [43]. See also [44].

Article 33

The parties to any dispute, the continuance of which is likely to endanger the maintenance of international peace and security, shall, first of all, seek a solution by negotiation, enquiry, mediation, conciliation, arbitration, judicial settlement, resort to regional agencies or arrangements, or other peaceful means of their own choice. The Security Council shall, when it deems necessary, call upon the parties to settle their dispute by such means.⁸²

Article 36(3)

In making recommendations under this Article the Security Council should also take into consideration that legal disputes should as a general rule be referred by the parties to the International Court of Justice in accordance with the provisions of the Statute of the Court.⁸³

The vision of the UN charter is legally strengthened by the Rome Statute, in which it is sufficient that either the invading country or the invaded country is a member in order that the court will have jurisdiction regarding war crimes, crimes against humanity and the crime of genocide, but regarding aggression usually the consent of both sides is needed (the crime of Aggression limits the right of a country to go to war, to impose a blockade or an occupation regime, or to annex a territory).⁸⁴ The Rome Statute establishes an international criminal court that may impose an individual responsibility and may also oblige to pay repressions.⁸⁵

The second way to shift from a negotiation in the shadow of the war to a negotiation in the shadow of international law is by a state's choice to subject itself *unilaterally* to international law.⁸⁶ Many countries prefer to accept the jurisdiction of the International Court of Justice and the International Criminal Court; this helps those countries to enjoy peace. The statute of the international court of justice determines:

The states parties to the present Statute may at any time declare that they recognize as compulsory ipso facto and without special agreement, in relation to any other state accepting the same obligation, the jurisdiction of the Court in all legal disputes concerning: the interpretation of a treaty; any question of international law; the existence of any fact which, if

⁸² U.N. Charter art. 33.

⁸³ U.N. Charter art. 36(3).

⁸⁴ See Rome Statute, art. 51, available at [https://legal.un.org/icc/statute/english/rome_statute\(e\).pdf](https://legal.un.org/icc/statute/english/rome_statute(e).pdf) [hereinafter Rome Statute];

Crimes within the jurisdiction of the Court The jurisdiction of the Court shall be limited to the most serious crimes of concern to the international community as a whole. The Court has jurisdiction in accordance with this Statute with respect to the following crimes: (a) The crime of genocide; (b) Crimes against humanity; (c) War crimes; (d) The crime of aggression.

Id.

⁸⁵ See Rome Statute, *supra* note 87, at art. 258 (“[1] The Court shall have jurisdiction over natural persons pursuant to this Statute. [2] A person who commits a crime within the jurisdiction of the Court shall be individually responsible and liable for punishment in accordance with this Statute.”).

⁸⁶ It is interesting that the international law enables unilateral declarations and obligation: “Any State possesses capacity to undertake legal obligations through unilateral declarations.” Int’l Law Comm’n, Guiding Principles Applicable to Unilateral Declarations of States Capable of Creating Legal Obligations (2006), https://legal.un.org/ilc/texts/instruments/english/draft_articles/9_9_2006.pdf. See also Rubin [45].

established, would constitute a breach of an international obligation; the nature or extent of the reparation to be made for the breach of an international obligation.⁸⁷

Seventy-three states chose to accept the compulsory jurisdiction of the Court.⁸⁸

Each State which has recognized the compulsory jurisdiction of the Court has in principle the right to bring any one or more other States, which have accepted the same obligation, before the Court, by filing an application instituting proceeding with the Court. Conversely, it undertakes to appear before the Court should proceedings be instituted against it by one or more other such States.⁸⁹

Realpolitik ignores that there are states which choose voluntarily to be subject to international law.⁹⁰ Realpolitik sees the obligation to international law as no more than beautiful empty words, since the court has no mechanism to enforce its decisions.⁹¹ Realpolitik's supporters ignore that even when the courts have no mechanism to enforce their decisions, the decisions and potential decisions matter.⁹² Other realists will say that it is because such countries have peace. They ignore that those countries enjoy peace since they accept international law. They ignore that while a country commits itself to respect the legal rights of the other country/people, they reduce the incentive to arm against them. Moreover, when a criminal state makes a concession, they always fear that it encourages terrorism; they ignore that what encourages terrorism is that they are ready to make a concession if and only if the other party strikes them.

⁸⁷ Statute of the International Court of Justice, INTERNATIONAL COURT OF JUSTICE, (2017), <https://www.icj-cij.org/en/basis-of-jurisdiction>.

⁸⁸ International Court of Justice, *Declarations Recognizing the Jurisdiction of the Court as Compulsory*, ICJ-CIJ.ORG, <https://www.icj-cij.org/en/declarations> (last visited August 12, 2022).

⁸⁹ International Court of Justice, *supra* note 91.

⁹⁰ Jack and Eric [46] ("International law is a real phenomenon, but international law scholars exaggerate its power and significance. We have argued that the best explanation for when and why states comply with international law is not that states have internalized international law, or have a habit of complying with it, or are drawn by its moral pull, but simply that states act out of self-interest.").

⁹¹ Scott [47] ("There is as yet no coherent theoretical explanation of the phenomenon that is able to reconcile the apparent discrepancy between the support that the United States showed for the system of international law in the immediate post-World War II years and the recent actions/inactions with which observers take issue. Realism, which has been the dominant paradigm in International Relations in the post-World War II era, has scant regard for international law. And yet this article suggests, somewhat counter-intuitively, that the most fundamental tenets of realism regarding state behaviour can in fact well account for US behaviour in relation to international law; the identified 'attitude' of the United States towards international law would appear to have been integral to the hegemonic rise of the United States.").

⁹² See [48]. Dothan argues that international courts interact with states under their jurisdiction and with their national courts. Id. International courts try to preserve their legitimacy vis-à-vis states; at the same time, they want to signal that states will comply with them even if they issue judgments states disagree with. Id. International courts can cooperate with national courts and gain legitimacy from interacting with legitimate national courts. Id. The norms that international courts apply constrain their ability to maneuver their judgments in ways that can help their legitimacy, but at the same time help legitimize their judgments. Id. International courts use various tactics to shape their reasoning in order to improve their legitimacy. Id.

Robert J. Aumann is used to give the example of the Israeli withdrawal from Gaza⁹³; he claims that it led to extreme violence, since it was in response to attacks against Israel.⁹⁴ Aumann is right that the Israeli withdrawal from Gaza had an effect of incentivizing terrorism. However, Aumann dismisses that it is because Israel adopted a policy of not respecting international law unless the victim of Israel's international law violation leads Israel to say to themselves that the price for the violation will be high enough, and this is even if the price is illegal violence by the victim. He further dismissed that if Israel withdrew from occupied territories as a step of regret on the criminal settlements and as a credible choice to respect the rights of the Palestinians, then these incentives would have never existed.

We will illustrate the mistaken approach of Aumann by this example: Aumann should be praised for publicly correcting his mistake and recognizing in the Israeli occupation.⁹⁵ However, we wonder why it did not lead him to change his mind regarding the Palestinians' rights, and his support in the settlements in the occupied territories. Thus, adopting the views of Aumann will encourage terrorism, since for Aumann international law is not a sufficient reason for avoiding from establishing settlements in occupied territories, although it is clearly forbidden. By his support in the Israeli settlements, Aumann unintentionally signals to the Palestinians: your international legal rights, or at least your international legal rights in the eyes of the majority of international lawyers, are not a strong enough reason for me to respect them. Thus, the conclusion is that Aumann unintentionally proposes to create a game in which every concession for peace is an incentive to terrorism. This is so since the

⁹³ Amanda Borschel-Dan, *Israeli-Palestinian Peace a Matter of Incentives, says Nobel Laureate Aumann*, THE TIMES OF ISRAEL (13 December 2018, 4:05 PM) <https://www.timesofisrael.com/mideast-peace-a-matter-of-incentives-says-nobel-laureate-aumann/> (Aumann claimed: Everybody wants peace in the Middle East, said Aumann; however, proclaiming that desire may actually drive the fulfilment of it farther away. This applies, too, to any "concessions," such as the 2005 Disengagement from Gaza, in which Israel unilaterally pulled its settlers and troops from the region, which quickly became a stronghold for the terrorist organization Hamas. "When you shout, 'peace, peace, peace,' then it's a signal [to the adversary] to up the price," said Aumann. "The expulsion from Gaza—ancient history—was a very very bad move," he said, and taught the Palestinians that if they put on enough pressure, Israel will capitulate. "We are giving them incentives to press on.").

⁹⁴ Lee Smith, *Wrong Move*, TABLET MAG. (Sept. 22, 2010), <https://www.tabletmag.com/sections/israel-middle-east/articles/wrong-move>.

⁹⁵ *Israeli Nobel Laureate: We Should Annex Now, Not 'Talk It To Death'*, JERUSALEM POST (June 6, 2020 8:33 A.M.), <https://www.jpost.com/israel-news/professor-aumann-we-should-annex-now-not-talk-it-to-death-630494>.

I used to be upset when people would talk about "the occupation." It's our country, which we're willing to share with the Arabs, so why do they call it "occupation?" But a while ago, not too long ago, I changed my mind. It is an occupation. We have a military government in Judea and Samaria.

There's been a military government for 51 years now. If you have a military government, then you have an occupation. That's what an occupation means. I think if we want peace, we have to end the occupation. What do you mean by that? What do I mean by ending the occupation? I mean that we belong there, but there has to be some kind of application of Israeli law in Judea and Samaria. Area C is very large, comparatively. It's not as big as Siberia, but it's quite large and there's lots of empty land and lots of Jewish communities there. I think we should go ahead, take the initiative and annex large tracts of Area C.

Id.

other side does not see the concession as a choice to respect their international legal rights or as an expression of generosity or peace-loving, but as a capitulation to violence; and Aumann criticizes every such concession to peace as an incentive to terrorism, and by this combination Aumann unintentionally blocks the game of negotiation without threats to use force.

In the game created by Aumann, it is impossible to have peace without giving a signal of capitulating to violence, and since Aumann resists to any capitulating to violence, and resists respecting the international legal rights of the other, his strategy is a one that makes peace impossible. Thus, Aumann's recommendations create a game similar to zero-sum game, in which agreements are impossible. This usage of game theory dismisses the achievements of modern economic theory, particularly that trade is for the benefit of the two players and hence we should not interrupt trade.⁹⁶

We criticize Aumann for not resisting the settlements although he recognized the occupation. Aumann misses that this policy incentivized terrorism. Furthermore, we argue that the policy of denying the occupation also incentivized terrorism. The Israeli Prime Minister, Ariel Sharon, resisted to say why he chose to withdraw from Gaza.⁹⁷ In an extremely rare moment, he said: "[o]ccupation is bad."⁹⁸ Immediately, the Israeli Chief Attorney, Eliakim Rubinstein, said to him, "[d]o not say occupation,"⁹⁹ since his use of the word could weaken Israel's position in negotiations.¹⁰⁰ By this, Rubinstein encouraged terrorism; he wished to block any Israeli acknowledgment of the occupation, since he denied the illegality of the Israeli settlements in the occupied territories. Consequently, the Israeli legal system prevents Israel from making concession based on international law, and by this they encourage terrorism; it sabotages the security of Israel by denying that the Palestinian have rights of occupied people in the occupied territories; the Israeli legal system makes respecting international law to be a submission to violence, and by this encouraging violence. The Israeli legal system forces Israel to play a game of a choice between encouraging terrorism by not respecting international law, or encouraging terrorism by respecting international law, which is a surrender to terrorism in the eyes of the Israelis who do not recognize the Palestinians' rights. Israel pays an enormous price for its institutional lies regarding the non-existence of the occupation. The choice to lie and deny

⁹⁶ Adam [49]. "[T]rade which, without force or constraint, is naturally and regularly carried on between any two places, is always advantageous, though not always equally." Id. at Book IV, ch. III, § II. When a state is committed to international law it is much easier for the state to play the game of bargaining without force or constraint that Smith recommends about. Id.

⁹⁷ Yael [50] ("Sharon explained that he was pursuing his plan because 'a situation has been created in which it is possible to do the things I want and to get an American commitment.'").

⁹⁸ AP Archive, *Israeli PM Says Occupation is Bad for Us and Them*, YOUTUBE, (Jul. 23, 2015), <https://www.youtube.com/watch?v=9fzlkAfxBs>. See also Kelly Wallace, *Sharon: 'Occupation' Terrible for Israel, Palestinians*, CNN (May 27, 2003), <https://edition.cnn.com/2003/WORLD/meast/05/26/mideast/>.

⁹⁹ Rebecca Trounsan & Megan K. Stack, *Sharon Says 'Occupation' Not What He Meant*, LA TIMES (May 28, 2003), <https://www.latimes.com/archives/la-xpm-2003-may-28-fg-mideast28-story.html>.

¹⁰⁰ Id.

the Palestinians' rights forces Israel to play a risky game, in which it is impossible to allocate the rights peacefully.

It is the complex of the Macho, that occupying countries may suffer from: the macho's roll when they have the power. They necessarily make mistakes in their calculation, but they cannot correct their mistakes, since it will be a capitulation to terrorism. We say that respecting international law is the right way to discourage terrorism. Honesty is the minimal demand and respecting international law is the minimal demand for a state to be honest. There is even a better strategy: this that was recommended by Keynes, the strategy of generosity.¹⁰¹ We recommend this international relations' strategy: being always honest and being conditionally generous.

7.6 Realist Negotiation Versus Negotiation in the Shadow of the Law

According to the traditional view, international conflicts should be solved via a mechanism of negotiation.¹⁰² This means that the conflict should be solved via negotiation; it does not tell it explicitly, but the implicit significance is that in a situation of failure to reach an agreement, the state of war will continue. Thus, the two bargaining sides know that if an agreement is not being achieved, the state of war will continue, and this may lead to actual war. Each side's alternative for an agreement is a state of war, namely, the game of a state of war. Thus, the resisting payoff of each side is a function of its payoff from playing the game of war, what may be called his value of playing the war game. The resisting payoff is the payoff of a side in the case of no agreement. the resisting payoff is also called the threat payoff. Thus, the agreement will be a function of power, which encourages us to prepare for war.

One alternative for the negotiation mechanism that we want to discuss is the Litigation mechanism. The word "Litigation" consists of negotiation and litigation;

¹⁰¹ See [40, 41].

¹⁰² Situation in the State of Palestine, ICC-01/18–103, Observations by the Federal Republic of Germany (March 16, 2020), <https://www.icc-cpi.int/court-record/icc-01/18-103>. In its submission to the International Criminal Court, Germany claimed:

It is Germany's long-standing and consistent position to support a negotiated two state solution and hence the goal of an independent, democratic, sovereign and viable State of Palestine. To this end, Germany aims at preserving the conditions allowing for a two-state solution. Germany is one of the most important donors to the Palestinians, linking development cooperation and stabilization funds to the build-up of state institutions. However, it is Germany's consistent position that a Palestinian State, and the determination of territorial boundaries, can be achieved only through direct negotiations between Israelis and Palestinians. The Court would be ill-suited for determination of these issues.

Id.

it is a negotiation in the shadow of the law.¹⁰³ This means that the two bargaining sides know that if the negotiation fails, a specific court will decide on the solution. The two parties may agree about a different tribunal, but there is a default of legal mechanism that they cannot choose. In this case, the two sides know that their alternative for an agreement is the game of litigation. It is important to emphasize that the court is not going to decide in any case. The great majority of cases are not going to arrive at a judicial decision. The two sides are incentivized to come to a settlement in order to save the litigation costs, including the risk, which is involved in litigation.

The current dominant mechanism in international law is negotiation.¹⁰⁴ The International Court of Justice has no universal jurisdiction.¹⁰⁵ The proposal that this court will have universal jurisdiction was rejected by the establishing states of the new order after the Second World War.¹⁰⁶ The jurisdiction of this court is dependent on the contest of the two parties (or on the authority given by the Security Council or the General Assembly, which can ask for advisory opinion).¹⁰⁷ The new mechanism of the international criminal court may change the picture since it has a partial universal jurisdiction regarding war crimes, crimes against humanity, and genocide.

Let us now compare between the game of international negotiation to the game of international Litigation, namely, a game in which if negotiation fails the parties will go to court. We will discuss what will be the distributive effect from changing the game of negotiation in the shadow of the war to a negotiation in the shadow of international law, what new incentive this change will create, and how it will influence the likelihood to achieve agreement.

¹⁰³ Galanter (51) (defining “litigation,” as “the strategic pursuit of a settlement through mobilizing the court process”). For Galanter’s general approach, *see also* (52).

¹⁰⁴ *See* Barnidge [53] (“Negotiation is undoubtedly the oldest means of dispute settlement. In their dissenting opinions in *Mavrommatis*, Judges Moore and Pessa referred to it as, respectively, the ‘legal and orderly administrative process by which governments, in the exercise of their unquestionable powers, conduct their relations one with another and discuss, adjust and settle, their differences’ and as ‘debate or discussion between the representatives of rival interests, discussion during which each puts forward his arguments and contests those of his opponent.’”). *See* *The Mavrommatis Palestine Concessions*, 1924 P.C.I.J. (ser. A) No. 2, at 11–12 (August 30).

¹⁰⁵ Thirlway (54).

¹⁰⁶ Hovell (55) (“Despite the conscience of humanity having been pricked by the state-deployed barbarism of the Holocaust and World War II, there was still no discernible shift from state to international jurisdiction... Although US Chief Prosecutor Robert Jackson opened the trial at Nuremberg observing that ‘the real complaining party at your bar is civilization’, the Nuremberg tribunal based its authority not on universal jurisdiction but on the territorial jurisdiction of the occupying powers.”).

¹⁰⁷ *See* U.N. Charter, art. 96 (“[1] The General Assembly or the Security Council may request the International Court of Justice to give an advisory opinion on any legal question. [2] Other organs of the United Nations and specialized agencies, which may at any time be so authorized by the General Assembly, may also request advisory opinions of the Court on legal questions arising within the scope of their activities.”).

7.6.1 *The Distributive Effect*

The shift from a game of realist negotiation to a game of negotiation in the shadow of the law has a significant distributive effect. While in the realist negotiation game, the settlement is a function of force, in the game of negotiation in the shadow of international law it is a function of law. If the international court has full compliance, then the settlement will reflect more or less the estimation of the judgment of the court, namely, the international legal rights.

For the goal of illustration, let us take this example, in which we compare between two ideal games:

Two sides have a dispute over a certain territory. The outcome of a war between them regarding the territory will be such that the first side is going to gain 75% of the territory, while the second only 25%.¹⁰⁸ Each side evaluates their war cost to be equivalent to 15% of the territory. In contrast, if they go to court, the judgment of the tribunal in this particular case will be (50%, 50%). The litigation costs of each side are equivalent to 1% of the territory.

In the game of realist negotiation, i.e., a game in which the parties negotiating without taking into account international law, each party will not agree to any settlement, in which it awards less than its outcome in a war minus their war costs. The first party will not agree to any settlement, in which it awards less than $75\% - 15\% = 60\%$. This means that its resisting payoff is sixty. The second party will not agree to any settlement, in which it awards less than $25\% - 15\% = 10\%$. This means that its resisting payoff is 10%. The peace settlement creates a surplus of thirty, which is the saving of war costs. If the two sides distribute equally the surplus between them, the settlement will be (75%, 25%).

In the game of negotiation in the shadow of international law the parties are incentivized to come to a settlement in order to reduce the litigation costs (in the ideal game that we discuss there is no legal uncertainty as in real life, and legal uncertainty creates litigation cost).¹⁰⁹ This time, each party will not agree to any settlement, in which it gets less than the judgment less the litigation costs. It means, the first party will not agree to any settlement, in which it gets less than $50\% - 1\% = 49\%$. The second party will also agree only to a settlement, in which it gets at least $50\% - 1\% = 49\%$. If they are going to equally distribute the surplus between them, then the settlement will be (50%, 50%).

We can see that the move from the negotiation mechanism to the Litigation mechanism in this particular example leads to a shift from a settlement of (75%, 25%) to a settlement of (50%, 50%). It means that this move leads to a transfer of 25% from the strong party to the weak party. While the first settlement reflects

¹⁰⁸ It can be so since they are expected to divide the territory (75/25) at the end of the war or because the first side has 75% to win the territory and the second only 25%.

¹⁰⁹ Weiss [56].

the balance of power in war, the second settlement reflects the balance of rights in court.¹¹⁰

One may think that since in the realist negotiation game, the strong benefits more territory than in the game of negotiation in the shadow of the law, it is worthwhile for this state to play the realist negotiation game. It is like saying: if you can rob without being caught by the police, do it. This policy may give the country more territory, but the honest policy will bring them more peace, security, democracy and prosperity. This game shows why fascism is so dangerous: the fetishism of territory without taking international law and justice seriously leads to risky games. History tells us the price of fascism.

Of course, there is uncertainty regarding the result of the war. A country may choose between the game of war that may lead them to loss of life and the game of peace that may lead them to loss of territory they may win in war. When we think about peace and war via this method that was proposed by Wald, this refutes the rationality of the nation's choice to go to war.¹¹¹ The player who takes the decision to go to war is usually the leader that in peace may lose their job, while in war others' life. This is why the international criminal court is so important, and particularly the (too limited) jurisdiction regarding aggression: since the responsibility is individualistic, this may reduce the agency problem in peace and war: the problem that many wars have been caused because of the self-interest of the leaders.

7.6.2 *The Morals from the Above Example*

In every negotiation each side has a resisting payoff. It is their payoff in the case of no agreement. The resisting payoff of a side is the minimal sum that this side will accept. It is rational for a side to reject lower proposals. In the negotiation mechanism the resisting payoff of each side is their payoff from the playing game of war. However, in the Litigation mechanism, the resisting payoff of each side is their payoff from

¹¹⁰ In the General Case, after we have shown the distributive effect in a particular example, let us examine a more general case. The outcome of war is (W_1, W_2) . The war costs are (WC_1, WC_2) . The judgment is (J_1, J_2) . The Litigation costs are (LC_1, LC_2) . Thus, in the Negotiation Mechanism, the threat payoff of the first side is $W_1 - WC_1$. The threat payoff of the second side is $W_2 - WC_2$. So, if they are going to distribute the surplus equally, the settlement will be $[W_1 + (WC_2 - WC_1)/2, W_2 + (WC_1 - WC_2)/2]$. In the Litigation Mechanism, the threat payoff of the first side is $J_1 - LC_1$. The threat payoff of the second side is $J_2 - LC_2$. So, if they are going to distribute the surplus equally, the settlement will be $[J_1 + (LC_2 - LC_1)/2, J_2 + (LC_1 - LC_2)/2]$. We can see that in the move from the Negotiation Mechanism to the Litigation Mechanism there is transfer of $[J_i + (LC_{-i} - LC_i)/2 - W_i - (WC_{-i} - WC_i)/2] = \{J_i - W_i + [(LC_{-i} - LC_i) - (WC_{-i} - WC_i)]/2\}$, which is the gap between its international rights and its force.

¹¹¹ See [57]. See also [58]. Abraham Wald asked a simple question: if you do not know whether it is going to rain, what should you do? He had a simple answer, but one that changes the theory dramatically: you need to choose between two potential mistakes: that you will not take the umbrella and want to use it, and that you will take it and not use it. Id. See also [59]. Clearly, you can decide what mistake is more expensive.

playing the game of an international adjudication. In the negotiation mechanism the bargaining power of each side is its force in war, while in the Litigation mechanism is its rights in court.

Martin Luther King distinguished Negative Peace from Positive Peace.¹¹² Negative Peace is the absence of tension, while Positive Peace is also the presence of justice.¹¹³ We conclude that realist negotiation leads to a negative peace, but not to a positive peace, while playing the game of negotiation in the shadow of international law leads to a positive Peace.

7.6.3 *The Reduction of Terrorism Effect*

The realist negotiation game encourages each side to reduce the payoff of the other side in the case of war, thus this game encourages each side to maximize the war costs of its opponent. In order to maximize their costs, it may take steps of terrorism, occupation, cruel blockade, collective punishment, etc. Keynes said that what gives trade union power in the negotiation is that they convince the employee that they may strike in the future.¹¹⁴ Trade unions take strikes in order to indicate that they may strike tomorrow, that they adopt a strategy of striking until their demands are accepted.¹¹⁵ Similarly, in a realist negotiation game a side may terrorise in order to indicate that they may terrorize again, if their demands are not met, that they adopt a strategy of fighting until their demands are accepted.

Let us illustrate. In the above-mentioned example, the resisting payoff of the strong side was 60%, which is payoff from playing the game of war: (75%) minus its war costs (10%). Let us examine what will happen if the weak side takes a policy of hard terrorism and increases the war costs to 30%. Then, the resisting payoff of the first side will be $75\% - 30\% = 45\%$. If the first party doesn't increase the war costs of the second party, then its resisting payoff will continue to be 25%. Hence, the settlement will be (65%, 35%). It means, that in the realist negotiation game, when one party increases its terrorism, it also decreases the resisting payoff of the other side.

However, if the game is negotiated in the shadow of international law, then no party can benefit from increasing the war costs of the other side (unless the court submits a threat in violence, and this example teaches why courts should not give in to threats to use violence).

We can study from this analysis that it is not true that international law only interrupts state to fight terrorism. Actually, a move from a mechanism of negotiation to an effective mechanism of Litigation reduces terrorism dramatically. This move

¹¹² King [60].

¹¹³ Id.

¹¹⁴ Keynes [61].

¹¹⁵ Id. See also [62].

neutralizes the incentive to terrorize and actually creates an incentive to be honest in order to gain the sympathy of the court.

The abovementioned game may be changed even unilaterally. If the strong party is ready to divide the land according to international rights, it will abolish the incentive of the weak party to pursue terrorism. Let us illustrate it: in the above-mentioned example, the division according to international law is (50%, 50%), while the division according to the power is (75%, 25%), when the weak side does not pursue terrorism, and (65%, 35%) while the weak side pursues terrorism. If the strong side is ready to share the law (50%, 50%) as international law commands, it abolished the incentive to manage terrorism and even to arm, but if the strong side refuses to respect international law, it leads to an incentive to pursue terrorism. Our point is that changing the game unilaterally by choosing to be obliged to international law leads to a huge improvement.

In his Nobel lecture, Aumann claimed that “Isaiah is saying that the nations can beat their swords into ploughshares when there is a central government—a Lord, recognized by all. In the absence of that, one can perhaps have peace—no nation lifting up its sword against another.”¹¹⁶ Our analysis teaches that even when we do not have a central government to enforce international law, a state may reduce dramatically the incentive to arm against them by being committed to international law, and that the state can do it even unilaterally.

7.6.4 *The Effect on the Chance to Achieve Peace*

According to the theory of Ronald Coase, the parties will maximize their pie, if there is no transaction cost.¹¹⁷ Coase did not define what transaction cost is, and the law and economics read him as saying that if there is no failure in the way of rational sides to maximize their common pie they will do it regardless to the initial allocation of the property rights or the legal rules (when they do not limit the freedom of contracts).¹¹⁸ This seems trivial, but it is also wrong, since it is not true for example when a dollar for the rich is not equivalent to a dollar for the poor.¹¹⁹ Despite this, we can study from Coase to ask what failures prevent agreements even when the two sides have

¹¹⁶ Robert J. Aumann, *supra* note 71, at 17078.

¹¹⁷ [63].

¹¹⁸ This is how Posner summarized what he called Coase Theorem: “[i]f transaction costs are zero, the initial assignment of a property right—for example, whether to the polluter or to the victim of pollution—will not affect the efficiency with which resources are allocated.” Posner [64]. This is how Weiss translated Coase theorem to the language of game theory: “the wrongdoing will be done if and only if the total benefit of the coalition of the manager and the sender from making the wrongdoing is bigger than the total cost of this coalition from committing the wrongdoing, including the transaction cost that is needed in order to create this coalition.” [5, 6].

¹¹⁹ See [65] (“The Coase Theorem is interpreted as asserting that the equilibrium level of an externally (e.g., pollution) is independent of institutional factors (in particular, assignment of liability for damage), except in the presence of transaction costs. It is shown here that absence of income

an opportunity to achieve mutual gain, and how to prevent those potential failures. We can also study from Coase's theory that the default is that the sides will not dismiss opportunities to mutual gain, and that in order to understand why and when agreements fail, we can think about failures. There are obstacles that prevent rational players from reaching agreements. In the case of internal legal disputes, the option of litigation prevents the violence. This solution should be applied to international relations too.

Rational players may go to war; we will analyse the potential failures of parties' way to achieve agreement, and then will attempt to find solutions for them. For example, since one of the major problems in achieving an agreement is a lack of information—asymmetric information¹²⁰ or excessive optimism—we will propose to establish mechanisms of information flow as a way to improve the chance to achieve peace. Wilson was right when he determined that every treaty between countries should be transparent,¹²¹ and this principle should be extended to other factors that influence the balance of power. One modest but very important outcome of this recommendation might be to open international negotiations to media coverage.

We can learn from discussion that also perfect rational players may fail to achieve cooperation, even when it is for their mutual advantage. Aumann proposed to learn from this that we should not say: "let's make love, not war."¹²² The truth is the opposite: since we cannot rely on mutual rationality to prevent wars, we should discourage hostile feelings, and encourage friendly feelings. Another moral is that since negotiation sometimes fails, we cannot rely on negotiation, but need to have international institutions, such as international courts. We should have institutions that in the case negotiation fails, the adopted alternative will not be war. Litigation, and not war, should be the continuation of politics by other means.

Bertrand Russell famously referred to the Cold War as a game of "chicken" between two teenagers driving toward each other on a collision course.¹²³ One of the drivers must swerve, or both may die in the crash, but if one driver swerves and the other doesn't, the one who swerved will be called a "chicken," meaning a coward.¹²⁴ Russell used the analogy to support his call for nuclear disarmament—as the possibility of a "crash" exists.¹²⁵ To achieve it, Russell supported the international government.¹²⁶

effects (due to parallel preferences or quasi-linear utility functions) is not only sufficient (which is well known) but also necessary for this to be true.”).

¹²⁰ Akerlof, *supra* note 84, at 488.

¹²¹ The Fourteen Points, (President Woodrow Wilson), available at <https://www.theworldwar.org/learn/peace/fourteen-points> (last visited September 1, 2022).

¹²² See Robert J. Aumann, *Game Engineering*, Discussion Paper #518, Hebrew Univ. Jerusalem 1, 11 (2009), <https://sites.duke.edu/niou/files/2011/05/Aumann-Game-Engineering.pdf>.

¹²³ Russell [66].

¹²⁴ *Id.*

¹²⁵ *Id.*

¹²⁶ *Id.*

Moreover, an additional obstacle to agreement may be that a party will not wish to give in to unfair demands; it is recognised in game theory that proposals that seem to be unfair may be rejected even in one-time anonymous situations.¹²⁷ The strategy of not capitulating to unfair demands may be rational, at least when it is a submission to coercion. This is so since a strategy of not giving in to coercion may prevent the coercion and a strategy of giving in to coercion invites the coercion. In international conflicts each side tends to think that they are right. This tendency is usually strengthened by the indoctrination of the formal educational system. People who appeal to the national narrative may be denounced as traitors. When the two sides have two contradicted narratives or values, there may be a situation that there is no agreement that will be seen by both sides to be one that is not a submission to coercion. When this is the case, and when each side commits itself sufficiently not to submit to coercion, there will be no agreement. International litigation may play a very important role here: it prevents this game, if respecting the decision of international court is not perceived to be a submission to coercion. Moreover, while war incentivizes each side to demonize the other side, litigation incentivizes each side to understand the claims of the other side. International litigation may prevent the above-mentioned failure in the way to peace agreements. The option of international litigation in case negotiation fails discourages sides from committing to hard lines.

Let us imagine that the Israeli Aumann will negotiate with the Palestinian Aumann; each of them will say that all the holy land is mine. I wish to have peace. However, the right way to make peace is not by concessions. If I give you a part of the holy land, I will incentivize you to command terrorism against me, since it is clear for both of us that I will not make any concession if it was not in my interest, and it is not in my interest to give you anything if you do not have power to oblige me. The inevitable result will be endless war. Respecting international law prevents the game of Aumann versus Aumann, and this is a big advantage of countries who respect international law. A peaceful nation will not adopt a strategy that if the two sides take it, it makes peace impossible, and international law should discourage such strategies.

In one of his public lectures, Aumann explained that it is rational to say: that all is mine. It is his lesson from the Mishna¹²⁸:

Two holding a garment. One of them says, "I found it," and the other says, "I found it." One of them says, "It is all mine," and the other says, "It is all mine." Then, one swears that his share in it is not less than half, and the other swears that his share in it is not less than half and it should then be divided between them.¹²⁹

¹²⁷ Such as in the ultimatum game. Participants in experiments of this game tend to reject proposals that give them more money than their rejection gives them. See [67].

¹²⁸ The Talmud assumes that every party speaks sincerely, and the Talmud obliges each side to take an Oath that he has at least half of the Tallit. (We thank Eli Rafal for the last observation regarding the Otha, a private conversation with Uri Weiss).

¹²⁹ The Mishnah: A New Integrated Translation And Commentary: *Mishnah Bava Me Tzia* 1:1. (Machon Y. Trust trans., 2012).

Aumann explained his support in the New-Right party by saying that they are convinced that the Jewish people have a right on all the holy land.¹³⁰

Aumann dismisses that if a party says that everything is its own, then either this side closes the door before any compromise or makes any compromise to be a submission to force, what he sees as encouraging terrorism.¹³¹ Thus, Aumann repeated the mistake of Ze'ev Jabotinsky, who said that he studied a little bit of Talmud but gained his (political) wisdom from the Talmud and said that he concluded from the abovementioned Mishna that we should say that all the holy land is ours.¹³² Similar to Aumann, Jabotinsky saw compromises as encouraging terrorism, and he resisted even to negotiation in the argument that it will lead the other side to illusions that will lead to more resistance by it.¹³³ The combination of the proposals of Jabotinsky is what makes them so dangerous.

States that instead of claiming strategically: “all is mine,” recognize the international legal rights of the other side, and adopt a strategy of respecting international law and are ready to litigate in the case if dispute, will have much more peace and security.

The game of negotiation is not enough in order to ensure peace. Thus, it is better to choose to play the game of negotiation plus respecting international law. By choosing to respect international law, a nation changes the game they play, having more opportunities to peace, and incentivizes much less terrorism against them.

7.7 Conclusion

We compared two games of international negotiations. In one game the inability to resolve a conflict by negotiation leads to war. In the other game, this inability leads to some international courts. The first game leads to negotiations under the shadow of war, whereas the second game leads to negotiations under the protection of international law. There are three important differences between these games. The first difference between these games is the distributive effect: in it each player can threaten the other. This renders negotiations a function of military setups. In the second game, the threat is of litigation in the international court. This renders negotiation a function of international law. The second difference between these

¹³⁰ Naftali Bennett, *Nobel Prize winner Yisrael Aumann announces support for the New Right*, YOUTUBE (Mar. 12, 2019), <https://www.youtube.com/watch?v=9Ki4F4Ff9RY&t=58s>.

¹³¹ Amanda Borschel-Dan, *Israeli-Palestinian Peace A Matter of Incentives, Says Nobel Laureate Aumann*, TIMES OF ISRAEL (December 13, 2018, 4:05 PM), <https://www.timesofisrael.com/mid-east-peace-a-matter-of-incentives-says-nobel-laureate-aumann/> (“‘The common wisdom—or foolishness—is that making concessions will bring peace. It doesn’t bring about peace, it brings about war—it’s the opposite,’ he said. ‘The expulsion from Gaza has brought all the wars in the Gaza area ever since. We are giving them incentives to keep pressing. We are rewarding their attacks.’”).

¹³² Ze'ev Jabotinsky, *a Program for temporal government in Israel, Jaffa (1919)* (available in Hebrew at <https://benyehuda.org/read/7047>).

¹³³ Jabotinsky [68].

games is that the first game provides incentives for armament for each party so as to render threats to attack credible. The third difference concerns situations that follow failures of negotiations. Sometimes parties fail to reach agreement even though potential agreements exist that would make all parties better off.

The above comparison between two games of international negotiations leads to two morals. First, the international community should change the game of international relations. The international community should oblige or at least encourage international arbitration. The second, perhaps more important, moral is this. States should unilaterally reduce conflict by preferring the game of negotiation under the shadow of international law over any game played under the threat of war. When a state is committed to international law, then they improve their own security. This is so since they thereby declare that they will not attack their neighbours even when an easy victory is assured. The commitment to respect international law reduces dramatically the incentive for playing the game of arms race. We thus recommend every country to adopt the policy of honesty, namely, of respecting international law unilaterally, and of conditional generosity. Generosity is the readiness to yield more than the law demands.

References

1. De Waal, F.: *Primates and Philosophers: How Morality Evolved*, vol. 3 (2016)
2. Hobbes, T.: *Leviathan* ch. 17 (1651). Available at <https://www.gutenberg.org/files/3207/3207-h/3207-h.htm>
3. Smith, M.J.: *Realist Through from Weber to Kissinger*, vol. 13 (1986)
4. Feld, S.L.: Why your friends have more friends than you do. *Am. J. Socio.* **96**, 1464–1477 (1991)
5. Weiss, U.: The ICC should not encourage occupation. *Touro L. Rev.* **37**, 797 (2021)
6. Weiss, U.: The Talmudic prisoner's dilemma. *Touro L. Rev.* **37**, 341 (2021)
7. Bolton, J.R.: Is there really "law" in international affairs? *Transnat'l L. Contemp. Probs.* **10**(1), 48 (2000)
8. von Clausewitz, K.: *On war* 596 (Matthijs Jolles, O.J. trans., 1943)
9. Austin, J.: *The Province of Jurisprudence Determined*, vol. 208 (1832)
10. Hathaway, O., Shapiro, S.J.: Outcasting: enforcement in domestic and international. *Yale L.J.* **121**, 252 (2011)
11. Schrijver, N.: The changing nature of state sovereignty. *Brit. Y.B. Int'l L.* **70**, 65 (1999)
12. Bartelson, J.: The concept of sovereignty revisited. *Eur. J. Int'l L.* **17**, 463 (2006)
13. Delbrueck, J.: International protection of human rights and state sovereignty. *Ind. L.J.* **57**, 567 (1981)
14. Trindade, A.A.C.: *International Law for Humankind*, vol. 10, 3rd edn (2010)
15. Kissinger, H.A.: The congress of Vienna: a reappraisal. *World Pol.* **8**, 264 (1956)
16. Kissinger, H.: *Diplomacy*, vol. 218 (1994)
17. Bevans, ed.: *2 Treaties and Other International Agreements of the United States of America 1776–1949*, at 43 (1972). Available at <https://tile.loc.gov/storage-services/service/ll/ltreaties//ltreaties-ustbv002/ltreaties-ustbv002.pdf>
18. Ebegebulem, J.C.: The failure of collective security in the post world wars I and II international system. *Khazar J. Humans. Soc. Scis.* **14**, 29–32 (2012)
19. Dorsey, L.G.: Woodrow Wilson's fight for the league of nations: a reexamination. *Rhetoric Pub. Affs.* **2**, 107 (1999)

20. Keynes, J.M.: The economic consequences of the peace **147**, 272–73 (1920)
21. Keynes, J.M.: A revision of the treaty: being a sequel to the economic consequences of the peace 77 (1922)
22. Anderson, K.: The rise of international criminal law: intended and unintended consequences. *Eur. J. Int'l L.* **20**, 331 (2009)
23. Agassi, J.: Liberal nationalism for Israel: towards an Israeli national identity 89–90 (1999)
24. Walkinshaw, R.B.: The Nuremberg and Tokyo trials: another step toward international justice. *Am. Bar Ass'n J.* **35**, 299–302 (1949)
25. Peskin, V.: Beyond victor's justice? The challenge of prosecuting the winners at the international criminal tribunals for the former Yugoslavia and Rwanda. *J. Hum. Rts.* **4**, 213 (2005)
26. Draper, G.I.A.D.: The Eichmann trial: a judicial precedent. *Int'l Affs. (Royal Inst. Int'l Affs. 1944-)* **38**, 485, 492–93 (1962)
27. Mann, I.: The dual foundation of universal jurisdiction: towards a jurisprudence for the "Court of Critique". *Transnat'l Legal Theory* **1**, 485–489 (2010)
28. O'keefe, R.: Universal jurisdiction: clarifying the basic concept. *J. Int'l Crim. Just.* **2**, 735–746 (2004)
29. Roht-Arriaza, N.: The Pinochet precedent and universal jurisdiction. *New Eng. L. Rev.* **35**, 311 (2000)
30. Sole, A.P.: The Pinochet case in Spain. *ILSA J. Int'l Compar. L.* **6**, 653 (1999)
31. Hola, B., et al.: International sentencing facts and figures: sentencing practice at the ICTY and ICTR. *J. Int'l Crim. Just.* **9**, 411 (2011)
32. United Nations.: Rome statute of the international criminal court. *Soc. Just.* 125–43 (1999)
33. Hobsbawm, E.: The age of extremes 34 (1996)
34. Keynes, J.M.: The economic consequences of the peace XXV (2017)
35. Nash, Jr., J.F.: Equilibrium points in N-person games. *Proc. Nat'l Acad. Sci. US.* **36**, 48–49 (1950)
36. Keynes, J.M.: A revision of the treaty 4 (2020)
37. Ekman, P.: *Telling Lies: Clues to Deceit in the Marketplace, Politics, and Marriage*, 21st edn, pp. 15–16 (1985)
38. S.A.H.: Note on the Franco-Soviet pact and the Locarno treaty. *Bull. Int'l News* **12**, 8 (1936)
39. Lindley-French, J.: In the shade of Locarno? Why European defence is failing. *Int'l Affairs* **78**, 789–811 (2002)
40. Weiss, U., Agassi, J.: The game theory of the European Union versus the Pax Romana. *DePaul L. Rev.* **70**, 551 (2020)
41. Weiss, U., Joseph, A.: The game theory of the European Union versus the Pax Romana. *DePaul L. Rev.* **70**, 551–556 (2020)
42. Balch, T.W.: The proposed international tribunal of arbitration of 1623. *Procs. Am. Phil. Soc'y* **46**, 302–11 (1907)
43. George, A.A.: The market for "Lemons": quality uncertainty and the market mechanism. *Q. J. Econ.* **84**, 488 (1970)
44. Branislav, L.S., Ahmer, T.: Mutual optimism as a rationalist explanation of war. *Am. J. Pol. Sci.* **55**, 135 (2011)
45. Rubin, A.P.: The international legal effects of unilateral declarations. *Am. J. Int'l L.* **71**, 1–30 (1977)
46. Jack, L.G., Eric, A.P.: The limits of international law 225 (2005)
47. Scott, S.V.: Is there room for international law in realpolitik?: Accounting for the US 'Attitude' towards international law. *Rev Int'l Stud* **30**, 71–73 (2004)
48. Shai, D.: How international courts enhance their legitimacy. *Theoretical Inquiries in L.* **14**, 455–78 (2013)
49. Adam, S.: *The wealth of nations*, 1st edn (1776)
50. Yael, S.A.: From warfare to withdrawal: the legacy of Ariel Sharon. *Israel Stud.* **15**, 149–72 (2010)
51. Galanter, M.: Worlds of deals: using negotiation to teach about legal process. *J. Legal Educ.* **34**, 268 (1984)

52. Galanter, M.: Why the “Haves” come out ahead: speculations on the limits of legal change. *L. Soc’y Rev.* **9**, 1 (1974)
53. Barnidge, Jr., R.P.: The international law of negotiation as a means of dispute settlement. *Fordham Int’l L.J.* **36**, 545–548 (2013)
54. Thirlway, H.: The international court of justice 35 (2016)
55. Hovell, D.: The authority of universal jurisdiction. *Eur. J. Int’l L.* **29**, 427–445 (2018)
56. Weiss, U.: The regressive effect of legal uncertainty. *J. Disp. Resol.* 149 (2019)
57. Wald, A.: Statistical decision functions which minimize the maximum risk. *Ann. Math.* **46**, 265 (1945)
58. Wald, A.: Statistical decision functions **25**, 52–59 (1950)
59. Wald, A.: On the principles of statistical inference. *Bull. Amer. Math. Soc’y* **48**, 639–40 (1942)
60. King, Jr., M.L.: Letter from Birmingham Jail. *U.C. Davis L. Rev.* **26**, 835–842 (1992)
61. Keynes, J.M.: The general theory of employment, interest, and money chap. 19, II, (6), p. 264. (1960). <http://gutenberg.net.au/ebooks03/0300071h/printall.html>
62. Weiss, U.: About suffering and law in the labour market. *J. Corp. L.* **46**, 385 (2020)
63. Coase, R.H.: Classic papers in natural resource economics: the problem of social cost 87–137 (1960)
64. Posner, R.A.: Ronald coase and methodology. *J. Econ. Perspect.* **7**, 195 (1993)
65. Hurwicz, L.: What is the coase theorem?. *Jpn. World Econ.* **7**, 49–74 (1995)
66. Russell, B.W.: Common sense and nuclear warfare 30 (1959)
67. Roth, A.E., et al.: Bargaining and market behavior in Jerusalem, Ljubljana, Pittsburgh, and Tokyo: an experimental study. *Am. Econ. Rev.* **81**, 1068 (1991)
68. Jabotinsky, Z.: The iron wall (1925). <http://en.jabotinsky.org/media/9747/the-iron-wall.pdf>
69. Keynes, J.M.: The economic consequences of the peace. **102**, 164 (1920)
70. Robert, J.A.: War and Peace. *Proc. Nat’l Acad. Sci. USA.* **103**, 17075–17078 (2006)
71. Henry, A.K.: The congress of Vienna: a reappraisal. *World Pol.* **8**, 264–280 (1956)

Chapter 8

Mutual Threat: The Cold War Game



What must be avoided during a cold war? The reply of Bertrand Russel [1] was that the game of chicken must be avoided. He described the game between the USSR and US as a super-game in which every country can refuse playing the (repeat) game of chicken. We will discuss some subsets of the chicken game: the simultaneous one versus the sequential one, one with free information and one without free information, one with an option of communication versus one without this option. Some games are clearly much more dangerous than others; they can be prevented easily by the flow of credible information. We will also contrast the replies of Schelling [2] and Aumann [3], who supported MAD strategy, with that of Ellsberg [4]. Schelling and Aumann have proposed to apply the strategy of attacking if and only if the other side attacks, while Ellsberg has pointed out that the commitment to attack with big enough probability is sufficient in order to prevent the other side from attacking. (Ellsberg actually proposed to minimize the price of deterrence, while Schelling did not see the price). We argue that Russel's proposal is better, and Ellsberg's is a better choice of the plan of action in the bad game. We propose that even small changes in the choice of the chicken game may make the game less risky. There are many variants of the chicken game, some are much less risky than the others, and some changes of the game can be done with ease.

8.1 The Cold War After 1949

What game was the cold war? What did that matter? In response to this, we will present some morals, such as the importance of freedom of information and of not posing as a sheep in a wolf's clothing.

The invention of game theory fuelled the continuing discussions of international relations, especially of the cold war. This is understandable, since the first questions in applied game theory, the initial task of analysing real-life games, always concern the game being played and the strategy that each party chooses; the answers to the

two questions are interdependent, of course. Almost all discussions of the matter fail in this initial task, due to the differences that game theoreticians see and those that the players see before them between the options and the consequences from them, and the priorities of the players regarding the possible results of the game. In real life situations, regarding the outcome of each strategy, the different parties who play a game seldom hold the same views about it as game theoreticians do.

Russel wrote:

Since the nuclear stalemate became apparent, the Governments of East and West have adopted the policy which Mr. Dulles calls 'brinkmanship'. This is a policy adapted from a sport which, I am told, is practiced by some youthful degenerates. This sport is called 'Chicken!'. It is played by choosing a long straight road with a white line down the middle and starting two very fast cars towards each other from opposite ends. Each car is expected to keep the wheels on one side of the white line. As they approach each other, mutual destruction becomes more and more imminent. If one of them swerves from the white line before the other, the other, as they pass, shouts 'Chicken!', and the one who has swerved becomes an object of contempt. As played by irresponsible boys, this game is considered decadent and immoral, though only the lives of the players are risked. But when the game is played by eminent statesmen, who risk not only their own lives but those of many hundreds of millions of human beings, it is thought on both sides that the statesmen on one side are displaying a high degree of wisdom and courage, and only the statesmen on the other side are reprehensible. This, of course, is absurd. Both are to blame for playing such an incredibly dangerous game. The game may be played without misfortune a few times, but sooner or later it will come to be felt that loss of face is more dreadful than nuclear annihilation. The moment will come when neither side can face the derisive cry of 'Chicken!' from the other side. When that moment is come, the statesmen of both sides will plunge the world into destruction.¹

The interaction between the US and USSR was often viewed as the chicken game and described as Russel did. Yet, as One may see in the above extended quotation, he held the unpopular view of it as a super game in which each side has the opportunity to avoid unilaterally playing the (repeatable) chicken game. The most important proposal of Russel was that we should prevent this chicken game as it is too risky. The conclusion from his proposal for game theoreticians should be to seek ways to prevent risky games. This is our main thesis here: Russell's way is the right way; we should restructure game theory around this idea. Russel had a minimalist view: avoid the risky game and try to propose a way to prevent it by replacing it with a new game: create a new world-order with a global government of sorts. A new world government may prevent not only the chicken game, but also the super-game: prevent the possibility of nations playing the chicken game. The very idea of a global government is that a nation cannot go to a war against another nation without it becoming a concern of all other nations. Russel had a minimal program: preventing the risky game of the cold war, as well as a maximal program: creating a new game of a global government. By this, he had some great advantages over the mainstream game theory and on the mechanism design theory. Game theory considers the game as given, while mechanism design theory enables the choice of the game, but on the questionable supposition that the players will choose the utopian game; this makes the theory useless. Moreover, in the mechanism design theory that concerns the

¹ Russell [1].

design of social settings to meet given ends, the social planner constrains the choice of a game to play. Russel spoke about a situation without such a social planner. He recommends the player to avoid playing a risky game, and he recommended the different players to convene in order to agree on a contract that will establish a central planner, namely, to create a new game (by agreement). Both in game theory and in mechanism theory, the existence or absence of the social planner is given; Russel differs. Thus, he promotes a super-super-game. We recommend taking this proposal of Russel as the basis of a new theory, the extended game theory. The mechanism design theory is viewed as a generalisation of Vickrey [5] who recommended to the auctioneer which mechanism of bidding to propose.² If the auctioneer is also a player, then it is not true that mechanism design is a generalisation of Vickrey since they recommend the social planner what to do, but not recommend the player not to do. The point of Russel is that the players can change the game and establish a mechanism of social planning, and this is dismissed by both game theory and mechanism theory. Both game theory and the mechanism theory ignore the social contract that enables players to change any game.³

Russel thought that the game that empires did not avoid from playing during the cold war was a repeated chicken game. It is not quite true, since the chicken game is a simultaneous game, with the full availability of all relevant information, in which communication is impossible. Let us distinguish between the classical chicken game and some of its variants: there may be a repeatable game of chicken, and there may be a sequential game of chicken: a game in which the one player chooses, and then the other responds; and there may be a variant of the game of chicken with limited information: for example, there may be a case in which one player does not know what is the game, and there may be a case in which possibly the game played is that of chicken, and there may be a variant in which communication is possible, and there may be a variant in which it is possible to sign a public agreement of one sort or another. Another variant is the game of who will blink first, in which the game ends when one player blinks. If no player blinks, it is the worst result for both players. Each player prefers the other player to blink. When no player blinks, the payoff of each party is decreased. (the pie shrinks). Thus, in this game it is better for a player to blink immediately than later. It is important to understand the differences between those variants, since there are variants that are much riskier games than the others, and the games may be transformed easily, and even unilaterally. Thus, even when

² Vickrey [5].

³ This approach of game theory and mechanism design theory is a deviation from the tradition of Adam Smith (1776) who saw the possibility that small number of people will erect and maintain a public good: "According to the system of natural liberty, the sovereign has only three duties to attend to; ... thirdly, the duty of erecting and maintaining certain public works, and certain public institutions, which it can never be for the interest of any individual, or small number of individuals to erect and maintain; because the profit could never repay the expense to any individual, or small number of individuals, though it may frequently do much more than repay it to a great society". Game theory and mechanism theory represents a regression from this approach while Russel proposed a progression to Smith's approach: to make it possible for coalitions of citizens to evolve into a grand coalition that would institute a global government.

we cannot avoid the whole group of variants of chicken, we may be able to prevent the game of chicken-without-information. When a player chooses to be transparent, they usually immediately change the game for the better.

The question, what game do certain parties play on a certain occasion is not always answerable in a clear-cut manner, since players are not always aware of all the options and then the consequences of their actions may become apparent only too late. The Chicken game, also known as the Hawk-Dove game, is such an example. In it, each side decides whether to act as a dove or as a hawk, where their joint decisions amount to choices from among four options, four possible payoffs, ordered in their degrees of desirability. If one party chooses to be a hawk and the other decides to be a dove, then the hawk will achieve the best payoff, and the dove will achieve the third. If they both choose to be hawks, then they will achieve the least desirable, fourth payoff. If they both decide to be doves, then both will achieve the second payoff.

	Hawk (do not move)	Dove (move)
Hawk (do not move)	Worst, worst	Best, third best
Dove (move)	Third best, best	Second best, second best

The game of chicken is completely equivalent to the Hawk-Dove game (they have the same matrix as shown above), but we have two different stories: in the story of the Hawk-Dove game each player chooses whether to be hawkish or dovish, and if they are both dovish then they will have a compromise to the benefit of both of them (usually such that each player will get 50% of the surplus, but not necessarily so), and if they are both dovish, there is collapse, and if one player is hawkish and the other is dovish they will not dismiss the opportunity to cooperate but in such a way that the hawkish will get much more.

The tables of the two games are equivalent, but the story of the chicken game sounds fit for a subset of the game, in which the payoff from collapse is much less than the payoff from being “chicken”, and the story of the hawk-dove game sounds fit also for much less extreme situations. Let us say, the story of the chicken sounds when this is for example the payoff matrix:

	Move	Don't move
Move	0, 0	1, -1
Don't move	-1, 1	-100,000, -100,000

The story of Hawk-Dove sounds when this is for example the matrix:

	Move	Don't move
Move	50, 50	25, 75
Don't move	75, 25	0, 0

Again, the hawk-dove game is equivalent to the chicken game. What determines whether it is this game or not is the order of the payoff, although the story sounds completely different. Russel is right in saying that it is stupid to play the particular chicken game mentioned in his original story, since in this game one can gain a macho honour but lose one's life and killing the other player; it should be taken into account, however, that it is possible to represent negotiation as the chicken game: a person who demands more than 50% of the surplus may be considered hawkish, and the one who demands 50% or less than the surplus may be considered dovish. If the two parties are hawkish, then the negotiation between them will collapse, but if the two parties are dovish, they will achieve a deal for mutual benefit. Russel spoke about a particular game of chicken in which the payoffs are such that it is stupid to play it, since the potential loss for either is enormous while the potential gains are negligible. Indeed, the chicken game represents almost every bilateral negotiation game. In a perfect competition the players do not play such a game, since there is no room for bargaining: the players will not deviate from the marketplace price. Thus, the free market reduces such games. Trade unions create incentives for it (what leads to strikes when the two parties play hawkishly enough). Russel would agree with us that on the whole trade unions improve society. He spoke against a particular game of chicken, the one that game theorists have meanwhile generalized. Furthermore, the point of Russel was that it is stupid to play on life, particularly in a game with the possible outcome of mutual destruction. He recommended the abolition of this game by establishing a world government. He was worried that the hawkish stance of both sides will usher the worst possible payoff of a nuclear holocaust.

Let us examine other differences between variants of the chicken game.

8.2 The Repeated Chicken Game Versus the One-Time Chicken Game

In the repeated chicken game, there may be a Nash equilibrium⁴ in which each side plays tit for tat.⁵ This will lead each player to act cooperatively in every round of the game. In such a case the action of each player will be as if they are dovish, exactly as if they took a policy of "always being dovish", the only difference is that they will maintain the threat to be hawkish if the other side becomes hawkish. Mutual strategy of playing always dovish is not a Nash equilibrium, since in this case the other player will be incentivized to play always hawkish. When one player is "always hawk", and the other player is "always dove", the game is in a Nash equilibrium.

However, in the one-time game there cannot be a Nash equilibrium in which both play in a cooperative way. In the one-time game, there may be a Nash equilibrium

⁴ A game is in Nash equilibrium if no player has incentive to change unilaterally their strategy.

⁵ A tit for tat strategy is a plan of those actions: to cooperate in the first round and then to do in each round what the player did in the previous round. Thus, if the two players adopt their strategy, they will cooperate in every round the game.

in which one player is Dove and the other player is Hawk, or a Nash equilibrium in which one player is Hawk, and the other player is dove. There is also a Nash equilibrium in “mixed strategies”. A mixed strategy is a strategy in which the player plays in probability P one strategy and in probability $1-P$ another strategy. The terrorist leader, for example, plays mixed strategy and also the police, since they do not check every case.⁶ In the symmetrical one-time Hawk-Dove game, there may be a Nash equilibrium in which each player plays Hawk with probability P , and plays Dove with probability $1-P$. Thus, there is a probability P^2 for collapse. The game theoretical literature celebrates mixed strategy but fails to provide interpretation. The key to understanding mixed strategy is to anchor game theory in social science. There is a social meaning to a mixed strategy, if and only if the game is played in a stable enough context. It may be when the game is repeated enough between the players, and it may be in a social context (what Nash called mass actions). For example, there may be a Nash equilibrium, accordingly when members in a particular society play Hawk-Dove, each member will be Hawk with P probability and Dove with $1-P$ probability. This may be because each member plays a mixed strategy. This may be because in a particular population P are hawks, and $1-P$ are Doves. In his thesis Nash [7] spoke about positions.⁷ He was too vague regarding this. There may be a Hawk-Dove game in which, in interactions between people from different positions, everyone sticks to the strategy of each position. There may be Hawk-Dove games between parties from different genders. There may be an equilibrium in which men are hawks, and women are doves in such interaction. This is why it is not sufficient to eliminate the legal and political discrimination in order to prevent gender inequality. There may be a chauvinistic Nash equilibrium, and they may be destabilized by legislation, by public discourse, and by pioneers who will rebel against them. (This is why patriarchal people are so afraid of women who break the chauvinistic norms, and this is why they should be praised).

From the comparison between the one-time game and the repeated game, one may conclude that the one-time chicken game is much more dangerous than the repeatable one.

⁶ The theory of Gary [6] actually proposes the state to enforce the law by the strategy of the terrorist: to reduce the number of policemen but to increase the punishment. Becker dismissed that the point of mixed strategy of making random choice cannot be achieved in real life, particularly when the police is racist, since then the exams will be based on race etc. The theory of mixed strategy can also teach us why racial profiling by the police or the security guards is risky: it gives immunity to people from the dominant groups, and to people who imitate their appearance. If the legal system legitimizes ethical profile exams, then in order to keep an equal level of punishment, those people from the dominated groups who are caught should face more lenient punishment. We propose to reject the terrorist theory of Becker, since where the state is terrorist in enforcing the law, the state will be criminal. The cost of law enforcement by the police is much cheaper than the cost of cruel punishment against the convicted people, what corrupts society. Becker does not recognize the possibility of mistake, although we know that there are false convictions. Their price in a legal system that adopts Becker is much more costly. Thus, when the theory of Becker stops to be trivial, it begins being a terrorist theory.

Becker [6].

⁷ Nash [7].

Moreover, in real life, the choice is not between being a hawk and being a dove, but between degrees of being this or that. Let us propose this non-binary Hawk-Dove game. This is the sophisticated dove-hawk game: each player has to choose how much they demand from the surplus created by cooperation, and if there is a room for agreement each player will receive their demand plus 50% of what is reminded to divide.⁸ There will be cooperation, if and only if the total demands are less than 100% of the surplus created by agreement. (The parties can increase the surplus, of course, for example by establishing not only cold peace but also trade agreements). This game is in a Nash equilibrium when the sum of what the players demand is exactly the total fund available. In that case, no player can benefit from changing their strategy. This equilibrium is risky, since the player may make mistakes, and it is sufficient that one player will be a little bit optimistic in order to achieve collapse. One may exaggerate one's assessment of the other player's flexibility; that will lead to excessive demand from the other, and that may lead to the collapse of the negotiation. This leads to four possible morals: 1. The one-time non-binary chicken game is very risky since not only that mutual dovishness is impossible as an equilibrium in this game, but that this game encourages countries to taking policies that may lead to wars because of misreading of the other sides. The Nash equilibrium in this game is such that a very small mistake will lead to a collapse. Since dictators tend to be arrogant, believe that they cannot make mistakes and do not have mechanisms such as freedom of speech to correct their mistakes, it is very risky to play this game with them. The problem is that even if the dictator demands 80% of the surplus, and the other side demands only 5%, the dictator may respond by demanding 95%, and so on until there will be a collapse. Thus, being dovish in the non-binary Hawk-Dove game may be insufficient to prevent the collapse, and thus this game should be prevented as possible, and when it is impossible it is very important to prevent mistakes by being transparent. The fascists are right that dovishness in such a game may not be sufficient for peace, but they ignore the possibility to prevent this game by peace agreements. They ignore that a peace agreement creates a new game. 2. Lack of information may lead to wars, while transparency may prevent them. We will expand this discussion later. 3. Communication that enables the sides to improve their proposals is essential to prevent wars. A game in which each player makes a take it or leave it proposal is a risky one. It is particularly risky when the player attempts to maximize their profit regardless of the rights and interest of the other sides. Countries that respect international law prevent this game. 4. When playing the non-binary chicken game, each player should choose between two possible mistakes: one possible mistake is to demand too less, and the price is to dismiss the opportunity to get more. The second possible mistake is to demand too much, and the price is that the cooperation will be avoided. Thus, in questions of peace and war, it is highly recommended for peace lovers not to risk the peace by insisting on territory. The Key is to respect international law and be generous. Moreover, it is a big mistake to see the success

⁸ One may also demand an ultra-sophisticated hawk-dove game: in this game, if the players succeed to cooperate, the first player receives their demand plus q from the reminded, and the second player will receive their demand from $1-q$ from the reminded.

of tough bargainers in the markets and to conclude that it will lead to a success in international relations too. When a tough businessperson dismisses a deal, they can reach another deal, and the cost of this mistake is usually small. However, when an opportunity for peace is dismissed the cost is always high. The game of chicken is a key for important insights, but it will be much more useful if we combine it with the theory of Wald that recommends choosing between different mistakes. Wald's theory enables us to see better the difference between a chicken game in international relation and the chicken game in business.

8.3 A Game with Complete Information Versus Games with Incomplete Information

In the Hawk-Dove game the assumption is that the player knows what game is played. They know the payoffs and the potential strategies. In the repeated game they know what the other player did in the previous game. However, the choice of the strategies takes place simultaneously. When the game is played in context, then the players may develop expectations regarding the strategies of the other player.

We would like to make the point that it is recommended for a state to make their strategy to be transparent, and thus to have freedom of information. It is highly recommended not to choose the combination of being hawkish and pretending to be dovish. Thus, while we strongly recommend respecting (even unilaterally) international law and being conditionally generous, we highly recommend for a state not to cheat and pretend that they respect international law or be generous, if they are not. Such pretending may provide false signals to the other party that may encourage them to adopt a policy that does not lead to war when the signals are true but does lead to war when the signals are false.

The question of when to fight, if any, is controversial. But obviously, if you can achieve your goal without fighting, it would be better. The art of deterrence is precisely the art of not using force: to cause the other side to withdraw before being forced to realize your threat.⁹ The other side will also benefit from this: instead of being attacked without an ultimatum, they will be warned first. They will have the opportunity to give up and prevent war.

So, whether we think it is worthwhile to be dovish or prefer to be hawkish, the worst thing for both parties is that one of them will be a hawk posing as a dove, a "wolf in sheep's skin." If the other side is going to attack a player if the player does not give up, they will both benefit if the player knows this, since then the player will have the opportunity to give up and prevent the war. If the policy is transparent, the two sides will have the opportunity to reach the outcome of the war even before the war—without the losses.

Let us present real life examples to the abovementioned theory. One may also learn how much the policy of "a wolf in sheep's skin" is risky from Harry Truman's

⁹ Schelling [8].

behaviour during the Cold War. Before the Korean War, the United States declared that Korea was outside the borders of defence.¹⁰ This means, the United States will not fight for Korea. Therefore, Stalin gave the green light to North Korea to invade South Korea. But the US did respond to the invasion by war, and millions were killed. We do not come here to argue that the United States should not have attacked, or to argue that it should have attacked, but to argue that it was a damaging and damaging mistake, that it acted like a wolf in sheep's skin. The United States made the Communists believe it would mess, and then attack. In doing so, the United States missed an opportunity to prevent war.

Another example is Stalin's deliberation on whether to invade Turkey. His spies at the Pentagon found that Truman had decided to respond to a future invasion by war. Thanks to those spies, Stalin decided not to attack. Those spies actually made the strategy of Truman visible by Stalin, which prevented the war. Truman also dropped an atomic bomb on Japan without threatening that the US has a nuclear weapon and is ready to use it if the Japanese do not surrender. The proposal of his scientific people was to impose the nuclear bomb on an uncolonized area, which will establish a credible threat without using it. Truman chose to attack without an ultimatum, which led to disaster. This missed an opportunity to prevent the many killings.

In the nineteenth century, the United States extorted an unfair trade contract from Japan. The US threatened Japan, and Japan surrendered. The war was spared.

The claim that the worst option is to be a "hawk in the skin of a dove" is to correct the claim that "if you choose to be dovish, you will transmit weakness, which will lead to war." When you give up, you get less but reduce the risk of a collapse. The problem arises when you mislead the other party into believing you will give up, that is, when you misrepresent. A nation's lies may drag her to war. What leads to war is not dovishness, as the fascists argue, but the pretending of being dovish. When liberal democracies oblige to respect international law, they prevent the other side from reading their respect for international law as a signal that they are open to extortion since they respect international law. When countries adopt a conditional generosity policy, misreading of their policy will not lead them to attack, but to cut their generosity.

Let us go now to the Israeli situation: Israel should be far more dovish, since peace and democracy are immeasurably important from the continuation of the occupation; But if Israel chooses to be a hawk—it would be better to avoid false displays of dovishness. One of the main reasons that Israeli Prime Minister Ehud Olmert (2006–2009) embarked on two wars was his wolf in sheepskin. He misled Hezbollah and Hamas that he would not respond to offensive actions in the war, which in fact did respond to them in the war. After the war, Hassan Nasrallah claimed that if he had anticipated the response, he would not have kidnapped the soldiers. Equally severe, as opposed to writing: "When thou comest nigh unto a city to fight against it, then proclaim

¹⁰ US President Harry S. Truman declared the Korean War as he declared its aim, he explained, to enforce a United Nations resolution calling for an end to hostilities and to stem the spread of communism in Asia. This latter aim caused the opposite result: it destroyed the hope to have a universal body that would arbitrate between hostile countries and reduce the likelihood of war.

peace unto it. (Deuteronomy 20:10; KJV)”, Olmert set out to fight without setting a real ultimatum. In the 2009 war against Gaza, he even deliberately misled Hamas: He declared that the government would discuss the Israeli response on Sunday and attacked Hamas on Saturday. Thus, he prevented Hamas from withdrawing at the last minute.

More generally, at the end of wars people are used to asking why the same arrangements that ended the war could not be reached before the war.

This question also arises in other contexts: why couldn't a compromise be reached that would end the labour dispute even before the strike broke out, and why could a legal compromise be possible that would reflect the outcome of the trial even before the trial? In all these cases, a compromise in advance is very profitable: it saves the costs of war, strike or trial.

Sometimes information problems also impede rational parties and prevent them from reaching agreements. Information problems can be expressed with over-optimism or asymmetrical information. For example, if each party believes that a war will allow it to gain full territory, and the losses that each party envisions are such that, from its point of view, they are equivalent to a quarter of the area, then neither side will accept less than three-quarters of the area. The result is that an agreement cannot be reached.

Israeli Defense Minister Moshe Dayan testified about the optimism he had before the Yom Kippur War: “I did not appreciate the enemy force, its combat weight, and exaggerated our assessment of our strength and ability to stand.” The reason why no agreement was reached before the Yom Kippur War is therefore perhaps the optimism that Israel took.

An optimistic assessment of the outcome of a war, therefore, does damage, so it is important to prevent it. The solution to this is freedom of information, disclosure and transparency. Freedom of information in democratic countries is one of the reasons why they do not fight each other.

Therefore, contrary to popular belief that freedom of expression should be restricted during an emergency state or regarding security issues, it is precisely in these times and matters that freedom of expression should be strengthened. Public discussion should be encouraged, and full information circulated. Moreover, the government is required for reliability and avoidance of lies. Moreover, reducing the information gaps between the parties may also prevent wars, since asymmetric information may lead negotiations to fail.¹¹ Thus, for example, Wilson's principle, which states that military alliances between states must be transparent—is a principle that prevents wars.

Let us now go to the conflict between the US and PRC regarding Taiwan. United States has been perceived to adopt a policy of Ambiguous Strategy.¹² The US makes it unclear if they respond to invasion by the PRC to Taiwan by attack, or by at least

¹¹ Akerlof [9].

¹² See Strategic Ambiguity and the Defence of Taiwan by Peter R. Mansoor Wednesday, June 30, 2021, Issue 73, Hoover Institution. <https://www.hoover.org/research/strategic-ambiguity-and-defence-taiwan>.

providing Taiwan with weapons to defend itself. One thing is to take a policy as recommended by Daniel Ellsberg: to make it open that it is an open question, which is consistent with transparency, and another thing is to have a policy but to make it a secret. The latter policy may lead China to say: if they have been hawkish, they would let us know, so they are dovish. However, a miscalculation may lead to war. Again, the worst is to be a hawk who pretends to be a dove. The best way is to prevent this risky game.

8.4 The Sequential Chicken Game Versus the Chicken Game

In the chicken game, the choices are made simultaneously. By simultaneous decisions we mean that when one party makes their choice, they do not see the choice of the other player. Of course, when the game is played in context a player may guess the decision of the other player. However, in real life many times the decisions are not simultaneous.

In the sequential game, one player makes his choice and then the other player makes their choice. If the first player chooses to be a hawk, then it will be in the best interest of the other player to choose to be a dove. Otherwise, they will get their worst possible result.

Thus, in the sequential game, the first player has a big advantage. They may force the other player to be a dove provided the other player is rational.

The choice of who is the first player is not necessarily by chance. A player may choose to be the first player, by making his choice first. Democracies have advantage: by making their policy transparent, they become the first mover.

Thus, liberal democracies have two advantages: first, by making their policy to be transparent they have advantage in the chicken game, namely in the negotiation. Second, by respecting international law, they prevent wars. This combination of respecting international law and having transparent policy, liberal democracies prevent wars. This combination actually reduces the number of the chicken game and achieves better and less risky results when the game is played.

The sequential chicken game is much less risky than the simultaneous one: in this game there cannot be a war between rational players, while in the simultaneous game, it is possible.

Of course, if we permit the possibility of mistakes, then also in the sequential game there may be wars due to mistakes. But, in the chicken game there may be a war also in the absence of mistakes.

Moreover, in the sequential game, the result that one player will be a hawk and the other player will be a dove will be achieved even when the game is played out of context. It is not a matter of stable norm. This result will be achieved even when the game is played between complete strangers.

Up to now, we spoke about situations in which both players are rational. However, when the second player is irrational in the meaning that they always play hawk regardless of the consequences, the first player who knows it will choose to be dove. This is why dictators pretend to be irrational. While democracy can choose to be the first mover by transparency, undemocratic regimes may choose to be the first player by establishing a reputation of an irrational dictator. The price that their society played is much more costly than democratic pay for transparency: the democratic regime establishes their advantage in negotiation by respecting the human rights of their citizen—this give credence to their transparency, while dictatorship society establishes their advantage in negotiation by oppressing their citizen—this gives them the reputation of being irrational hawkish.

Since one irrational hawkish may meet another irrational hawkish, it is a matter for the international community to prevent this game and discourage those kinds of leaderships.

What will prevent the collapse? Let us repeat: In this one-time sequential hawk-dove game, if the second player is a rational player, the second player will respond to a hawkish choice by dovish choice, and thus in this game the first player will gain most from choosing a hawkish policy provided the second player is a rational player. However, if the second player is not rational in the sense that they will respond to a hawkish policy by a hawkish policy, the first player will choose being dovish. Thus the conclusion is that if the first player is rational, and the game and the rationality or irrationality of the second player is clear, there will be no collapse. However, if there is uncertainty regarding the rationality of the second player or regarding the game that is played, there may be collapse. One possible mistake is that the first player will think that it is a one-time game, while the second player will see it as a repeatable game. Game theory may lead to this failure since what makes the difference between one-time game and a repeatable game is not that two slides will play this game more than once, but the potential to provide incentives by accumulating reputation. Even if the two parties play this game only once, the rational second player may respond to hawkishness by hawkishness, if their acts are viewed by other players that will play with them.

8.5 A Game with a Possibility to Coordinate by Communication and Agreements

In the Hawk-dove game, the implicit assumption is that there is no option of communication or agreement. Moreover, Nash limited his theory to situations in which communication is impossible.

However, in real-life communication and agreements are possible. They may prevent the collapse.

Of course, if we the players can come to an enforceable agreement, they can for example agree that they will be a dove. However, also in the game without

enforcement of agreement they may come to an agreement that one will be a hawk, and the other will be a dove. They can also come to an agreement that if event A happens the first player will be the dove and the second the hawk, and if event A does not happen the first player will be the hawk and the second the dove. Every game in which there may be a potential of collapse may be improved by agreement, since the agreement may be such that gives every player at least their payoff in a case of no-agreement and a part of the surplus created by agreement. Thus, when the chicken game is played in a context of a Nash equilibrium in mixed strategies, there are agreements that may be in the benefit of both players.

The question arises: but since there is no enforcement mechanism the parties may violate the agreement! If the game is played in context in which agreement creates expectations to fulfilment, then the player who is expected to be dove will not play hawk, since then this player will come to their worst result. However, if the game is played in context in which there is no expectation to the fulfilment of the agreement, then the agreement will not influence the outcome. However, what will be the effect of the agreement if we play in a vague context? Or, what will be the result of the agreement if there is a potential to make a mistake in understanding the context? Let us take this example: there are two countries that come to agreement that if a particular event happens, the first country will be the dove, and if a particular event will happen, then the second country will be the hawk. If the player who is supposed to be the hawk believes that the game is played in a context in which agreements are fulfilled, and the other player believes that the player who is supposed to be the hawk, believes that agreements do not matter, then the other player may play the game as if there is no agreement. In such a case the agreement will increase the likelihood of war, since it misleads the player who comes to fulfil their right to be hawk based on the belief that agreements are kept.

Thus, one may see that where there is no clear context that agreements are kept, an agreement that one player will be the hawk and the other player will be the dove, may be risky or at least not prevent the risky game. Let us compare it to another agreement: there may be an agreement that the two countries will play the dove. This agreement is much less risky since if one country violates it, this will not lead us to collapse, namely to the worst result for both parties. However, the disadvantage with such an agreement is that even if it is played in the context in which agreements matter, the agreement does not create expectations that prevent the parties from violating it. They may be incentivized by establishing or keeping their good name. However, in a case in which the players believe that they cannot benefit from keeping agreements, then the agreement will not motivate them to keep it. Furthermore, if each player believes that the other player keeps their promise and that it is a mistake to keep promises, then the agreement will lead to collapse.

Democracies have some benefits: first, they will attempt to prevent this game, at least not to play a game, when the stake is mass killing. Second, their transparency prevents mistakes by the other party in reading their intention or belief regarding the context. Third, their transparency enables them to choose their policy before the game, and by this being the first mover. This is why regimes without freedom of information have incentive to stick to irrationality in international relations. Their

transparency prevents them from being the first mover, and the second mover in the sequential hawk-dove game gains more if they are perceived to be irrational players.

8.6 The Mad

A simpler, and an obviously more credible variant of the chicken game is the game of mutual destruction: each side plans to use nuclear weapons against the other if and only if the other uses nuclear weapons. This means that no side will be the first to strike, but each side will respond to a strike by full retaliation. The obvious result of the adoption of this strategy by both parties will have to be no use of nuclear weapons. This was the first suggestion about the game of nuclear war; it was Niels Bohr who made it; he did so as soon as he learned that nuclear weapons were within reach. (This did not apply to the first use of nuclear weapons, as at the time only one party was in possession of nuclear weapons. It was clear then that this situation was temporary.) This is how leading game-theoretician Nobel Laureate Thomas Schelling of the University of Maryland has described this game—more or less.¹³ His main recommendation was that the US should make a commitment to respond to the use of nuclear weapons by a nuclear retaliation. Against his proposal, and especially against commitment to respond to nuclear attack by nuclear attack by constructing the doomsday machine that is the automation of nuclear retaliation, as the famous movie *Dr Strangelove* has popularized it. That movie showed how it was possible that with no intention this game may bring about the worst results. The movie was a comedy, yet it was used as a serious argument against Brinkmanship.

The strategy of the MAD is based on some assumptions: first, the leader of the other side will be rational enough; they will not attack when it is against their interest. One problem is that conventional war may lead to loss of rationality that may lead to nuclear escalation. Second, there will not be situations in which the personal incentive of the other side's leader will cause them to attack despite the price their country is going to pay. Third, there will not be mistakes that lead to nuclear war that no party wishes. Fourth, the other side will not succeed in building defense systems that will cancel the threat against them. (What Ronald Reagan actually attempted to do). Fifth, the nuclear game will not be part of a bigger game, in which the other side may coerce by credibly threatening to use the nuclear weapon even in a case they will not be attacked. Sixth, the assumption is that one of the clients of the US/USSR will not lead them to a nuclear war. Let us say that both the US and USSR adopt MAD strategies, but imagine that during the 1973 war Egypt successfully occupied half of Israel, and Israel responded by using a nuclear weapon. Has the equilibrium between the US and USSR remained stable in such a scenario?

An improvement of the MAD was proposed by Ellsberg [4]. He proposed that in order to prevent the other side from attacking, it is sufficient to have a mixed strategy: if the other side does not attack you, you will not attack; however, if the other side

¹³ Schelling [10].

attacks you, then you will respond to their attack by attack with a probability that should be bigger than the critical probability that is sufficient to prevent the other side from attacking. The advantages of his theory are that this policy makes the cost of responding cheaper, and that it also reduces the cost of mistakes. The intuition is that this policy deters less, however since it is less costly to implement such a policy, this makes the threat proposed by Ellsberg to be more credible than this proposed by Schelling. However, what challenges the policy proposed by Ellsberg is that the other side may say: well, since the threat is to attack with a particular probability the lottery may be faked. Thus, the challenge in maintaining the policy proposed by Ellsberg is how to make the threat credible. Since in democracies there is a distribution of the power to decide, different opinions may establish a credible threat to use mixed strategy. Of course, when the situation is repeated it is easier to establish a reputation of mixed strategy, and this is not the case regarding nuclear attacks.

Let us propose another improvement: even if we have an equilibrium where both the US and the USSR maintain the MAD strategy, the equilibrium will be more stable if the two sides come to a public international agreement that no party uses the nuclear weapon unless they are attacked by nuclear weapons. Since both sides adopted the Realpolitik approach, they did not take this option seriously. In this book we argue that there are degrees of stability, and agreements strengthen the degree of stability. Agreements may reduce the tension and the mistrust and prevent destructive beliefs that the other side adopts a policy of “always defect”, which in the nuclear game may lead to preemptive attack that will lead the world to nuclear disaster.

Recently, Nobel Laureate games-theoretician Robert Aumann made a public lecture in which he described the game, as *seen by the strategists of the USA*, such that the USSR needs to choose whether to use nuclear weapons, and then the USA needs to decide whether to respond.¹⁴ The best result for the USSR is that they will attack, and the US will not respond by attack. However, the USSR will prefer mutual peace on mutual attack.¹⁵ The Americans prefer a result of being attacked without attacking back on mutual attack, however if they take a strategy of responding by peace for any strategy of the USSR, then the USSR will respond by attack. Therefore, they wish to take a strategy that they will respond to peace by peace, and to attack by attack, which will lead to mutual peace, their first best. In order to adopt this strategy and to make it visible *ex ante*, they need to make a commitment in advance that they will respond to attack by attack. This is actually possible by changing the game, such that before the USSR makes their decision, the Americans make their decision, namely commit themselves.

One may see some differences between Russel and Schelling or Aumann. One of them is that Russel described a simultaneous game, in which each side chooses before they see what the other side did, while Schelling and Aumann described a sequential game, in which one side makes its decision and then the other one takes

¹⁴ Robert Aumann, Technology Forecasting and Policy Implications: Will Robots Eliminate War? The 7th Annual INSS International Conference—2014 Conference held at Museum of Tel Aviv Date: 27th Jan 2014. <https://www.youtube.com/watch?v=nPgZAln34Wc>.

¹⁵ Aumann [3].

its decision. Another difference is that the main recommendation of Russel was to prevent the risky game.

We study from each of them, and we raise the possibility that this was the game of the cold war. There was a super game, in which the two states choose if to go to peace or to war. Either they choose to go to peace or to war, they need to choose if to use the nuclear weapon or not. When they are at peace, each of them takes the strategy that they do not use nuclear weapons unless the other side uses them, and this leads to a result that no side uses the nuclear weapon. However, if they go to war, then there is an unelected positive probability that one side will change its strategy and will decide to attack first by nuclear bomb, which will lead to mutual destruction. Therefore, the game in war is much more dangerous than this in peace. There is the super-game that each side needs to take a hawkish or dovish strategy. If they both take a hawkish strategy, then they will play the game of war that may lead to mutual use of nuclear weapons. However, if at least one of them is dovish, there will not be war. Sometimes, they play this super game as a simultaneous game, and sometimes they play it as a sequential one. The simultaneous one is much more dangerous. Therefore, there is also a super-super-game to make the super-game simultaneous or sequential. One prominent way to pass from the simultaneous one to the sequential one is by strengthening the freedom of information. Of course, there is a super-super-super game in which the countries may cancel this game by different mechanisms: establishing a global government, or coming to other sorts of agreements, such as mutual concession of the nuclear weapon or at least reducing the number of bombs.

References

1. Russell, B.W.: *Common Sense and Nuclear Warfare*. George Allen and Unwin, London (1959)
2. Schelling, T. C.: *The strategy of conflict* (1960)
3. Aumann, R.J.: War and peace. *Proc. Natl. Acad. Sci.* **103**(46), 17075–17078 (2006)
4. Ellsberg, Daniel.: *The theory and practice of blackmail*. Rand Corp Santa Monica CA (1968)
5. Vickrey, W.: Counter speculation, auctions, and competitive sealed tenders. *J. Financ.* **16**(1), 8–37 (1961)
6. Becker, G.S.: Crime and punishment: an economic approach. In: *The Economic Dimensions of Crime*, pp. 13–68. Palgrave Macmillan, London (1968)
7. Nash, J.F.: *Non-cooperative games*. Ph.D. Thesis, Mathematics Department, Princeton University, (1950)
8. Schelling, T.C.: An essay on bargaining. *Am. Econ. Rev.* **46**(3), 281–306 (1956)
9. Akerlof, G.A.: The Market for “lemons”: Quality Uncertainty and the Market Mechanism, pp. 235–251. *Uncertainty in economics*, Academic Press (1978)
10. Schelling, T.C.: *The Strategy of Conflict*. Harvard University Press (1980)

Chapter 9

Equilibria of War and Peace: Diverse Options of Cooperation



9.1 Preface

A repeated game without communication between players is in Nash equilibrium if no player has incentive to change strategy unilaterally. Game-theoretical equilibrium is different. It occurs when no player sees incentives to change strategy unilaterally. A game may be in Nash equilibrium and not in game-theoretical equilibrium due to mistaken judgment. The advantage of Nash equilibrium over game-theoretical one is obvious. The advantage of game-theoretical equilibrium over Nash equilibrium is this. A mistaken move is commoner than the choice of the best move available. Considerations of both kinds bring game theory nearer to Wald's decision theory.

Diverse Options for Cooperation.

9.2 What is a Game?

What is a game? Von Neumann and Morgenstern [1] said, it is "simply the totality of the rules which describe it." Arrow (1994) raises the obvious objection about this answer, worded as a rhetoric question. Since the games that people play are social constructs and "have definite rules that are constructed, indeed, by a partly social process, who sets rules for" them?

In effort to take care of Arrow's objection, we suggest an improvement of the view of von Neumann and Morgenstern on games: when payoffs are not given, they depend on the preferences of the players. Thus, for example, the same game that is a prisoner's dilemma for two particular players may be a stag-hunt game for another two particular players; this choice may depend on preferences. For example, when the two players love each other enough, the rules cease to define a prisoner's dilemma.

In this context, Nash [2] has proposed the following idea:

For us an n -person game will be a set of n players, or positions, each with an associated finite set of pure strategies; and corresponding to each player, i , a payoff function, p_i , which maps the set of all n -tuples of pure strategies into the real numbers. When we use the term n -tuple we shall always mean a set of n items, with each item associated with a different player.

This allows different preferences in the same game; it invites discussions of games within the social sciences such as trade (say, played by suppliers and consumers). Can the mathematical discourse of Nash allow for considering games within empirical social science? In the above quotation, Nash viewed the payoffs as depending on the rules of the game alone. He had extended game theory to include non-zero sum games and this move allows for a further extension, for the inclusion of political and legal institutions that may change some spontaneous order—to meet his spectacular observation that a spontaneous order may lead to results undesired all round. At that stage, Nash considered the payoff as given; he did not discuss the option of players' choice of payoffs. Later, game theorists have suggested the distinction between games with and without complete [relevant] information. This goes beyond the definition that Nash has proposed, as it excludes games whose rules do not determine payoffs uniquely.

9.3 Nash Equilibria

A game is in a Nash equilibrium if in it no player has incentive to change strategy unilaterally: each player's strategy is then the best response for the strategy of the other. In other words, in a Nash equilibrium no player can benefit from changing their strategy, given the strategies of the others are fixed.

Nash [3] limited his theory to games without communication between players; consequently, all changes of strategies are undertaken *unilaterally*. Consider an infinitely repeated prisoner's dilemma with both players practicing the strategy of always-defect. Non-communication leads to no incentive to change strategy, whereas communication may lead to a friendly bilateral change like tit-for-tat, to mutual advantage. Moreover, even the mere hope of one player that one-sided change of strategy will bring an overall change may suffice as incentive for a change of strategies. (This is how trust between arrested-and-isolated spies pays.) A variant of this game that allows communication may impart this hope for an all-round improvement due to cooperation. Nevertheless, we follow Nash—reluctantly—and in deference to tradition, we limit our discussion to games without communication between players.

As stability implies no disposition to change, it is a matter of degrees. How stable is traditional Nash equilibrium? Consider the stability of a physical system as the simplest. It is in equilibrium when the net force on each body in it is zero. It is stable if a small temporary deviation from it does not destroy it. It is unstable if it does. (The equilibrium is indifferent, if such a deviation leads to a different equilibrium.) Moreover, as equilibrium is relative to a given set of extant forces, a system can be stable regarding one such set and not regarding another. In game theory, a game is in a *game-theoretical equilibrium* if no player sees incentive to

change strategy unilaterally. This equilibrium can change if players may change strategies even without any incentive (real or imagined) causing it. The equilibrium that survives any permissible change of strategy is hyper-stable.

A game is in a Nash equilibrium if no player has incentive to change strategy unilaterally. In addition, Nash equilibria in which both players know that they have no incentive to change strategies unilaterally (call it a *type 1 Nash equilibrium*) is a subset of the set of the games that are in game-theoretical equilibrium. A Nash equilibrium in a game in which at least one player sees incentive to change strategy unilaterally (call it a *type 2 Nash equilibrium*) is not game theoretical. Moreover, not all type 1 Nash equilibria are stable. Consider a game that allows in addition to strategy-change also changes in the rules of the game. Some equilibria remain stable even after the implementation of some specified change, but not after a change in mutual expectations of the players. Thus, *the stability of an equilibrium is relative to the set of permissible deviations from it.*

Let us now restate the proposed equilibrium in the language of Nash. Nash [2] defined his equilibrium such that:

Any n-tuple of strategies, one for each player, may be regarded as a point in the product space obtained by multiplying the n strategy spaces of the players. One such n-tuple counters another if the strategy of each player in the countering n-tuple yields the highest obtainable expectation for its player against the n-1 strategies of the other players in the countered n-tuple. A self-countering n-tuple is called an equilibrium point.

Additionally, here is the definition of game theoretical equilibrium in the same language:

Any n-tuple of strategies, one for each player, may be regarded as a point in the product space obtained by multiplying the n strategy spaces of the players. One such n-tuple virtually counters another if according to the (right or wrong) belief of each player their strategy in the countering n-tuple yields the highest obtainable expectation for themselves against the n-1 strategies of the other players in the countered n-tuple. A self-virtually-countering n-tuple is called a game theoretical equilibrium point.

9.4 The Hostile Prisoner's Dilemma

In a repeated prisoner's dilemma, the two players can see the *moves* but not the *strategy* of each other. This is how pioneering study of Neumann and Morgenstern (2007) poses games. They present a strategy as the complete plan for a given game. A strategy of a given player, then, specifies how that player will act in any specific situation that the given game allows for: a strategy will thus prescribe for that player an action for each case in which action depends on some possible information that is relevant to the game—according to the specified rules of that game.

Of course, this allows for the possibility that different strategies lead to the same actions in a particular game. For example, if in the repeated stag-hunt/prisoner's

dilemma the two player come to mutual cooperation, it may be because they both adopt strategies of “tit-for-tat”, or because they both adopt strategies of “always cooperate” (or because other combinations).¹ In a case of known mutual cooperation a player in the repeated prisoner’s dilemma can know if the other players take a strategy of “tit-for-tat” or of “mutual cooperation”, but not otherwise.

We call “the hostile prisoner’s dilemma” the particular subset of the repeated prisoner’s dilemma in which every player assumes that the other player adopts the most hostile strategy possible unless observed actions refute this assumption. In this game, each player assumes that the other player adopts the strategy of always-defect except in the case of a cooperative move. What is the best response of each player given that this assumption is true? In this case, the best response may be to adopt the always-defect strategy; nevertheless, it may also be better to adopt this as a conditional strategy: begin with defection but respond to cooperation by cooperation. This is the epsilon-tit-for-tat strategy: begin with defection and then take in each round the move that the other player took in the previous round. This game allows for a Nash equilibrium of always-defect. It may also be the (non-Nash) equilibrium of strategies, such that each player will adopt the epsilon-tit-for-tat strategy, resulting with mutual defection ad infinitum. It is an equilibrium in the sense that no player sees incentive to change strategies; it stabilizes the norm. Nevertheless, minimal openness to the possibility that the other player does not cling to the strategy of always-defect obviously leads to the preference for the epsilon-tit-for-tat-strategy over the always-defect strategy in that same game. (This is an example of a minimal openness that may suffice for improvement).

Prevention of the hostile prisoner’s dilemma game is possible, say, by making one’s strategy transparent. Democracy thus blocks this game between nations, whereas emergency laws invite it. Transparency among members of any team (including spouses) also blocks it. One who chooses transparency as a general (meta-) strategy will thereby block this kind of games—as it is too risky. This is a good argument and a general one in favour of the meta-strategy of making any strategy transparent!²

Let us assume that the two nations adopt a strategy of “tit-for-tat” in the prisoner’s dilemma. One day, a new political leader tells his nation: you know, the other nation takes “always cooperate”, so let us defect! This is a real option in the real repeated prisoner’s dilemma, but not in the repeated prisoner’s dilemma.

Consider the case of two nations playing a repeated prisoner’s dilemma in which representatives of one nation suppose that those of the other nation consider it no more than a series of cases of one-time prisoner’s dilemma game. In this case, the one nation will take always defect strategy, the other nation will then also take the always defect strategy. This will represent a game theoretical equilibrium. The results will be consistent with the expectation of the one nation, so they will have no option of getting rid of their mistake. The mistake will block the possibility of cooperation.

¹ Note: in the repeated prisoner’s dilemma mutual always cooperate is not in a Nash equilibrium.

² This raises the question of the usefulness of military secrets. It is a question that deserves study.

To conclude: *expanding game theory to include non-Nash Equilibria is game theoretically interesting and politically beneficial.*

9.5 Other Equilibria

Consider then any system that is in a game-theoretical equilibrium but not in a Nash equilibrium. Let us begin with the strategy for the infinitely-repeated two-player prisoner's dilemma with players who adopt a cautious attitude defined as follows. In the first round betray; in the second round imitate the choice of the other player in the first round; in the third round cooperate if the other player chose to cooperate in the *first* round; otherwise imitate the other player's behaviour in the second round; in all other rounds imitate the last choice of the other player. This strategy has an advantage. It is this. It does not recommend cooperation with one whose strategy is to always-betray and it repeatedly recommends cooperation with one who plays tit-for-tat without incurring more than loss in one round. If both players adopt this cautious strategy independently of each other, then the game will be a constant mutual betrayal. Fortunately, this does not amount to a Nash equilibrium, since both parties will be better off if they alter their strategies, say, to tit-for-tat. Yet the following scenario is of a game-theoretical equilibrium: if both players adopt the cautious strategy while each of them assumes that the strategy of the other is to always-betray, then neither will see the incentive to alter their strategies unilaterally.³ This assumption is erroneous, yet the error is reasonable; it is the source of needless wars caused by distrust. The Nash equilibrium theory ignores these equilibria as they rest on stable errors. A game is thus in an *erroneous equilibrium* if all players see no incentives to change strategies unilaterally, and erroneously so. There are two kinds of game-theoretical erroneous equilibrium, (empirically) refutable and irrefutable. There may be a game theoretical equilibrium based on error, yet without being an erroneous equilibrium. For example, when the two players adopt a strategy of tit-for-tat in the stag-hunt game, and that each player believes that the other player plays "always cooperate". One of the advantages of the stag-hunt game on the prisoner's dilemma is that such a mistake does not destabilize the cooperation in the stag-hunt game, while destabilizes the cooperation in the prisoner's dilemma game! Let us define a new equilibrium based on the previous discussion: a game is in a neglected mistake equilibrium if no player sees incentive to change their strategy, and additionally no player has incentive to change their strategy and additionally at least one of the players has a wrong belief regarding the strategy of the other player! The neglected mistake equilibrium is therefore a subset of both Nash equilibrium and the game theoretical equilibrium.

³ Here is another example. Consider cases in which both players adopt a strategy of defecting in the first round and doing then always what the other player did in the previous one. If both mistakenly take the strategy of each other to be always-defect, then neither will see incentive for a unilateral change.

Consider any international repeated prisoner's dilemma that representatives of two hostile countries play, where both sides adopt the cautious strategy. This is not a Nash equilibrium, but it may be a game-theoretical equilibrium. It will be if both sides do not see extant incentive to change their strategies unilaterally. A rational party will not see incentive to change strategy unilaterally if they see the other party as having adopted the always-defect strategy. In particular, nations and their representatives may do so, since they tend to ascribe to the enemy the always-betray strategy.⁴ In such a case, the mutual strategies lead to a result that includes approval of the mutual mistake regarding strategies.

This erroneous equilibrium is obviously stable despite its being undesirable all round. Fortunately, minimal change may prevent it or at least destabilize it. Suffice it for this that one player should ascribe a minimal likelihood to the possibility that the strategy of the other player permits sufficiently many rounds of cooperation. (If the strategy of the other player is not fixed, even less should suffice: it would suffice that one player would ascribe to the other player the readiness to desist from the strategy to always-defect so as to permits mutual cooperation and that this will then persist for sufficiently many rounds.) For that, minimal trust may suffice. For that, minimal readiness to render one's own national strategy transparent may suffice. Hence, an advantage of democratic discourse and liberal values such as freedom of information is that this may destabilize undesirable erroneous equilibria and even prevent them in the first place. The prevalence of equilibria based on false assessments of the strategy of others as hostile makes them interesting, especially to game theorists but also to political scientists, politicians and peace lovers. This should be particularly interesting if only one hostile player is a democracy.

The present study follows Hahn [4], who has argued that

the belief of the orthodox that given sufficient time men discover their true environment suggests a certain ignorance of both anthropology and history.

We support this opinion also in the context of the repeated prisoner's dilemma. Hahn considered an economy in which individuals can transact false prices: he

considers an economy in which individuals can transact at 'false' prices. When they do they encounter quantity constraints, this in turn, as Arrow has noted, stops them acting as perfect competitors. In particular, they must form an hypothesis concerning a possibility of affecting their quantity constraints by a change of price. This hypothesis is called a conjecture. A set of prices and quantity signals at which desired trades are achieved and no prices change is advantageous under the conjecture is a conjectural equilibrium.

A conjectural equilibrium, then, comprises a set of prices and quantity signals at which desired trades are achieved and no prices change is advantageous under the received conjecture. Hahn claimed that

⁴ This may happen even when the game between the nations is a prisoner's dilemma, but the game between the leaders is such that the best result for each leader is a permanent tension represented by mutual defect. The leaders may pretend that it is a repeated prisoner's dilemma and each leader will convince their nation that the other adopts the always betray strategy, so that there is no partner to cooperate with.

in the orthodox tatonnement matters are normally too complicated to give a precise account of the evolution of prices from a given starting point. But the dynamic equations induce the definition of an equilibrium as stationary points. If the auctioneer is replaced by the agents who change the prices at which they are willing to trade whenever they consider this profitable, then the stationary point of the dynamic system will have to be a set of signals at which agents do not see profits due to changes of price. The set of stationary points or equilibria may include those of the tatonnement but clearly need not coincide with the set of equilibria of the latter.

The present study likewise follows Fudenberg and Levine [5], who expanded the theory of equilibrium beyond the customary Nash equilibrium by introducing a self-confirming equilibrium, in which.

each player's strategy is a best response to his beliefs about the play of his opponents, and each player's beliefs are correct along the equilibrium path of play. Thus, if a self-confirming equilibrium occurs repeatedly, no player ever observes play that contradicts his beliefs, even though beliefs about play at off-path information sets need not be correct.

Our aim here is to render this discussion clearer and more critical, particularly regarding the possibility of a survey of different common mistakes. The present study should then be admitted as part-and-parcel of a social science proper. The set of self-confirming equilibria does not include every refutable *erroneous equilibrium*. Hence, the set of game-theoretical equilibria is broader than that of the self-confirming equilibria.

Fudenberg and Levine also wrote,

Self-confirming equilibrium describes a situation in which players know their own payoff functions, the distribution over Nature's moves, and the strategy spaces of their opponents.

Obviously, the game-theoretical equilibrium presented here is not limited the way Fudenberg and Levine describe. Our presentation thus naturally renders natural some applications of game theory to social science. They rightly observe that

it is easy to generalize self-confirming equilibrium to allow for players who do not know the distribution of Nature's moves.

This is significant, since every step in the direction they indicate invites the application of game theory to genuine social situations.

Fudenberg and Levine [6] go further and observe this:

in a self-confirming equilibrium, each player correctly forecasts the actions that opponents will take along the equilibrium path.

By contrast, game-theoretical equilibrium (even when erroneous) can happen under diverse conditions. All this invites adding to the discussions of the traditional cases (in which players act on expectations of each other's actions) and also discussions of players who have no specific expectations. Even this is not enough. All theoreticians, including those whom we have just cited, ignore the frequent cases of action on negative expectations only, namely, on ones regarding what will *not* happen, without having expectations of what will happen. The set of game-theoretical equilibria that we introduce is therefore border than that of the self-confirming cases; it

is more suitable to apply to common social cases of all sorts. Nash equilibrium is not necessarily self-confirming, since players may entertain false opinions or lack information regarding the best options available to them. Hence, the popular view of self-confirming equilibria as a super-set of Nash equilibria is erroneous.⁵

Recently, Winter and Heller [9] proposed:

Heller-Winter “equilibrium condition requires that: (1) each player chooses a best-response strategy to his distorted belief about the opponent’s strategy, and (2) the distortion functions form best responses to one another”.

The aim of this study differs from that of many other game theoretical studies, such as this of Myerson [10]. He seeks to reduce the number of Nash equilibria for given games. We, on the contrary, consider it a great achievement the discovery of Nash that some games have many equilibria. This discovery has valuable applications, as a society may be in an equilibrium that is not optimal. Indeed, famously, social norms are often stable even when better ones are readily available. Let us quote Philip Dybvig who said in his prize Nobel lecture on 8 December 2022 that having a multi-equilibria was largely viewed as a defect in models, “if you do not have a unique equilibrium it is not a real economic model, because you cannot do prediction” but “having multi-equilibria can be the main point, it can be an important part of economics that we should be concerned about”. The greatest achievement of Selten [11], we suggest, is (not his more refined equilibria but) his comparison of diverse equilibria, and in particular in his discovery that the move from simultaneous game to sequential one removes some Nash equilibria. Thus, the simultaneous chicken game is much more dangerous to all of its players than the sequential one is. This move results not in a different representation of the same game, but in an altogether different game. Therefore, it is beneficial in international relations, for example, to replace a simultaneous chicken game with a sequential one. Democracies have a great advantage here: by making their policies transparent, they choose strategies before potential aggressors do, thus preventing many a simultaneous chicken game. (Hence, transparency enables a country to make a viable commitment.) This explains the hostility to democracy of power-hungry leaders as not due to the democratic ban on some political tools but as a rejection of this advantage of democracies.

This case is an example of what we propose: *the more equilibria the better*. The single equilibrium case may be better for providing a prediction about a society, but the multiple equilibria case is better as social engineering, since it provides tools for choices of ways to solve social problems. Game theory says what equilibria are available and what ways to choose between them are available and, above all, what games it is better to refuse to play and possibly also at what cost. (Philip Dybvig claimed in his prize lecture (2022) that deposit insurance and other institutions can

⁵ For example, [7] asserts, “every Nash equilibrium is a self-confirming equilibrium”. Similarly, [8] claim, “in a Nash equilibrium, each player’s beliefs about the strategies of his opponents are exactly correct”. This is said in an oversight of the Nash equilibrium that is not a self-confirming equilibrium, as are, for example, situations in which players erroneously act on the supposition that it is in their best interest to replace a strategy even though it is in a Nash equilibrium. Another example is Nash equilibria in which players will not change their strategies even though they do not know the strategies of their opponents and act on mistakes regarding them.

eliminate the bad equilibrium but leave the good equilibrium. We add: in such a case deposit insurance and other institutions can eliminate the super risky game. His paper with Diamond [12] claimed: “Demand deposit contracts with government deposit insurance achieve the unconstrained optimum as a unique Nash equilibrium (in fact, a dominant strategies equilibrium) if the government imposes an optimal tax to finance the deposit insurance.” We add: then it is clearly a new game: it is not a coordination game anymore. In such a case what the demand deposit contracts did was to prevent the dangerous game).

Moreover, the existence of multiple possible equilibria teaches us an extremely important lesson: international relations are not only a function of interests, but also of ideas. When we have two identical stag-hunt matrices, it means that the balance of interests are the same in both games, but the results of the games depend on the norm, namely on the mutual expectation, namely on ideas. This is a clear refutation for the Realpolitik or any other approach that proposes that only interests influence the interactions between players.

The introduction of possible errors to game theory brings it closer to the contribution of Abraham Wald to decision theory. His big achievement [13, 14] was to propose a model that helps people choose between kinds of potential errors. Similarly, a player or a social planner who chooses a game or a strategy should attempt to prevent bad equilibria caused by expensive errors, and at least prevent them from destabilizing better equilibria. Similarly, the best game to play may become the worst game when a new error is added to the list of possible errors to take in consideration. One of the biggest achievements of democracy is that it precludes some less desirable equilibria. Also, the game that a democracy plays may be much less dangerous than the same games that a dictatorship plays—due to its transparency and the multitude of equilibria available to it (due to frequent elections) as Popper [15] has noted when he proposed the ability to dismiss undesirable leaders as the minimal condition for democracy and when he described a stable society that is undesirable since it is undemocratic.

9.6 Game Theory as Social Science

Our agenda is to anchor game theory in the social sciences. This renders game theory realistic and flexible, as it permits diverse interpretations suggested by the diverse social contexts of any game and of any particular solution to any problem that it raises. Nash equilibrium is an equilibrium of strategies, and it wisely prompts us to check strategies and the very idea of a strategy as a solution to any nagging problem. This suggests a far-reaching revision of the initial games-theoretical text of von Neumann and Morgenstern [1]. We are indebted to these pioneers for their having considered a strategy any player’s plan that specifies what choices that player will make in every possible situation for every possible information that the player may possess at a given moment—in conformity with the pattern of information that the rules of the game provide for the player for that case. They meant to encompass

this way more options than were initially considered. To this end, they excluded error from consideration. Yet, in this they blocked all serious effort to apply their results to problematic social cases. Social science discusses much more important problems than those that the tools of von Neumann and Morgenstern could help solve. Complex game theory should help solve harder problems: the most challenging games that extant theory examines are the prisoner's dilemma and its variants, such as the repeated prisoner's dilemma, stag-hunt game and chicken. The tools proposed by Nash helped find more interesting things about these problems, but not enough. The current strategy of research in game theory as social science is this: game theoreticians attack mathematical problems that hopefully generate new mathematical tools that social scientists may attempt to apply to problems encountered in the social sciences. We propose a change of strategy: game theoreticians may tackle interesting questions in social science and look at them from different perspectives, including game-theoretical ones.

The inventors of game theory have intended to offer players of every game plan for action in every possible situation that the game permits. This has rendered their project utopian, much contrary to their initial intent. No chess player has a strategy according to their conception, and, as Kenneth Arrow has indicated, to demand even the mere writing down of such a strategy is already excessive. On the face of it, this limits the social applicability of game theory as they have first conceived it; the limitation is serious: it is too extremely simple games and even these are scarcely realistic. They are instructive nonetheless, as they discuss strategies—such as tit-for-tat—that can be written down with ease and at times even applied. Their difference from chess strategies is conspicuous; even checkers is much more demanding than the games that those pioneers have examined.

To meet the initial intent of game theory, some alterations in the theory are required: view any strategy as a policy; use less mathematics and address social problems.

Hence, game theory should cease to be limited to cases in which the players have strategies. As Zermelo's theorem about chess indicates, game theory has interesting things to say even about games in which the strategy is not or even cannot be specified. Zermelo's theorem says, in any finite two-person game of perfect information in which the players move alternately and in which chance does not affect the decision making process (such as chess), at least one player can adopt a strategy that insures a win or at least a draw. Game theory can provide predictions about sufficiently simple games or point out potential equilibria in sufficiently simple games; it can also fit games that are too complicated with some social situations, in accord with the initial intent of the originators of game theory. For example, it is beneficial to replace any zero-sum game with a negotiation game that may benefit all concerned parties. Moreover, game theory may help choose games to play, and more so choose games to refuse to play. The controversy between Adam Smith and his predecessors are thus translatable to terms of game theory: (international) trade is not a zero-sum game, (and therefore should not be discouraged). Game theory can prove that Smith is right by the argument that trade between rational and reasonably (though not necessarily perfectly) informed players is impossible as a zero-sum game. For,

otherwise the very consideration that leads one player to choose a transaction should lead the other player to desist from it. Thus, even though we are usually uninformed about the strategies of traders, game theory is informative about the game of trade. This restatement of Smith seminal argument to game-theoretical terms is trite; it is therefore a reasonable illustration.

Translating social science to game theory is beneficial. Translating game theory to social science is beneficial too. Consider the same illustration again. Present Nash equilibrium not in traditional terms of game theory but in cases that are comparatively too non-specific. Ask how much specification is necessary for what specific conclusion. This way Nash equilibrium may appear as an equilibrium of strategies. More often than not, players have no strategy or only partial ones. Consider as a game a two-players' situation when and only when the strategy of each player maximizes pay-off given the strategy of the other player. Thus, the strategy of each player is optimal against those of the other. Thus, Nash did to game theory what Smith made to economic theory. Smith taught us that bargaining is not a zero-sum game, and Nash gave us the most important tool to discuss games that are not zero-sum games. They both made an important social science as the science of non-zero-sum game, and by this contributed to science, to peace, to economics, and to democracy.

Try to apply this to chess or to any zero-sum game with no probability considerations. This is no limitation on the discussion, since, von Neumann and Morgenstern proved, mathematically (not socially, of course) any non-zero-sum game for n players is equivalent to a zero-sum game with $n + 1$ players; similarly, probability considerations proliferate options. Now, society becomes increasingly non-zero-sum as it becomes increasingly complex, specialized, and interdependent [16]. Obviously, a zero-sum repeatable game will disappointingly bring about no win.

We propose to view game theory, particularly the theory of Nash, as part and parcel of social science. Viewing Nash theory as anchored in traditional social science enriches it, to allow for a meaning for it. Its most important aspect judged as mathematics differs greatly from what is most interesting in it judged as social science.

Nash wrote in the abstract of his dissertation [2]:

The main mathematical result is the proof of the existence in any game of at least one equilibrium point.

Not quite: not in every game is the concept of Nash equilibrium socially significant. In the words of Aumann [17],

Even when there is just one Nash equilibrium, it is not at all clear that the players 'should' expect its payoff.

The possibility of too many Nash equilibria prevents Nash theory from yielding predictions as to the results achieved in a given game; it only helps find what potential results are relatively stable; and this holds regardless of the number of potential Nash equilibria that a game may have!

Nevertheless, Nash equilibrium still may serve as a stabilizing norm; indeed, it has significant social function only in cases in which some norm is possible. This translates into the following social-scientific observation.

Corollary: the theory of Nash signifies socially if it applies to games played in sufficiently stable social contexts.

This obvious corollary could have saved much disappointment to people who vainly attempted to transfer reasonable technologies to environments too unstable to sustain them (such as the foreign aid programs of president Kennedy that failed almost totally). This is an important moral to political science: *one kind of equilibria may flourish in one kind of society and fail in another*. Sometimes, in order to achieve an equilibrium such as lasting peace, changing the regime involved may be insufficient; a change of the society involved may also be needed, as, for example, making it better educated. Therefore, subsidising the education of poor countries may be a very good investment for peace loving countries.

It may then be the prevalence of a game in a culture (its “mass action”, namely, the dependence of the effect of the game on the frequency of players and of playing within a given population): its sufficiently frequent repetitions create sufficiently stable mutual expectations to signify and thus lead that country to equilibrium in that game. The contribution of Nash is regrettably not popular in the social sciences despite its obvious possible usefulness there. Obviously, its great use is its raising new problems of great practical value, such as, what conditions render a society capable to use productively what kind of mass demonstrations?

Game theorists make this usefulness inaccessible when they concentrate on two-player one-time games that are of little use as a means for social insights. Those who wish to apply the theory of Nash equilibrium to practical politics will improve their ability to do so if they notice the subtle difference between it and a received norm that amounts to the same from the viewpoint of game theory. At times Nash equilibrium exists, but only at times. It is an equilibrium of strategies, and it is of limited usefulness since people seldom have strategies. We may have observations about norms that prescribe them, but these norms too seldom exist.

Moreover, there is a difference between a norm that social science studies and a norm that game theory tacitly takes for granted. Every society has members who regularly violate some of its received norms. They are the criminals, eccentrics, nonconformists and others; they are collectively called deviants. By definition, the very possibility of deviance requires sufficiently stable norms. Game theory considers following completely a given norm while playing a game that is possibly in a Nash equilibrium. This may be true by definition, if we view playing a game in a deviant fashion as playing a different game. Social scientists view norms as descriptions of rules that people *normally* follow, the exceptions being the deviants. There is a big difference between full compliance, such as in Nash equilibrium, and almost full compliance, such as in what is considered a stable norm in given societies and in the social science that studies it. Without some pressure to conform, deviants may become the majority and the norm will evaporate. Hence, we suggest, it is within the domain of game theory to discuss such cases. Not only pressure to conform is a part of the payoff of a social game; a part of that payoff is also the rules or norms as to what choice makes a player leave the game (by expulsion, incarceration or any other social process). What is obvious here is that interpreting a stable norm as Nash

equilibrium requires checking the interpretation for its accuracy. This is of great concern for social science, since the conditions for social stability are of supreme interest in all social sciences. Nash equilibrium has thus brought game theory nearer to social science, but far from enough.

Consider Hans Christian Andersen's "The King's New Clothes". In this fable, everyone voiced a lie until the innocent child pronounces the truth and wins rapid general agreement. What game fits this story? It is a coordination game: everyone wishes to lie if everyone else voices a lie and everyone wishes to say the truth if everyone else says the truth. In this game, both options comprise Nash equilibria. In this game society can come to an equilibrium that everyone lies, even if everyone prefers telling the truth!

There is more to the fable: it describes the transition as rapid. What assumption determines the speed of this shift? Clearly, a chain-reaction is faster than a domino effect. The question of what changes mutual expectation—of truthfulness or of any other behaviour pattern—is a social question. The paradigm case here is the expectation that the bank will bankrupt: that prediction fulfills itself rapidly or not at all. In this case, a child will not be able to create a rapid change of expectation. This is a social observation, since the question of when a child can make a change is social: when is a child considered reliable? The Talmud determines that if we wish to know whether a letter in a specific text is clear enough, we should not ask a scholar, but a child.

Consider then the following variant of "The King's New Clothes": a coordination game in which everyone wishes to comply with public opinion. Then, both perfect lies and perfect truthfulness are Nash equilibria and no player will deviate unless they assume that the majority is on the brink of a deviation. This equilibrium is more stable than that of the initial fable. Yet it too is not very stable, since some events change the common expectation regarding what other players will do soon. The event may even depend on choice. Thus the choice of the police not to punish deviants tore the Berlin Wall rapidly. In such cases, the first deviants may be gamblers: one would choose to deviate on the supposition that others will follow. The traditional theory of Nash speaks about unilateral change and the traditional game theory speaks about rational players. Now let us replace this with the social scientific assertion that there are always some deviants; suppose that one irrational player deviates and leads to a change of the mutual expectation or that one rational (say, high-minded) player may deviate in order to change the expectations of the others regarding what the other will do.

The game-theoretical moral from this story is that one deviant may be able to dramatically change a social Nash equilibrium; one deviant may suffice to improve matters dramatically. This happens, however rarely. The paradigm case here is novelist Émile Zola who forced the French military to change its decision to avoid a retrial of an innocent victim. More frequently we see crass violations of norms destroy them fast.

This shows that it is hard to predict the result of such a game, since it is extremely difficult to know when one deviant will catch the public eye and manage to trigger a change manifestly. This may also explain why leaders of closed societies are so

eager to hound all deviations. It may also explain how a mass society can move from one dogma to another with a flick of an eye as George Orwell describes in his 1949 caricature of the Soviet Union *1984*. Few cases of stampede are laudable.

Consider then another literary item, the poem *The Unknown Citizen* by W. H. Auden:

When there was peace, he was for peace: when there was war, he went.

Both war and peace are then possible Nash Equilibria. Fortunately, this equilibrium is unstable: non-conformists may disrupt it by supporting peace even when the norm is to support war. Given that they are rational, this means that they play a different game. Rubinstein [18] used to describe game theory as fables. This brief discussion supports him. Alas, game theorists often take his description as an insult rather than as a compliment. The difference between these two options is that (hopefully) game models are open to criticism, whereas fables and legends are hardly ever more than thought provoking. We hope to turn game theory into a means for raising critical standards in the social sciences at large.

References

1. von Neumann, J., Morgenstern, O.: Theory of Games and Economic Behaviour. Princeton University Press, Princeton NJ (1944)
2. Nash, J.F.: Equilibrium points in n-person games. Proc. Natl. Acad. Sci. **36**(1), 48–49 (1950)
3. Nash, J.: Non-cooperative games. Ann. Math. 286–295 (1951)
4. Hahn, F.H.: Exercises in conjectural equilibria. Topics in Disequilibrium Economics, pp. 64–80. Palgrave Macmillan, London (1978)
5. Fudenberg, D., Levine, D.K.: Self-confirming equilibrium. Econometrica **61**(3), 523–545 (1993)
6. Dekel, E., Fudenberg, D., Levine, D.K.: Payoff information and self-confirming equilibrium. J. Econ. Theor. **89**(2), 165–185 (1999)
7. Shimoji, M.: Outcome-equivalence of self-confirming equilibrium and Nash equilibrium. Games Econ. Behav. **75**(1), 441–447 (2012)
8. Fudenberg, D., Kreps, D.M.: Learning in extensive-form games I. Self-confirming equilibria. Games Econ. Behav. **8**(1), 20–55 (1995)
9. Heller, Y., Winter, E.: Biased-belief equilibrium. Am. Econ. J.: Microeconomics, Forthcoming (18 Feb 2019). Available at SSRN: <https://ssrn.com/abstract=3281674> or <https://doi.org/10.2139/ssrn.3281674>
10. Myerson, R.B.: Refinements of the Nash equilibrium concept. Internat. J. Game Theor. **7**(2), 73–80 (1978)
11. Selten, R.: Reexamination of the perfectness concept for equilibrium points in extensive games. Internat. J. Game Theory **4**(1), 25–55 (1975)
12. Diamond, Douglas W., Philip H. Dybvig.: Bank runs, deposit insurance, and liquidity. J. Polit. Econ. **91**(3), 401–419 (1983)
13. Wald, A.: Statistical decision functions which minimize the maximum risk. Ann. Math. **46**(2), 265–280 (1945)
14. Wald, A.: Statistical Decision Functions (1950)
15. Popper, K.: The open society and its enemies (1945)
16. Wright, R.: Nonzero: The Logic of Human Destiny (1953)

17. Aumann, R.J., Dreze, J.: Rational expectations in games. *Am. Econ. Rev.* **98**(2008), 72–86 (2008)
18. Rubinstein, A.: *Economic Fables*. Open Book Publishers (2002)

Chapter 10

The Game Not Chosen



10.1 Preface

The different equilibria that game theory proposes concerns plans of action. However, players may choose not only plans of action for given particular games but also what game to play. We propose different new equilibria of super-games that comprise choices of plans for what games to play and for how to play them.

Nash theory allows for equilibria for games and for achieving inefficient equilibria in some games. Similarly, the theory should allow for equilibria for super-games: equilibria of the choice of a game. This paper concerns inefficient equilibria in some super-games of the choice of a game to play: possibly all players will stay with a particular game even though they will all benefit from moving from that game to another possible game.

People may adhere to the equilibrium of war even when they have an option of peace: they may avoid peace negotiations out of ignorance of the need to change both the game and the strategy.

10.2 Motivation

Existing game theory provides many ways to think about failure to reach efficient outcomes in general (for example, mutual betrayal in the repeated prisoner's dilemma). Players may achieve inefficient Nash equilibria of strategies (for example mutual "always defect" in the infinite repeated prisoner's dilemma), even when efficient Nash equilibria of strategies are possible (for example, mutual "tit for tat" in the infinite repeated prisoner's dilemma). In this paper, we examine the many ways of thinking about failures to reach efficient outcomes in the choices of games (for example, the choice of playing the prisoner's dilemma game instead of the stag hunt game). Obviously, players may play inefficient games although better games are available, and this choice of a game may be stable: it will be an equilibrium in a

super-game in which players can choose what game to play. The application of game theory is most useful in discussions of choices regarding which games not to play. This is a development of Nash theory.

10.3 Definitions

What does one lose by making a particular choice? The traditional answer is this. One loses the next best option that was available before the implementation of that choice, that the option that the implementation has nulled. This is known as the opportunity cost. Thus, if a business choice leads to profit a while foregoing the next best option with the smaller profit b , then, all other things being equal, the opportunity cost of the choice of profit a is the profit b . Similarly, when one gets married, the opportunity cost of that marriage is the option of marrying the next desirable candidate who was previously available and whose availability the choice has annulled. This is the standard opportunity-cost theory. We propose a slightly but significantly different idea: by making a particular choice, one loses the ability to make this choice: one loses the ability to play the game that one has played. For example, when a person chooses a spouse, the opportunity cost of that choice is narrower: it is ceasing to be a bachelor, it is ceasing the very search for a spouse; playing a move in a game is the loss of the move in that game that one loses, in that case, the game of choosing a spouse.

The two ideas obviously differ. The difference becomes significant when one has not yet decided on one's own relevant preferences, say, because does not have yet all the relevant information available, or does not have finished calculating the results of all the considerations necessary for the decision: the standard opportunity cost theory is indifferent to the availability of the information (or to imperfect calculation capacities and cognitive abilities). Game theory refers to the situation as it is, known or not, assuming that the preferences of the individual players are somehow given. Thus, by game theory in its current version these items make no difference; for the individual player, however, this may matter very much. And so possibly game theory can stand an improvement here.

Game-theoretically, the shift from seeing the loss of alternative to the seeing of the closing of a game may lead to new equilibria. To facilitate this discussion—of the significance of the difference between the options that a game theoretician faces—we propose the following definitions.

We define a super-game as a game in which the players may choose what game to play and what game not to play, and they have at least two options. A super-game may be a strict super-game, one in which they have a fixed set of potential games (for example, they can choose between the game of religious marriage and the game of civil marriage, and possibly also of cohabitation with no marriage at all). A super-game may be a quasi-strict, in which the players may also choose the set of potential games (for example, they may choose between a marriage in accord

with the community of the one spouse or the other). A super-game may also be one in which the players may choose the superset of the set of games, etc.

We distinguish between the existence of incentives and awareness of incentives, two options that traditional game theory lumps together thereby becoming less realistic. Thus, we define ultra-equilibrium of a super-game as the case in which no player has incentive to change unilaterally the choice of the game or the choice of the strategy in each potential game; and we define super-equilibrium of a super-game as the case in which no player is aware of any incentive to change unilaterally the choice of the game or the choice of the strategy in each potential game. We also define duper-equilibrium of a super-game as the case in which no player sees incentive to unilaterally change the choice of the game and no player has such an incentive. We define virtual-equilibrium of a super-game as the case in which no player sees incentive to change strategy in the game not played and, given this, players also have no incentive to change their game. And we define stupid-equilibrium of a super-game as the case in which no player has incentive to change their strategy in the game played, and no player has incentive to change the game given the player plans to adopt the same strategy in the new game. (Stupid Equilibrium is a subset of the Virtual Equilibrium, and this happens when the player plans to take in the game not chosen the same strategy they took in the chosen game). We will present these equilibria in our attempts to explain why so often societies dismiss the opportunity to have opportunities to stabilize peace or to achieve peace, why societies refuse to negotiate peace-accords even when peace is obviously in the interest of all parties to any dispute.

Game strategy	No player has incentive to change unilaterally the game given their planned strategies	No player sees incentive to change unilaterally the game
No player has incentive to change unilaterally their strategy in each potential game	Ultra equilibrium	Duper equilibrium
No player sees incentive to change unilaterally their strategy in each potential game	Virtual equilibrium	Super equilibrium

10.4 The Game Not Chosen

The transition from prices to relative prices was an important step in the development of classical economic theory. This, however, did not apply to total wealth. This is measurable as a potential, as the capacity to do something with the wealth, including the capacity to consume and to invest. The transition of economic theory from nominal to real wealth is significant. Both consumption and investment create loss

of wealth that any economic activity is.¹ Another significant transition of economic theory was from discussing prices to discussing opportunity cost: the opportunity cost of any expenditure is more real than its nominal cost in money (price). One may judge the cost of a decision to use money in any way for any purpose from three different viewpoints. The first is the point of view of the nominal cost of the expenditure. The second is the realist point of view, judged as what else one could do in the particular time and place with the cost of the expenditure. The third is the opportunity cost theory that judges the cost as the best option lost by spending the amount of money. A still more accurate evaluation of that cost is what the person who has spent the money could do with it instead.

Economic theory should allow for considering opportunity cost relative to consumers' conditions. Consider, for a rare but instructive example, people who do not care what happens to their wealth after their demise, or those who live in societies with inheritance tax that amounts to the confiscation of their wealth soon after their demise. Consider them too rich to be able to use all their money in their lifetime. For them, the opportunity cost of any expenditure is zero, independently of its prices.

Opportunity cost is a useful tool for the study of the design of incentives. Consider the design of incentives meant to influence the behaviour of a rational player of a given game. The simplest way to do so is to change the cost of and benefit from choices of particular options in that game. What influences behaviour then is not the nominal cost or the cost in real value, but the opportunity cost. For, the assessment of the incentive depends on the estimate (not the opportunity cost but) the addition to the opportunity cost that the designed incentive would create, that is much more practical than the size of the designed opportunity cost. To show that the difference signifies, let us contrast our suggestion with what [1] says of these assessments. He said, successful social planning is impossible since designers of incentives have no information about the preferences of the players whom they wish to influence. Consider some examples. A liberal state will increase the opportunity cost of criminal activity with the intent to render it less appealing and to render its alternative more appealing: the conduct of a state is liberal if its legislators try to create palatable alternatives to the life of crime. The state may also raise heritage tax in order to reduce the opportunity cost of consumption in order to raise consumption [2]. The state may raise the punishment for threats in efforts to decrease the opportunity cost of performing them [3]. And the state may subsidize public transportation so as to increase the opportunity cost of using private cars so as to raise the opportunity cost of pollution.

Knight [4] wrote,

¹ What we find amazing regarding consumption is that if a customer buys the same item for less, they will pay less taxes, even though they gained much more. This encourages investing more time in seeking opportunities to buy the same for less money. This is an incentive for the individuals to correct market failures.

“The cost of any alternative (simple or complex) chosen is the alternative that has to be given up; where there is no alternative to a given experience, no choice, there is no economic problem, and cost has no meaning”.

This claim of Knight’s is sheer common sense. It is hard to integrate it into the general system of current economic theory for an obvious reason: the theory assumes perfect knowledge of all actors in the economy. The deviation from the truth that this assumption causes is usually viewed as negligible. The claim that the lack of perfect information has negligible effects is labelled “friction”, in allusion to the deviation of Galileo’s law of gravity from observation that friction causes. Now just as friction is negligible in calculations of the free fall a stone but not of a feather, so friction is negligible in considering the behaviour of the market in equilibrium but not in the case of opportunity cost. In a system with excessive imperfect information and computational abilities or rationality the theory does not apply before we answer the question: is opportunity cost the loss of a real alternative, or is it the loss of the best alternative to take under perfect conditions? Knight’s presentation cited above leaves this question open. Saying that opportunity cost is what decision-makers would take in situations of perfect knowledge renders the theory impracticable except when the imperfection of the information available is judged insignificant. Obviously, at times it is judged highly significant. The paradigm case is the information that makes inside trading so successful as to render it illegal.² (The opportunity cost of foregoing crime is highly under-determinate; liberalism is the proposal to reduce it drastically). We would go so far as to say that in a system with perfect information Hayek’s argument against efforts to alter a popular system of preferences does not hold.

Our general agenda toward economic theory is that it should be part-and-parcel of social science. Decisions are made in context, and games are played in context; and the theory should also embrace the context and the possibilities to choose or change it. This is particularly necessary in the theory of opportunity cost, since opportunity cost is highly context-dependent. The traditional theory is the study of the opportunity cost of a choice that an omniscient decision-maker would make in utter regard for the possibility of the decision-maker to alter the situation first. Progress in technology often occurred when an entrepreneur realized that a small change in circumstances may render a second-best option into an option by far superior to any extant one. This is a well-known complaint: standard economic theory overlooks innovation. We contend that for some situations game theory can help overcome this difficulty.

We find game theory useful in replacing or enriching the concept of opportunity cost, particularly since game theory can recommend what game not to play and since the game may be the context. We propose to view the real cost in opportunity cost not as the loss of the option or alternative not chosen, but as the loss of the game

² The same problem will be with other common presentations such that of [1]:

Opportunity cost is the evaluation placed on the most highly valued of the rejected alternatives or opportunities. It is that value that is given up or sacrificed in order to secure the higher value that selection of the chosen object embodies.

chosen not to play. Tradition represents the opportunity cost of accepting a job the next best job dismissed by that choice (on the supposition that the preferences are fully known), whereas we represent as opportunity cost the opportunity to accept or dismiss alternative jobs (with or without knowledge). By this we are similar to the Search theory but with significant differences. Let us explain the approach of the search theory, and then the difference and then the source of the difference: we adopt the method of Wald's decision theory [5, 6], while they adopt the method of Expected Utility Theory. Consider the case of labour economics that is discussed by search theory: a worker's reservation wage is the lowest at which that worker would be willing to accept a particular proposal. The reservation wage is how the lottery of continued searching is worth it for them. Therefore, according the Search Theory, their reservation wage, when they are risk neutral, is their expected wage if they dismiss the proposal; and when they are risk averse (or risk lovers), the reservation wage is how the lottery of continue searching is worth for them given their preferences and their beliefs regarding their alternatives. Decision makers accept proposals if they prefer accepting them to continuing negotiations. At times, decision-makers cannot calculate their own reservation wages, but they can decide the worth of the game for them. Search theory should allow for such cases our approach follows Abraham Wald and not [7] in that we do not assume utility theory, but recognize the junction in which players choose to bargain or make personal decisions whether to choose between three options: accepting an offer, continuing to bargain, and stopping bargaining.

Similarly, during negotiations, often one party does not know whether continuing the negotiation is useful or not. If one party does not have a preference between accepting the latest offer and no-deal, and if the cost of continuing to bargain is negligible, then it is preferable for that party to make a counter-proposal rather than to accept the last offer. Recommendations about such no-lose strategies can be much more advantageous than recommendations based on ignorance.

To conclude, our approach, that combines social science, game theory and decision theory is both more realistic and more versatile. We will now expand on the options that standard literature does not consider suitably and that we propose to take seriously.

10.5 New Equilibria

Consider the real opportunity cost of a decision as the game not chosen, as the decision-problem-situation given up. This consideration opens the door to new theories, equilibria concepts and super-games. We propose this thesis. *The opportunity cost that (the political leadership of) a state pays when it decides to play with another state the prisoner's dilemma game is its ability to play the stag-hunt game, if it is an option for the state to choose playing this game instead of the prisoner's dilemma with no additional cost.* The loss from playing a prisoner's dilemma instead of a stag hunt game depends on the norm in the stag hunt game. If the norm in stag

hunt games is mutual defection, then the result of the stag hunt game will be the same as the prisoner's dilemma game, and there is no gain in the transition from the prisoner's dilemma game to the stag hunt one. However, if the norm in the stag hunt game is mutual cooperation, then the players will benefit from moving from a prisoner's dilemma to the stag hunt game. (We assume that the choice of the game will not change mutual expectations). When the norm in the stag hunt game is mutual defection, a nation has no incentive to move from one game to another (unless they see an opportunity to change the norm); however, when the norm in the stag hunt game is mutual cooperation, then a nation has an incentive to change the game. So, let us propose this kind of equilibrium: a super-game is in ultra-equilibrium if no player *has* incentive to unilaterally change the choice of the game or the choice of the strategy in each potential game.

Let us analyse the following super-game: the two players play a prisoner's dilemma game unless one of them chooses to play a stag hunt game. If the two players adopt a strategy of "always defect" in both prisoner's dilemma and the stag hunt and play prisoner's dilemma (and the choice to move to stag hunt game is not enough in order to change these expectations), the game is in ultra-equilibrium! This is so since no player has incentive to change the game given all the players cling to their strategies!

This may explain why nations sometimes adhere to their choice to play risky games: they dismiss the opportunity to move to the less risky game, since they expect that in the less risky game they will also fail to achieve cooperation.

Query. Why would these players not take into account the option that the other players may change their strategy and thus change the game? Here our proposal resembles Nash's theory [8] in not taking into account the option that in the stag hunt one player change of strategy may make the other player change strategy. This is the point in the "unilateral" change, where we follow Nash by limiting our discourse to unilateral change. Nash limited his theory to a situation without communication between players. He ignored the game with possibilities of communication. This description in Nash's theory renders the rationality of the players "bounded rationality" so-called! Nash counted the absence of communication between players not as friction but as a condition of a game that his theory deals with. This is alright, yet it leaves unexamined the case in which communication is possible, much less the possible moves that render communication possible as well as the conditions that render such moves beneficial and at what price. Nash saw his theory as applicable to mass action, and for that case the assumption of no communication may be very reasonable—at least as long as we ignore the socio-political institutional settings within which that mass action occurs. Nevertheless, obviously, his theory is applicable also to repeated games, and then this assumption becomes increasingly questionable. Nations at the verge of war may communicate in order to promote cooperation in the game they may choose to play and then they will have incentive to change the game. This holds even for nations at war, especially due to protest against the prolongation of the war. Notice that an ultra-equilibrium (or a Nash equilibrium) represents a bad result, may lead within one side or two to the recommendation or

even the demand to communicate with the other side in search for a way to a bilateral change of strategy, or to a change of the game.³

The ability of the choice of the game to play to change the expectations of the players may destabilize the equilibrium that the game may be in. It is something that the theory of Nash overlooks: he assumed that the very choice of the game signals the possible expectations of the players. The choice of a player to play a stag hunt game may signal that the player does not expect the other player to defect. This shows how much the context of the game is important; hence, even when unspecified, classical games are played in context; and so, applied game theory should attend to the context.

Another case of ultra-equilibrium obtains when (1) nations play repeated prisoner's dilemma, (2) each follows a tit-for-tat strategy, and (3) one nation can choose to change the game from a repeated prisoner's dilemma game to a repeated stag hunt game. (This is the case of the game Israel chose to play with Hamas in Gaza for years). In this case, the mutual strategies of tit for tat and the choice to play prisoner's dilemma represent an ultra-equilibrium; neither nation has incentive to change strategy or game unilaterally. (Any incentive to change them comes from Egypt).

This is so even though the stag hunt game is riskier in another context. The ultra-equilibrium, such as any other equilibrium, represents relative stability. The game may be replaced and then what is ultra-game theoretical equilibrium or Nash equilibrium loses its stability. Thus, we follow Nash by assuming that players display a bounded rationality in that when the players choose their responses, each views the strategy of the other as fixed; we deviate from Nash when we propose to explore the conditions of improving upon this bounded rationality and the cost of doing that.

Let us now propose a variant of this kind of equilibrium. This time we do not ask whether the players have an incentive to change their strategies of the game that they play or their choice of a game to play, but whether they see any incentive to change the game or the strategy that they have chosen. A super-game is in a super-equilibrium if no player *sees* incentive to unilaterally change the choice of the game or the choice of the strategy in each potential game. Sometimes nations stick to bad equilibria because they do not see what it is in their best interest.

A particular kind of super-equilibrium is when the players do not see incentives to change the game since they do not see that the other player has\sees incentive to change their strategy in a potential game. For example, a state can choose to play the game of war claiming that the other state will not change their strategy even in the case of peace.

We deviate from traditional game theory that allows for players to make mistakes. (It is not enough to show people the right way: as Wald has illustrated, it is often important to discuss the high cost of errors that makes it highly advisable to avoid them). In the case of a super-equilibrium, we speak about the incentives that players see, and mistakes that they may make. Sometimes they have a strong incentive to

³ The aim of this study differs from that of many other game theoretical studies, such as [9]. He wished to reduce the number of Nash equilibria for given games. We, on the contrary, consider a great achievement the discovery of Nash that some games have more than one equilibrium. This discovery has valuable applications, as a society may be in an equilibrium that is not optimal. Indeed, famously, social norms are often stable even when better ones are readily available and desired.

change a game or strategy, but they do not have the information and changes of the information may help them to get rid of their mistakes.

Let us now propose a third kind of equilibrium. A super-game is in virtual-equilibrium, if no player *sees* incentive to change their strategy in the game not played *and*, given this, players *have* no incentive to change their game. Sometimes, a player may not see incentive to change their strategy in the game not played because they do not consider this option at all. The game is in a strong virtual-equilibrium, if no player has incentive to change strategy in the game chosen, and no player sees incentive to change strategy in the game not chosen, and, given this, no player has incentive to change the game that they do play.

Let us consider now the game of choosing whether to enter negotiations. Each side needs to choose whether to negotiate; they will play the game of negotiation if both sides agree to play it. If they both choose the strategy of demanding more than half of the profit from the success of the negotiations, then that will lead to the breakdown of the negotiation. If both sides do not consider the option of a change of strategy in the case of negotiation (which, we remember, is their bounded rationality) then this comprises incentive for both sides to choose not to negotiate. It is not a case of ultra-equilibrium, since in the potential game of negotiation, every side has incentive to change their strategy unilaterally. However, given no player sees incentive to change the strategy in the game not played, the game played is in virtual-equilibrium!

It seems that the virtual-equilibrium is common in international relations, since it embraces situations in which nations do not change the choice of the game since they do not imagine that a game change recommends a strategy change. Nations can adopt super hawkish strategies, but they may replace them when they negotiate for peace.

Furthermore, our proposed theory explains the repeatedly observed fact that people choose the wrong game because they choose the wrong strategy in the game not played. They choose too hawkish a bargaining strategy, so that they choose not to negotiate. It is harder to correct mistakes in the game not played, and this makes the virtual-equilibrium very important yet look speculative and so too risky.

Let us propose then this equilibrium: A game is in a *stupid equilibrium* if no player has incentive to change their strategy in the game played, and no player has incentive to change the game given the player plans to adopt the same strategy in the new game.

This concept may be criticized by this: “there is no reason why strategies of games should be comparable”. We have two answers for this. First, in the most important games in game theory, such as the prisoner’s dilemma game, the Hawk-Dove game (or the chicken game), and the stag hunt game; the strategies are comparable. This is so since what makes the difference is not the different story that is common to describe those games, but the different matrix of payoffs. Therefore, strategies such as cooperation or defection are applicable for all of the above-mentioned games. Strategies such as “tit for tat”, “always defect”, “always cooperate” etc. are applicable for all of the above-mentioned games in their repeat variants. Second, what is important is how those strategies are perceived in the eyes of the players. (it is a boundedly rationality theory).

Consider this example: a nation should choose whether to choose between war and peace. When they play any of these two games, they also choose whether to adopt a strategy of war economy or a strategy of peace economy. This will be their table of payoffs:

	A strategy of war economy	A strategy of peace economy
Game of war	Second best	Worst
Game of peace	Third best	Best

There are two possible stupid equilibria: choosing the game of peace and the strategy of peace economy; or choosing the game of war and the strategy war economy.

The above example is parallel to a coordination game in which one player chooses the game and the other chooses the strategy (and they have the same payoffs). There will be two Nash equilibria: peace economy in a state of peace; war economy in a state of war. Sometimes the decision making of a nation is distributed between different players: one chooses the game and another the strategy. Sometimes, the political system chooses the game, and the private industry chooses the economy. Choosing the game of war by the political body encourages the industry to choose the strategy of war economy. The shifting from an equilibrium of a state of war with war economy to a state of peace and peace economy may be blocked by transition cost (or a lack of communication between the player who chooses between war and peace, and the player who chooses between war economy and peace economy), but also by a lack of imagination. Given that peace is much cheaper even if the nation should compensate the war industry for their loss, it is a lack of imagination, and this is covered by the theory of the stupid equilibrium. The lack of imagination may suffice to lead a nation to prolong the game of war.⁴ Hence, people may choose the wrong game because they choose the wrong strategy, particularly in the game not chosen. They choose too hawkish a bargaining strategy that makes them choose not to negotiate. This will be the case when they dismiss the option of change of strategy in the new game.

When do nations or individuals choose the wrong game because they do not imagine that in a new game they can choose a new strategy? Game theory cannot reply to this question but it can help understand what will be the effects of such behaviour. This makes it advisable to make game theory part-and-parcel of social science. Consider the poem of W. H. Auden and Christopher Isherwood “The Dog Beneath the Skin”: “Man is changed by his living; but not fast enough. \ His concern to-day is for that which yesterday did not occur. \ In the hour of the blue Bird and the Bristol Bomber, his thoughts are appropriate to the years of the Penny-Farthing: \ He

⁴ Another case in which a state cannot compensate the industry for peace is when there is a “market failure” or “transaction cost”, such as information problems that block the possibility of coming to agreement regarding compensations. This problem may be reduced by neutralizing obstacles to internal agreements. One of the main obstacles is the denial that there are groups that enjoy economically from war and could be compensated in the case of peace.

tosses at night who at noonday found no truth". Game theory can help understand the ignorance that Auden and Isherwood described: people may adhere to equilibrium of war even when they have an option of peace: they may avoid peace negotiations out of ignorance of the need to change both the game and the strategy.

The optimistic side of all this is that factors that may destabilize such equilibria and even to prevent them in advance are available, even if at a cost. For example, the expanding of imagination may do this, and the cost is the change of the national education system, aimed at improving the intellectual capacities of the population. Incentives may be created for inventions that improve the particular imagination regarding the particular negotiation and for the establishment of the employment of these inventions in the education system. In chess, it is much easier to think of steps in advance when players can use the board freely. This is also regarding peace negotiation. Meeting of people, even unofficial ones, from the two hostile states may improve the imagination, and the project of the EU, for example, contributed to it. When the German people and the French people meet each other, they discover that their negotiation may lead to a cooperation. When there is a trade between nations the leaders and the peoples see that agreements are possible. Experiments of negotiation and private peace agreements may improve the situation.

References

1. Hayek, F.A.: Planning, science, and freedom. *Nature* **148**(3759), 580–584 (1941)
2. Keynes, J.M.: The general theory of employment, interest and money. Macmillan and Co. Limited, London (1936)
3. Weiss, U.: The robber wants to be punished. *Touro L. Rev.* **37**, 267 (2021)
4. Knight, F.H.: Notes on utility and cost. University of Chicago Press, Chicago (1935)
5. Wald, A.: Statistical decision functions which minimize the maximum risk. *Ann. Mathe.* **46**(2), 265–280 (1945)
6. Wald, A.: Statistical decision functions (1950)
7. Von Neumann, J., Morgenstern, O.: Theory of games and economic behaviour. Princeton University Press, Princeton NJ (1944)
8. Jr Nash, J.F.: Non-cooperative games. *Ann. Math.* **54**(2), 286–295 (1951)
9. Myerson, R.B.: Refinements of the Nash equilibrium concept. *Int. J. Game Theory* **7**(2), 73–80 (1978)

Chapter 11

Cooperative Game Theory Mobilized for Peace



How can cooperative game theory contribute to the prevention of wars? Some scholars who appreciate cooperative game theory express frustration at the paucity of its applications. Yet, some small changes in the theory, particularly enabling small changes in games, may change both the theory and the games for the better. Abstaining from playing risky games is clearly commendable, and so is the search for peaceful means for the prevention of playing risky games. Games that tend to discourage cooperation and to promote war are better not played.

It has been seen that so far, cooperative game theory, namely, the theory of games with perfectly enforceable contracts, has no significant use. It will be more useful, however, particularly for social planners, if it is armed with a toolkit for the choice of games to play in order to promote peace and cooperation, and for the choice of games to avoid playing for the same reason. Also, integrating cooperative game-theory into the social sciences may encourage study of the conditions that help promote peace and cooperation. In addition, it is commendable to import these achievements of non-cooperative game theory to cooperative game theory. The application of the theory of Nash equilibrium, *mutatis mutandis*, to cooperative game theory, may help prevent playing games that may incite war.

11.1 Preface

How can cooperative game theory contribute to the prevention of wars? Some of the scholars who appreciate cooperative game theory express frustration at the paucity of its applications. Some small changes in the theory, particularly enabling small changes in games, may change both the theory and the games for the better.¹

¹ Uri Weiss thanks Professor Ehud Guttel for challenging him to investigate how cooperative game theory may be applied to law. I have thought 10 years about his challenge, and this piece is an attempt to handle with his challenge.

How can cooperation be encouraged? Both cooperative and non-cooperative game theory investigate both conflicts and cooperation. Cooperative game theory differs on this matter from the non-cooperative one, since only cooperative games allow for assuredly enforceable contracts. Considering degrees of enforceability, the range between the theory of cooperative games as one pole, and the theory of one-time non-cooperative games without communication as the other, enable the study of cooperative game theory in a manner that may contribute to understanding of what happens between the poles, particularly in discussions of enforcement in general. This then can help decide what games to play, and, more importantly, what games to avoid playing for the sake of keeping the peace. It may also lead to improvements of the current version of the cooperative game theory that is thus far almost useless. (Cooperative game theory has already achieved one aim: it enables finding equivalence between different sets of rules of distribution: it can help identify some pairs of games, described by different sets of rules, as leading to the same outcomes.) We particularly recommend integrating Nash theory about equilibrium of strategies and cooperative game theory. We present here cooperative game theory and some ways to make it useful. Which obstacles must be overcome so that cooperative game theory will be better able to apply productively to social science, particularly to the theory of agreements? How can cooperative game theory help encourage cooperation? All this should be part and parcel of the social sciences.

What then is the goal of cooperative game theory? Different game theoreticians address different goals; in particular, some seek stability and others seek efficient, fair distribution of wealth.² Our aim is the maintenance of peace. Let us now go into details.

11.2 The Map of the Possible Games

Game theory is often divided into cooperative and non-cooperative (also known as strategic and axiomatic, or strategic and coalitional), as well as repeatable and non-repeatable. The difference between cooperative and non-cooperative games is that only the cooperative game allows players to achieve an assuredly enforceable contract.³ Cooperative game theory is thus one pole of game theory. In it, players can make perfectly enforceable contracts, and it is assumed—even though tacitly—that

² Aumann and Maschler wrote: “the basic difficulty in n -person game theory is due to the lack of a clear meaning as to what is the purpose of the game. Certainly, the purpose is not just to get the maximum amount of profits, because if every player will demand the maximum he can get in a coalition, no agreement will be reached. Thus, one decides that the purpose of the game is to reach some kind of stability, to which the players would or should agree if they want any agreement to be enforced. This stability should reflect in some sense the power of each player, which results from the rules of the game”. See [1]. On the other hand, Nash wrote: “Hence, we may think of one point in the set of the graph as representing the solution, and also representing all anticipations that the two might agree upon as fair bargains”. See [2].

³ In the first paragraph of his paper “Two Person Cooperative-Games” Nash wrote: “THE THEORY presented here was developed to treat economic (or other) situations involving two individuals whose

the game allows for communication, transactions, coalition-formation and any other means for achieving agreement between players—all as cost-free (in the broad sense of costs as any investment intended to remove any obstacle to efficient agreement). As these assumptions are changeable within cooperative game theory, we recommend developing a version of it with coalition-formation costs, with asymmetric information, and optimism or strategic behaviour⁴—even when these prevent the formation of efficient coalitions. The opposite pole is the case of a one-time non-cooperative game with no possible communication. Nash theory of equilibria,⁵ which we see as the most important theory in game theory,⁶ discusses games in which communication is impossible.⁷ Those two cases are extreme poles: one is of (cooperative and non-cooperative) games in which communication is possible at no cost and the other is of games in which communication is impossible. Although they are ideal, they signify for the study of real cases. In this they resemble the case of monopoly and perfect competition in classical economic theory.⁸ The benefit from the attitude that allows the view of ideal cases as targets to approximate, is that it helps consider a

interests are neither completely opposed nor completely coincident. The word cooperative is used because the two individuals are supposed to be able to discuss the situation and agree on a rational joint plan of action, an agreement that should be assumed to be enforceable”. See [3].

⁴ By a popular error, the view of the division between axiomatic game theory and strategic game theory is deemed equivalent to the division between cooperative and non-cooperative game theory. For example, game theorists sometimes see the work of Shapley-Gale (1962) as the most important work in cooperative game theory. They present it as an example for the productivity of this field. Yet this work, although it definitely belongs to axiomatic game theory, is no part of cooperative game theory, since it ignores enforcement. The same holds for the leading application of the matching theory of [4], “The question was how to develop a marketplace to allow transplantation to occur when otherwise it would not have”. His interest is then in the hidden question, how is it best to ensure agreements to exchange organs for transplantations, given that they are legal but not enforceable. Clearly worded, the problem invites thinking about revision of the law and possible solutions in terms of financial obligations. That makes the discussion more rational, though seemingly less mathematical. Also, [5].

⁵ See [6]. Let us expand: a game is in a Nash equilibrium if and only if no player can benefit from changing their strategy unilaterally. Nash equilibrium is actually a stable norm, so we propose that Nash equilibrium has a social significance where there is a norm, namely when the game is played in stable enough context such that the players can develop expectations. It may be in games with many players and it may be in repeated enough game. One may learn from Nash’s theory that sometimes may achieve many possible equilibria, and the players may stick to an inferior equilibrium that every player wishes to get rid of, but every player has no incentive to unilaterally deviate from, so the inferior may equilibrium will survive, unless the system will be changed. This is an important moral for the theory of legislation, since legislation may change the system.

⁶ Nash made in game theory the revolution Adam Smith made in economic theory. Nash theory is a theory that can analyse non-zero-sum game (without making them reduction to zero-sum game with additional player). Nash theory investigates.

⁷ Sometimes game theoreticians erroneously use this theory without sufficient attention to this assumption.

⁸ Fritz Machlup wrote: “We have seen that a subdivision of the groups and sub-groups of our classification seems appropriate, distinguishing perfect from imperfect monopoly, perfect from imperfect monopolistic competition, perfect from imperfect pure competition. But we have still to bear in mind that the kinds of imperfections are so manifold and different that it is hardly permissible to label the various market positions satisfactorily with the few tags now currently in use”. [7]

game close to perfect competition as all round better than a game close to perfect monopoly. The insight that perfect competition is only an extreme and unrealistic pole leads to theories such as the second-best theory: the best policy in one game is not always the best policy in games that resemble it, even a close resemblance. The understanding that we cannot achieve a perfect competition, leads to doubts as to the wisdom of efforts to come as close to perfect competition as possible [8]. Similarly, comparison might be interesting between cooperative and non-cooperative game theory, particularly in the case of one-time games without communication. The interesting question there is: How does the game change to allow for contracts or communication.

Particularly, altering the prisoner's dilemma⁹ by making enforceable contracts possible, makes it a totally new game; the new assumption we add, that there is no transaction cost, then, renders the game of prisoner's dilemma with possible cooperation possibly reasonable to play. We call this last game the cooperative prisoner's dilemma. The cooperative prisoner's dilemma, permitting its players to cooperate, makes it realist and at times even reasonable. Adam Smith strictly supported enforcing contracts and saw this enforcement as one of the most important causes for economic success [9]. As Smith emphasized, some cooperation (such as collusion between entrepreneurs) is undesirable, possibly better to prevent; those situations will not have regular contract laws but rather a clause of unenforceability. In the case of collusion, the cooperative prisoner's dilemma game is obviously undesirable. Hence, while contract law brings the game close to cooperative game theory,¹⁰

⁹ Prisoner's dilemma: suppose the police arrest two individuals for possession of illegal weapons near a bank immediately after an armed robbery took place there. The police have strong enough evidence to charge them with the minor infringement that incurs a lenient penalty, but not enough evidence to charge them with the severe infringement that incurs a severe penalty. To achieve that the police isolate them and propose a plea bargain to each of them. The options that the game offers are then as follows. If they both betray each other, they will both receive a medium penalty; if they cooperate with each other and keep silent, then they will both receive a lenient penalty. If only one betrays the other, then that one will walk, and the other will receive the severe penalty. The outcomes then are A (freedom), B (lenient penalty), C (medium penalty) and D (severe penalty):

	Cooperate	Defect
Cooperate	B, B	D, A
Defect	A, D	C, C

¹⁰ To translate the main justification for contract law into the language of game theory: contract law changes prisoner's dilemma games to cooperative prisoner's dilemma game; that promotes cooperation to the benefit of both players. This justification expires when the cooperation is against the public interest (including cases of extortion) as well as when the clause of unenforceability should enter the picture in order to prevent the prisoner's dilemma game becoming a cooperative prisoner's dilemma game. Sometimes, the clause of unenforceability is not sufficient for that end, since the situation may be a repeatable prisoner's dilemma game in which cooperation is possible, and such cases need enforceable antitrust laws in order to alter the game into one in which cooperation is

antitrust laws make the game much closer to non-cooperative games without communication.¹¹ Current antitrust laws do not go so far as to render the game similar to the one-time game, since these laws do not prevent Nash equilibria of cooperation that may be established in repeated prisoner's dilemma games (even without communication).¹² Hence, decriminalizing trusts might lead to improvement, since it will expand the toolbox to handle with anti-competitive behaviour, particularly when there is no criminal intention, or at least not one that can be proved in the standards of criminal law. This will prevent the rise of the power of cartels, and thus increase competition and reduce penalties, which in turn will lead to more honest, free, and competitive markets to the benefit of all.

Considering games in between the prisoner's dilemma and the cooperative prisoner's dilemma, it is an important insight that infinitely repeatable version of the prisoner's dilemma soon makes players able to reach cooperation akin to enforceable agreements. Aumann has said in his Nobel lecture (2006), "The fundamental insight is that repetition is like an enforcement mechanism" [10]. (This insight of

impossible. Antitrust laws attempt to make a repeatable prisoner's dilemma game no more than a series of one-time prisoner's dilemma games.

¹¹ Usually there is a prisoner's dilemma between the sellers. They can benefit from a contract that they will increase the price or reduce the quantity. Yet, not only that the law courts will not enforce such a contract, but coming to this agreement is illegal. Anti-trust usually blocks even the communication that may enable cooperation.

¹² According to Sherman Antitrust Act, 15 U.S.C. §§ 1–7 Sherman Act § 1, 15. U.S.C. § 1:

Every contract, combination in the form of trust or otherwise, or conspiracy, in restraint of trade or commerce (https://www.law.cornell.edu/definitions/uscode.php?width=840&height=800&iframe=true&def_id=15-USC-509055121-1913737444&term_occur=999&term_src=title:15:chapter:1:section:1) among the several States (https://www.law.cornell.edu/definitions/uscode.php?width=840&height=800&iframe=true&def_id=15-USC-80204913-1913675986&term_occur=999&term_src=title:15:chapter:1:section:1), or with foreign nations, is declared to be illegal. Every person (https://www.law.cornell.edu/definitions/uscode.php?width=840&height=800&iframe=true&def_id=15-USC-991716523-1913513574&term_occur=999&term_src=title:15:chapter:1:section:1) who shall make any contract or engage in any combination or conspiracy hereby declared to be illegal shall be deemed guilty of a felony, and, on conviction thereof, shall be punished by fine not exceeding \$100,000,000 if a corporation, or, if any other person (https://www.law.cornell.edu/definitions/uscode.php?width=840&height=800&iframe=true&def_id=15-USC-991716523-1913513574&term_occur=999&term_src=title:15:chapter:1:section:1), \$1,000,000, or by imprisonment not exceeding 10 years, or by both said punishments, in the discretion of the court.

This law imposes a severe punishment on "contract, combination in the form of trust or otherwise, or conspiracy, in restraint of trade or commerce (https://www.law.cornell.edu/definitions/uscode.php?width=840&height=800&iframe=true&def_id=15-USC-509055121-1913737444&term_occur=999&term_src=title:15:chapter:1:section:1)". However, what is a contract, or combination, or conspiracy? One may study from Nash's theory that a coordination can be achieved even without a contract, or combination, or conspiracy, and that this coordination will be equivalent to contract. In a repeat game there may be a Nash equilibrium of unplanned coordinated prices. No player will have any incentive to deviate from the unplanned coordinated prices. In other words, collusion may be a result of evolutionary process without any plan or active coordination. The criminalization of anti-trust law insures the fiasco, since they prevent blocking collusion when there is no any criminal intention.

Aumann is a clear-cut refutation of *Realpolitik*. In other words, the theory of Aumann refutes the supposition that an agreement is useless without an institution to enforce it).¹³ Considering players' intent to maintain reputation a sort of enforcement mechanism. The division of games to the repeatable one and the non-repeatable one may look coextensive with their division to games with an option of coming to contract and games without option to coming a contract, possibly even to cooperative game theory as well as to non-cooperative game theory. This however is inaccurate for two reasons. First, repetition is not equivalent to an enforcement mechanism since repeatable games do not insure the enforcement of the cooperation, as in cooperative game theory. In some repeated non-cooperative games, the players may achieve Nash equilibrium in which they both cooperate, such as mutual tit for tat in the repeated prisoner's dilemma, but also the players may achieve a Nash equilibrium in which they both defect, such as mutual always defect in the repeated prisoner's dilemma, and even in the repeated stag hunt.¹⁴ Second, in games with contracts, the enforceability of the game does not depend on moves being rational, while may depend on rational moves.¹⁵ Despite this, in games with an option of coming to agreements with limited enforcement, and in real life enforcement is always limited, retraction of a move has the advantage that it may permit cooperation even in case courts and any possible agency of enforcement fail as mechanisms of enforcement.

Let us discuss this case, as it shows the advantage of repetition as a mechanism of enforcement. In a given transaction, where the buyer pays for the seller's obligation to provide some goods and the seller fails to perform, the buyer may appeal to a court of law, ready to bear the litigation cost. If this situation is a one-time game, it may be rational for the player to accept a settlement in which they get their right minus the cost of enforcing their right, which is the litigation cost.¹⁶ It may be rational for a one-time player who does not care much for reputation to press for such a settlement, particularly concerning considerable property such as real estate. Yet,

¹³ For the way to exclude *Realpolitik* from international relations see [11].

¹⁴ In the stag hunt game two hunters choose simultaneously whether to hunt a stag or rabbits, when a successful stag-hunt requires two hunters whereas going for rabbits one hunter is assured of success. It is then best for both if both go for the stag; but otherwise it is wiser to go for rabbits. Going for rabbits, one hunter prefers the other to go for the stag. Consider then four levels of success, from A to D:

	Cooperate	Defect
Cooperate	A, A	D, B
Defect	B, D	C, C

¹⁵ The prevention of nuclear attacks wants an effective law court to enforce the agreement not to use weapons of mass destruction. This is problematic. For, players may not be rational enough to avoid using nuclear weapons, and they may not respect agreement, if only by mistake.

¹⁶ A sense of *noblesse oblige* may prevent a buyer from accepting such a settlement. It makes a one-time game situation look repeatable.

respect for contracts is obviously in the best interest of a seller who is engaged in business professionally, and who is no fly-by-night.

The abstract character of the cooperative version with assured enforcement makes it too idealized to count as social scientific;¹⁷ nor is it sufficiently intriguing to count as mathematical. It is replaceable with a theory with a weaker assumption regarding the enforceability of contracts plus an assumption regarding means of enforcement. Nash pointed out that “we need a sort of umpire, who will enforce contracts or commitments” [3]. He tacitly assumed here that his umpire takes no part in the game, as this makes bribery enter the picture as an option.¹⁸

The distinction is significant between non-cooperative game theory and cooperative game theory; the difference between them is better considered a matter of degrees, from the lowest to the highest degree of capacity to come to (implicit or explicit) agreement. The spectrum between non-cooperative & cooperative games may roughly be designated thus: 1. One-time games with no communication possible. 2. Repeatable games with no communication possible. 3. Repeatable games with communication possibility and with no external mechanism that enforces agreements. 4. Games with communication possibility and with an imperfect informal mechanism to enforce agreements.¹⁹ 5. Games that permit communication and apply imperfect formal mechanisms to enforce agreements. This is the case of contracts in markets in countries that apply the rule of the law as (imperfect) mechanisms to enforce agreements. 6. Games that allow communication and use mechanisms that enforce contracts perfectly. 7. Games that allow communication and use perfect mechanisms that enforce contracts and cost-free (or negligible cost) communication and transaction means.

Traditional microeconomic theory includes discussion of games with possibly assuredly enforced agreements: the implicit assumption is that the parties can come to a deal without potential enforcing costs or litigation costs, while the economic study of contract law comprises study of games that allow coming to agreements with no assured enforcement.²⁰ The “Law and Economics” movement introduces

¹⁷ The high idealization of the game prevents describing particular social situation as a particular cooperative game.

¹⁸ *Id.*

¹⁹ An example of an informal mechanism for the enforcement of the agreement is reputation. In international relations, even with no legal mechanism to enforce the game, public knowledge that states enter agreements may create incentive. This refutes Realpolitik See [11]. Trade in eBay is a success mainly due to two factors. One factor is the possibility of participants to rank each other. The other factor is the possibility of eBay itself to develop informal mechanisms such as the exclusion of some sellers.

²⁰ Posner proposed this problem:

Suppose I sign a contract to deliver 100,000 custom-ground widgets at \$10 apiece to A, for use in his boiler factory. After I have delivered 10,000, B comes to me, explains that he desperately needs 25,000 custom-ground widgets at once since otherwise he will be forced to close his pianola factory at great cost, and offers me \$15 apiece for 25,000 widgets. I sell him the widgets and as a result do not complete timely delivery to A, who sustains \$1000 in damages from my breach. Having obtained an additional profit of \$1250 on the sale to B, I am better off even after reimbursing A for his loss. Society is also better off. Since B

into the picture also the cost of litigation in the broadest sense of costs,²¹ including costs due to the uncertainty of contract laws [13]. Studying the map of the different games, namely, looking on the picture of the different games, cooperative and non-cooperative as well, is beneficial because it helps comprehend the difference between the available games, which comprehension signifies, since it facilitates decision on the choice of a game and its cost. In other words, we recommend not to study a game as it stands by itself, but as one possible game that may be replaced by some other game. This choice of what game to play and particularly what game not to play is—or should be—a part of social planning, as it helps study the opportunity-cost of different contracts. Such a study may help players to decide whether to come to a contract, which kind of a contract to prefer, and whether to make it possible to cancel a contract under which condition. Such a study may help social planners to determine what kind of contract should be enforced or, alternatively, should be legal but recognized as unenforceable or even be made illegal. When should even communication be rendered illegal? What should a breach of a contract entail? In particular, what is the criterion for compensation for a breach of a contract? How are international agreements to be enforced? How should international law reflect the degree of current enforceability of international accords? When players decide to make a purchase, they still may decide under what conditions to do so. Is it safe to stipulate conditions that the law courts do not enforce? States can choose the game they play by choosing whether they respect their contractual obligation, and, in particular, whether they respect international law. Players in international relations can choose a game, since international relations comprise games that help develop reputation. New spouses can decide what game they wish to play, making their agreement legally binding or avoiding this step. Traditional contract law recognizes the right of parties to choose whether to play the game of binding contract or the game of honourable agreement impossible for law courts to enforce. As honourable agreements differ from contracts, they deserve attention. Similarly, game theory should refer to the great picture with different games, including cooperative ones.

11.3 The Current State of Cooperative Game Theory

Eric Maskin won the 2007 Nobel Prize in economics for his achievements in mechanism design, namely, the design of sets of rules for games intended to achieve specific

was willing to pay me \$15 per widget, it must mean that each widget was worth at least \$15 to him. But it was worth only \$.14 to A—\$.10, what he paid, plus \$.04 (\$1000 divided by 25,000), his expected profit. Thus, the breach resulted in a transfer of the 25,000 widgets from a lower valued to a higher valued use.

See [12].

²¹ The “Law and Economics” movement offers studies of the inaccuracies that the advocates of standard economic theory ignore, usually under the pretext that they are mere “friction”.

desired outcomes of games.²² He values cooperative game theory, and he considers its founding fathers “geniuses”. [15]. Yet, he views cooperative game theory thus far unsuccessful, as it is obviously much less applicable than its noncooperative version.²³ Why is cooperative game theory barren? What should be done to make render it useful? Maskin has presented this problem and offered a solution to it (for which we offer an alternative).²⁴

Maskin asks, how One may make game theory to be more useful, and recognizes that non-cooperative game theory is much more useful.²⁵ He proposes that we should detail not only the benefit that a particular formed coalition gives to its members, but also the benefit that the formed coalition brings to the players who are not members in the formed coalition; and it will make a big change since sometimes it may be rational

²² This is how the Nobel Prize Committee reasoned his prize:

Prize motivation: “for having laid the foundations of mechanism design theory”.

Contribution: Developed implementation theory, a theory for achieving particular social or economic goals. An important problem is that a mechanism typically admits multiple equilibria. Even if the best outcome is possible to achieve other inferior solutions may exist. Maskin was first to develop conditions under which all equilibria are optimal.

See [14].

²³ *Id.*

²⁴ *Id.* Maskin says,

J. von Neumann and O. Morgenstern devoted most of their seminal book to cooperative theory, with subsequent major contributions by Nash and Shapley.

Id.

He then described their failure thus,

... cooperative game theory has been used far less than noncooperative theory as a predictive tool in economics. Indeed, inspection of the current leading game theory textbooks ... reveals that the ratio of cooperative to noncooperative theory is remarkably low ... all Nobel Memorial Prizes awarded for game theory to date have recognized work exclusively on the noncooperative side.

Id.

He has found this failure surprising:

Cooperative theory seems to offer the important advantage of giving insight into how coalitions behave, namely, how subsets of players bargain over which actions are played. ... cooperative theory appears to be far less dependent on particular details about strategies ... than noncooperative theory.

Id.

²⁵ *Id.*

... why, despite these advantages, is cooperative game theory currently dominated by noncooperative theory as applied to economics.

for a player to benefit from the created good created by a coalition without joining it.²⁶ Maskin teaches that we should take into account that sometimes players may benefit from the good that created by a big coalition without joining the coalition, the free rider problem, what may prevent the creation of the grand coalition.

This “open task” indicates that cooperative game theory invites clarification, one that will be facilitated by rendering game theory part and parcel of social science. This rendition is a necessary condition for making game theory useful. The fact that “noncooperative is more detail dependent”²⁷ than cooperative, to echo Maskin,²⁸ makes it more fruitful than the cooperative. It is likewise advisable to enable the details²⁹ of cooperative game theory to influence its outcome much more. Such a move renders the highly abstract axiomatic approach less suitable; hence, it is better to import the methods of non-cooperative game theory into cooperative games than the other way around. Games with externalities comprise only one example for this needed revision. Other examples for possible beneficial revisions may be the outcome of a study of games with transaction costs as well as games with no assurance of enforcement of contracts, not to mention games in which arbitrators are also deemed players as well as games that permit credible threats to precede signing contracts.

Maskin introduces (positive) externalities into cooperative game theory, and he should be praised for this extremely important step, but there is also a place for improvement; we argue that it will be better to analyse the cooperative game with externalities by developed tools of Nash theory of equilibrium in non-cooperative game theory than by the traditional tools of traditional game theory.

Maskin attempted to illustrate by an example³⁰ a point he made that “there is a good theoretical reason why, in a model with externalities, we should not expect the

²⁶ *Id.*

Perhaps one answer is that the characteristic function, by assumption, rules out externalities—situations in which a coalition’s payoff depends on what other coalitions are doing... In my view, it remains an open [task]... to develop an approach that properly accommodates the formation of multiple coalitions”.

²⁷ *Id.*

²⁸ *Id.*

²⁹ Von Neumann and Morgenstern write: “We shall therefore, in the discussions which follow, make use of the possibility of the establishment of coalitions outside the game; this will include the hypothesis that they are respected by the contracting parties”. We argue that they put the most important details outside the game, and they are still there.

³⁰

... consider the following three-player game, in which coalitions can produce public goods. The coalition of players 1 and 2—{1; 2}—can produce a total payoff of 12 for itself, {1; 3} can produce 13, and {2; 3} can produce 14. The grand coalition {1; 2; 3} can produce 24. A player can produce nothing on his own. However, if the other two players form a coalition, he can free-ride on the public good they produce and enjoy a payoff of 9 (which is the externality that the coalition confers on him).

grand coalition to form".³¹ Maskin analysed a game in which it is better for a player that the rest of the players will join the coalition that creates the public good, but the player will not join it, what enables the player to join the public good without paying; and in this game that it is better for the rest of the players that such a coalition will be created than that there will be no cooperation at all. (In other words, it is better for the other players that they will pay, even though the free rider does not pay, and the public good will be supplied, than a result that no one pays and the public good is not created). We argue that Maskin is right that the grand coalition will not necessarily be formed, but his analysis dismisses that the grand coalition may be formed also in such scenarios,³² and this will happen when every member refuses to join a coalition unless everyone joins. In other words, the grand coalition may be formed when every player takes a strategy that they will not join unless everyone joins. This is a way to threaten the potential free rider, and if the threat is credible, everyone pays, namely everyone joins the grand coalition!

Is Maskin right about all coalition formations possible? No. It depends on the options open to players, including the options to threat and promise during the negotiation,³³ and thus far these are sadly not specified here. Assuming that each player has the option to join a coalition and that each player can have a strategy, then (still following the very recommendation of Maskin) none of them can benefit from a strategy change. Nevertheless, this is not the whole story: the case is different when

³¹ *Id.*

³² Maskin presents the end of this game as:

I claim that, we should not expect the grand coalition to form in this game. To see why not, imagine that all bargaining is conducted at a particular site and player 1 arrives there first, followed by 2, and finally by 3. When player 2 arrives, player 1 can make him offer to join 1 in a coalition. Let us explore what 2 must be offered to be willing to join. Notice that if he does not join 1, he will be in competition with 1 for signing up 3. In this competition, 1 will be willing to bid 13 (the gross value of the coalition with 3) minus 9 (which he would get as a free-rider if 3 signed up with 2), namely, 4. Similarly, 2 will be willing to bid $14 - 9 = 5$. Hence, 2 will win the bidding war for 3 and will pay 4 (notice that because, in this thought experiment, 1 and 2 don't form a coalition, 3 has no possibility of free-riding and so will be willing to accept 4). Hence 2's payoff if he refuses to join with 1 is $14 - 4 = 10$. Thus, player 1 must offer him 10 in order to sign him up. Assuming 2 is signed up, 1 must then offer 3 a payoff of 9 to attract him to coalition {1; 2} (because 3 has the option to free-ride on {1; 2} and get 9 that way). Hence, altogether player 1 must pay $10 + 9 = 19$ in order to form the grand coalition. But this leaves only $24 - 19 = 5$ for himself. Clearly, he would be better off refraining from signing up 2—in which case ... 2 will form a coalition with 3. And 1 obtains a free-riding payoff of 9. I conclude that with arrival order 1, 2, 3, two separate coalitions will form: {2; 3} and {1}. A similar conclusion follows for the five other possible arrival orders.

³³ Maybe this is a good description of the difference between the approach of cooperative game theory to negotiation and the approach of non-cooperative game theory: in the literature of cooperative theory, the players usually have the options to delete options, and this is not a part of cooperative game theory. Major works that emphasized the options to delete options are: [16 and 17]. The advantage of Ellsberg is that he discussed seriously both the benefits and the costs of deleting options, while Schelling emphasized only the advantages.

players 2 and 3 agree that they will not sign an agreement unless player 1 joins them.³⁴ It is also possible that every player in the example that Maskin discusses will adopt this strategy: they may refuse to join a coalition of two but agree to join a coalition of three.³⁵ The example of Maskin is ingenuous and appropriate, but not his method, much less his solution, to the problem that he poses. Better cases are those displayed in non-cooperative game theory such as the theory of Nash. For its players may want to devise strategies. Importing into cooperative game theory the methods of non-cooperative game theory, *mutatis mutandis*, will enrich cooperative game theory. Moreover, coalition games avail themselves of the following equilibrium positions. A game is in a coalitional equilibrium if and only if no player and no coalition of players can benefit from changing their strategy unilaterally. A strategy of a coalition is the strategy that its members agreed to adopt (again, such as not hiring a cleaner unless all neighbours cooperate).

Here we deviate from the condition of unilateral deviation in the Nash theory. (The original work of Nash does not even permit communication!³⁶) Consider a game in which two firms interact. It is in equilibrium if and only if no coalition (namely, firm, or a new coalition, such as a new firm that will be the outcome of an integration³⁷) can benefit from changing its strategy unilaterally and no player (including a manager or a stockholder) can benefit from changing strategy unilaterally.

Let us compare now between the traditional way to make cooperative game theory, and the way this article recommends about: the importing, *mutatis mutandis*, of Nash's theory about equilibria of strategies into cooperative game theory. We will present one of the most fundamental games in cooperative game theory in order to illustrate that the coalitional equilibrium, we defined above, also holds for the fundamental game that cooperative game theoreticians discuss as the default option and leads to interesting results. This is the game: three players can divide a pie of 100 units. In order to reach it, at least 2 players should support it. If every player adopts the strategy of joining the coalition of three and only this coalition, then no player can benefit from changing strategy unilaterally. Of course, if one player changes strategy, then another player can do likewise and then a new coalition of two will be able to exploit the third (given that it is legal³⁸). However, equilibrium is reachable by following the condition of unilateral deviation (a condition that Nash has proposed), namely, the strategies in which every player joins the grand coalition and only the

³⁴ This is not abstract: it resembles the familiar agreement of neighbours sharing a joint residence and interested in hiring a cleaner: they may agree to do so if and only if all neighbours cooperate.

³⁵ This coalition, incidentally, is in a Nash equilibrium.

³⁶ Nash wrote in his paper about non-cooperative games: "Our theory, in contradistinction, is based on the absence of coalitions in that it is assumed that each participant acts independently, without collaboration or communication with any of the others" [6].

³⁷ This example teaches that the stability of the marketplace is a function of the antitrust laws; their goal is to stabilize the market, such that the market will not cease to be a market, namely to influence the equilibrium such that societies will not play bad games.

³⁸ As such conduct is undesirable, it may be advisable to outlaw it.

grand coalition.³⁹ The stability of this equilibrium is a matter of degree. What within a democratic system stabilizes it is that its parties choose to play a variant of the above-mentioned game in which the party that wishes to exclude the minorities from the coalition harms its own reputation.⁴⁰ In the game of the open society, the payoff from excluding minorities is negative (one way or another). Most game theoreticians regrettably do not discuss the question, what should be the payoff, as their concern is with the equilibrium achieved under given payoffs; they ignore the fact that society can choose their values, what may change the game.

Coalitions may adopt strategies. Von Neumann and Morgenstern ignore this. Nash has laudably expanded their theory, but not enough: he ignores many possible cases of equilibrium. A game is in a Nash equilibrium if and only if no player can benefit

³⁹ By our analysis, in which we apply Nash equilibrium of strategies to cooperative game, we reject the methodology proposed by Aumann and Shapley: “Two general types of “solution concept” are distinguished in game theory: cooperative notions, such as the core, bargaining set, von Neumann–Morgenstern stable sets, and Shapley value; and noncooperative notions, principally the Nash equilibrium point and its variants and elaborations, but including also the max–min solution based on “safety level” or “worst case” considerations. Cooperative notions are appropriate for situations where contracts among players are customarily adhered to and can be made legally binding; noncooperative notions where there is mistrust and no external enforcement mechanisms are available. The long-term international scene is most naturally classified as noncooperative, since there is no effective international jurisdiction in most cases, even in the short run. Adherence to major international agreements is essentially a matter of national self-interest, and to be effective in the long run such agreements must be written to be self-enforcing, namely, so that it is to the continuing advantage of all sides to adhere to them. Quite a bit is known about Nash noncooperative equilibria in “continuously competitive” situations, and we shall review some of this material here. It turns out that individual self-interest in such situations can in fact dictate a kind of cooperative behaviour, in many cases, sustained by the fear of “punishment” by the other players for failing to “cooperate” with the general plan—this in spite of the fact that the players have no way of legally binding themselves to carry out such punishment. The ability of the noncooperative theory to describe such arrangements and to account for their stability in a “selfish” world is an encouraging point in its favour. The price that is paid, however, is the high degree of non-uniqueness in the Nash solutions (as revealed in the two theorems described below), which removes from this theory most of its predictive power”. We argue that Nash theory is applicable also to cooperative games, and in this paper we propose how to do it.

⁴⁰ Jean Jacques Rousseau saw the republic as a regime in one everyone should vote for what they see as the general good of the republic, but when there are section (namely, coalition) who vote for their group interest, and not for the general good of the republic as the end of the republic and the social contract [18]. Cicero even said:

“Those who propose to take charge of the affairs of government should not fail to remember two of Plato’s rules: first, to keep the good of the people so clearly in view that regardless of their own interests they will make their every action conform to that; second, to care for the welfare of the whole body politic and not in serving the interests of some (<https://www.perseus.tufts.edu/hopper/text?doc=Perseus%3Atext%3A2007.01.0048%3Abook%3D1%3Asection%3D85#note2>) one party to betray the rest. For the administration of the government, like the office of a trustee, must be conducted for the benefit of those entrusted to one’s care, not of those to whom it is entrusted. Now, those who care for the interests of a part of the citizens and neglect another part, introduce into the civil service a dangerous element—dissension and party strife”. M. Tullius Cicero. *De Officiis*. With An English Translation. Walter Miller. Cambridge. Harvard University Press; Cambridge, Mass., London, England. 1913. (Book I, Article 85).

from changing strategy *unilaterally*. This permits the introduction of a new equilibrium: a game is in a coalitional equilibrium if no player can unilaterally change their strategy, and in addition no coalition can benefit from changing strategy. In other words, a coalitional equilibrium includes the results that cannot be improved upon by a player or a coalition of the players by an alternative permissible *strategy*. A coalitional equilibrium is a subset of Nash equilibrium: coalitional equilibrium demands more than Nash equilibrium does.⁴¹ And, to repeat, the present text differs from the literature in that it examines coalitions with strategies.⁴²

Let us now compare the coalitional equilibrium and the approach of cooperative game theory. Cooperative game theory ignores changes of strategies, and centres on alternative moves. Coalitional equilibrium theory follows cooperative game theory: cooperative game theory is an examination of changes that a player or a coalition of players may introduce.⁴³ Nash equilibrium is an equilibrium of strategies chosen by players, while cooperative game theories are interested in an equilibrium of actions (namely, moves) chosen by players or coalitions. We should now go into this case in detail.

The difference between the idea of Nash and coalitional equilibrium is that coalitional equilibrium demands more: it demands also preventing the created coalition from destabilization by a change in its strategy, namely, by a coordinated change of strategy. If a game is in a coalitional equilibrium, then in addition to the condition that a player cannot benefit from a unilateral change of strategy, there is a condition that any number of players cannot benefit from a coordinated change of strategy. Thus, a game in this equilibrium is more stable than a game in Nash equilibrium. Here a new equilibrium invites itself, an equilibrium that is useful particularly in situations in which mistakes are taken in account: a game is in a *de facto* coalitional equilibrium, if and only if no player or a coalition of players *consider* it as beneficial

⁴¹ Let us take this example of a game that is in a Nash equilibrium but not in a coalition equilibrium: those are the rules of the game: the consent of the two players is demanded for cooperation, and the two players will benefit from cooperation. This is how the game is played: player 1 does not wish to cooperate with Player 2, and player 2 does not wish to cooperate with player 1. This game is in a Nash equilibrium, but not in a coalitional equilibrium. This game is in a Nash equilibrium, since no player can benefit from changing their strategy, however the coalition of player 1 and player 2 will benefit from the change. Nash theory teaches that those situations are a problem, and while considering coalition, One may see that there is hope in such situations. Nash theory assumes that there is no communication, and cooperative game theory as a part of the great picture can teach that communication can lead to an extreme improvement, that communication may make all the difference. This game is important since it is often the case of wars, in which the two players do not wish peace, but will benefit from peace. This is the case of the Israeli-Palestinian conflict, and this is why transparent negotiation is so essential. Another game that is in a Nash equilibrium but not in a coalitional equilibrium is the repeated prisoner's dilemma in which each player adopts a strategy of "always defect". The option of communication prevents risky games such as the repeated prisoner's dilemma.

⁴² See Supra note 48.

⁴³ Nash's theory regarding non-cooperative games does not consider changes that a coalition of players may make.

for themselves to change their strategy unilaterally.⁴⁴ Let us take the situations in which a coalition excludes a minority from itself. Economists assert repeatedly that discrimination is detrimental [19–21]. Hence, discrimination prevents optimization and thus it prevents reaching a coalitional equilibrium; it may nevertheless reach a de facto coalitional equilibrium—when every player or coalition of players does not see it as beneficial to change their strategies unilaterally. What stabilizes equilibrium in societies that discriminate against their own minorities is the ostracism of any subset of the majority that declares itself ready to enter into a coalition with the ostracized minority. This is a Nash equilibrium. A more stable coalition is one that cannot benefit from changing its strategy. This invites the definition of a third equilibrium, one that combines between the two former ones: a game is in a strange equilibrium if no player can benefit from changing their strategy unilaterally, and no coalition considers changing their strategy beneficial. This is usually what stabilizes discrimination: anti-liberal society punishes those who do not discriminate, and the society does not deem it against its interest. This also stabilizes national militaristic strategies. Suggesting that a country should replace its strategy benefits none of its citizens; this, then, is a national loss.⁴⁵ The change can come from the few deviants ready to pay the personal price for breaking from the collective blindness. The degree of freedom of speech will influence the growth of their numbers within the population.

11.4 About the Need for Clarifications in Cooperative Game Theory

We are interested in the applicability of game theory to law and politics, particularly for one of the most important problem in international law and in political science, how to prevent wars. When we come to apply game theory, we should handle the difficulties that result from cooperative game theoreticians being not clear enough, as we will explain in this paper. Cooperative Game theory will be much more applicable if it less confused, and the problem is that when game theoreticians try to interpret what cooperative game theory can accomplish, they sometimes add to the confusion. We hope that we understand them while trying to clear their systematic confusion. Particularly, there is a confusion about which question is under which discussion. Is the theory in question positive or normative? Are given efforts to “solve” a game positive or normative? The confusion about this is disappointing, given that the

⁴⁴ It is possible that a change of strategy will be beneficial, and it is possible that it will not be beneficial, but what is important in this equilibrium is what the players notice. A game may be in a de facto coalitional equilibrium because of mistakes that players commit.

⁴⁵ The parallel example in the business world for players and a coalition in bad strange equilibrium is the case in which to the loss of a firm none of those involved in its success has interest in declaring its strategy stupid. This may be even in small business, say, a coffee-shop, in which no employee would criticize its management, to everyone's loss.

founding fathers of game theory, von Neumann and Morgenstern,⁴⁶ “The reason why mathematics has not been more successful in economics” [23]. They said,

*The lack of real success is largely due to a combination of unfavourable circumstances, some of which can be removed gradually. To begin with, the economic problems were not formulated clearly and are often stated in such vague terms as to make mathematical treatment a priori appear hopeless because it is quite uncertain what the problems really are. There is no point in using exact methods where there is no clarity in the methods and issues to which they are to be applied. Consequently, the initial task is to clarify the knowledge of the matter by further careful descriptive work.*⁴⁷

We suggest that the task of clarifying the knowledge of the matter by further careful descriptive work is still challenging.

Cooperative game theory often aims at describing games by specifying games. Each game specifies two items: what each player might achieve separately (with no coalition), and what each coalition will achieve. This description of the game may lead to different questions. Von Neumann and Morgenstern wrote: “we want to analyse the possibility of coalitions the question between which players, and against which player, coalitions will form”. Other possible questions are: Which player will then benefit from entering a contract in which coalitions will be created; what will be the division of what they achieve by the contract; what the fair division of what is achieved; which division will not exploit players; what will lead to stability; what kind of contract will give rise to what kind of social structure; what should a mediator recommend to the parties; how much the opportunity to play the game is worth? Cooperative game theoreticians usually do not ask a clear question; they present a game, usually by ignoring the enforcer, and then they offer what Von Neumann and Morgenstern have called a “solution concept” [23]. They explained: “the immediate concept of a solution is plausibly a set of rules for each participant which tell him how to behave in every situation which may conceivably arise”.⁴⁸ However, as Michael Maschler has pointed out, a “meaningful interpretation” of all “solution concepts”⁴⁹ is not always available. Hence, it is not always clear “which solution concepts to use in any particular case” [24]. Nor can it be clear which solution is right in any particular case prior to the clear-cut statement of the question; the problems that Maschler has raised need the anchoring of cooperative game theory in the social science. It seems that some leading game-theoreticians sense that they cannot solve this problem as it stands.⁵⁰ What is needed is not more mathematics, but rather a move from pure game theory to applied game theory, namely, from mathematics

⁴⁶ This is how Arrow describe their status: “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”. See [22].

⁴⁷ *Id.*

⁴⁸ *Id.*

⁴⁹ We find Nash’s equilibrium theory to be much clearer than Von Neumann and Morgenstern’s theory.

⁵⁰ For example, Roger Myerson said

to social science. This is particularly the case in cooperative game theory. Shifting from discussing “solution concept” to discussing equilibria will make the discussion of cooperative game theory much clearer and more transparent. This is one of the advantages of non-cooperative game theory that should be adopted by cooperative game theory. The contribution to game theory of Nash is much better than that of Von Neumann and Morgenstern,⁵¹ whom should be praised for recognize the weakness of their theory,⁵² and we criticize him for not rebelling against them much more. While the theory (that has been established by Nash) about equilibrium corresponds to the theory of equilibria in mechanic, the discourse about “solution concept” (of Von Neumann and Morgenstern) corresponds to the essentialist philosophical tradition according to which the language speakers do not decide about the meaning (of solution in this case), but discover their virtues [27].

In order to decide how to make and use cooperative game theory in social law, politics and social science, we need to ask: what is the goal of cooperative game theory? Different game theoreticians aimed at different goals; some thought about achieving stability, and others about achieving efficient and fair division [3]. The latter cooperative game theoreticians are not clear if they have a controversy with the former, if they propose another tool to achieve other goals, or if they disagree with the goals, and maybe with the assumption (this is a result of their view of game theory as mathematics instead of social science). Let us present how leading game

Recall ... the general response to the problem of multiple equilibria in a game is Schelling's (1960) focal-point effect. This theory asserts that, in a game with multiple equilibria, anything that tends to focus the players' attention on one particular equilibrium, in a way that is commonly recognized, tends to make this the equilibrium that the players will expect and thus actually implement. The focal equilibrium could be determined by any of a wide range of possible factors, including environmental factors and cultural traditions (which fall beyond the scope of analysis in mathematical game theory), special mathematical properties of the various equilibria, and pre-play statements made by the players or on outside arbitrator. See [25].

⁵¹ Let us mention some advantages of Nash to Von Neumann and Morgenstern. First, while in the theory of Von Neumann and Morgenstern the players take the game as given, Nash wrote: “In Theory of Games and Economic Behaviour a theory of n-person games is developed which includes as a special case the two-person bar- gaining problem. But the theory there developed makes no attempt to find a value for a given n-person game, that is, to determine what it is worth to each player to have the opportunity to engage in the game. This determination is accomplished only in the case of the two-person zero sum game. It is our viewpoint that these n-person games should have values; that is, there should be a set of numbers which depend continuously upon the set of quantities comprising the mathematical description of the game and which express the utility to each player of the opportunity to engage in the game”. See [26].

Another advantage of Nash, which is his revolutionary contribution game theory, is that his theory of equilibrium in non-cooperative games enable to find equilibria in non-zero sum game. Von Neumann and Morgenstern emphasized their theories in zero-sum games.

⁵² We praise Von Neumann and Morgenstern for their sincerity regarding the weakness of their theory: “56.1.3. The prospect of having to start all over again would be very discouraging: we have already spent considerable effort on these concepts and the theory based on them. Furthermore we face a conceptual problem and the qualitative principles on which our theory was based do not seem to carry beyond the zero-sum case. Thus this final generalization the passage from the zero-sum to the non-zero-sum case would seem to nullify all our past efforts. We must find therefore a way to avoid this difficulty”.

theorists present the purpose while they present their “solution concept”. Aumann and Maschler saw stability as the purpose the cooperative game; they said:

the basic difficulty in n -person game theory is due to the lack of a clear meaning as to what is the purpose of the game. Certainly, the purpose is not just to get the maximum profits, because if every player were to demand the maximum they can get in a coalition, no agreement will be reached. Thus, one decides that the purpose of the game is to reach some kind of stability, to which the players would or should agree if they want any agreement to be enforced. This stability should reflect in some sense the power of each player, which results from the rules of the game [1]

Their search for stability as the goal of the cooperative game seems consistent with von Neumann and Morgenstern, who said:

Let the physical basis of a social economy be given—or, to take a broader view of the matter, of a society. According to all traditions and experience human beings have a characteristic way of adjusting themselves to such a background. This consists of not setting up one rigid system of appointment, namely, of imputation, but rather a variety of alternatives, which will probably all express some general principles but nevertheless differ among themselves in many particular respects. This system of imputations describes the ‘established order of society’, or ‘accepted standard of behaviour’. Obviously no random grouping of imputations will be as such ‘a standard of behaviour’: it will have to satisfy conditions which characterize it as a possible order of things. This concept must clearly provide for conditions of stability.⁵³

Von Neumann and Morgenstern interpreted their solutions to zero-sum four-person games to mean that: “In these solutions a defeated player is in general not ‘exploited’ completely, not reduced to the lowest possible level... This phenomenon of not ‘exploiting’ a defeated player completely is a very important possible (but by no means necessary) feature of our solution—namely, of social organization. It is likely to play a greater role in the general theory also.”

We presented the approach of Aumann and Maschler as well as of Von Neumann and Morgenstern regarding the goal of the cooperative game, in other words their approach toward what cooperative game theory may achieve. We will present now the approach of Nash regarding what a cooperative game may achieve [23]. Here the theory introduces Nash bargaining solution. A bargaining solution is a decision to agree or not agree; Nash presented conditions for a solution to be rational: it is one that does not incur needless loss, that does not prefer one party to a bargain over another, and that depends neither on the size of the achieved deal nor on options that neither party entertains. Nash said about Nash bargaining solution: “we have now solved the negotiation model, found the values of the game to the two players, and shown that there are optimal threats and optimal demands (the optimal demands are the values)”. If this is the case, why was the cooperative model introduced in the first place? The clue comes from the fact that the group of players in the cooperative version of the game is viewed as a virtual coalition. It may comprise two players, so as to qualify as a game proper, and it may comprise a large number of players,

⁵³ See [23]. It is interesting to see also the following interpretation of Wald in his review about their book: “Solution V may be regarded as a possible standard of rational behaviour which possesses a certain inner stability”. See [28].

so as to qualify as social-science substitute: the search here is for a game-theoretical stable solution that may serve as a basis for the social sciences, especially for political theory; one of the most important cases in social science is when one may consider consent as due to the social contract; in other words, when will the state create a grand coalition?

The stability will be achieved by answering the question, what assumption about the game of signing a contract will make all participants in the game wish to sign what kind of social contract so as to attain a coalition-rationality, so as to achieve stability (Machiavelli) [29]? Therefore, the required stability is of a degree that encourages the different parties to wish to sign the contract. And then, it was hoped, the contract should make the situation sufficiently stable. Thus, Aumann and Maschler ask, what leads to the decision? Like Nash and Shapley [30] Aumann and Maschler assume that in the cooperative games stability will achieve when the agreement leads every player to profit relatively to a result of no agreement, and of course the result should be feasible. Yet it seems that they have different goals concerning rules for the division of profits between players: Aumann and Maschler were interested in recommending a rule that would lead to a contract, whereas Nash and Shapley were interested in fairness.⁵⁴ For, Nash and Shapley are much more committed to equality than Aumann and Maschler are.⁵⁵ Thus, considering the bilateral bargaining problem,

⁵⁴ It is interesting to compare to Adam Smith who wrote: “trade which, without force or constraint, is naturally and regularly carried on between any two places, is always advantageous, though not always equally”. See ADAM SMITH, AN INQUIRY INTO THE NATURE AND CAUSES OF THE WEALTH OF NATIONS 489 (R. H. Campbell & A. S. Skinner eds., 9th ed. 1827). Aumann and Maschler demanded that the trade will be advantageous for both sides and they ignore considerations of equality in the distribution of the surplus created by the agreement, while Nash and Shapley are interested not only in the mutual advantage, but also in questions of fairness. This may be interpreted as a dispute if the game of negotiation should be like the game of the competitive market, in which trade leads every player to be better off, but there is no any aspect of equality, or in the game of negotiation, we should introduce fairness into the division of the surplus. In other words, is the goal of negotiation is to come to an agreement that will make every player better off, or is the goal to come to a fair agreement? Von Neumann and Morgenstern were closed to Aumann and Maschler, in the sense that they did not demand fairness, but they demanded that no player will be completely exploited. The studies of this controversy is important for the theory of law and legislation regarding contracts, international agreements and legal negotiation toward legal settlements and plea bargaining. There are questions that arise when not every player is a price taker. When should the legislator design rules that lead to stable agreement and when should the legislator design rules that lead not only to stable agreements but also to fairness?

⁵⁵ Shapley said: “we can measure the given outcome against the initial prospects and opportunities of the players, and base a comparison on the presumption that each player ‘got what he deserved’-namely, that the outcome was in some sense *equitable... the first set of weights becomes a guide to the maximization of social welfare, the second to the sharing of social profit*”. While in his later work (1968) Shapley spoke explicitly about fairness, in his initial work (1953) Shapley spoke about demand for symmetry. See [31].

It may be possible to combine Ronald Coase’s theory and Shapley. According to Coase, with no transaction cost the parties will come not only to a result that is Paetro optimality (namely, a result in which no mutual improvement is dismissed), but also to the best result regardless to the legal rule or the initial allocation, the result that will serve their common interest most. (This is how Posner summarized what he called Coase Theorem: “If transaction costs are zero, the initial assignment of

Nash and Shapley⁵⁶ offer one division, whereas Aumann-Maschler allow for any division that is feasible and between rational individuals (both parties increase their income by cooperation).⁵⁷ It seems that in international relations the search is mainly for stability, since the result of instability is bloodshed, whereas within a national market stability is taken for granted and the search is for fair and efficient contracts.

a property right—for example, whether to the polluter or to the victim of pollution—will not affect the efficiency with which resources are allocated”). Then, the only question is what the division between the parties will be (namely, who compensates whom), and the division will be a function of the legal rule. In the context of bargaining, Shapley recommends coming to the best result for the parties and to divide the profits in a fair way by using side payments (namely, the party who gets less than they deserve will be compensated by the others). Shapley actually added the element of fairness to Coase’s theory. Coase describes what homo economics will do, while Shapley describes what fair homo economics should do. The disagreement between Coase and Shapley is that Coase does not recognize the idea of fair price, while Shapely and Nash introduced it into the theory without any serious discussion about fairness. While Coase theory particularly analyses legislation (including by the judge) and transaction costs, the theory of Shapley may be a theory of just and efficient contracts that sees the legal rules and the initial allocations as given. The moral from Shapely may be to think what reform will serve the public interest mostly and then to compensate its victims, such that the benefits from the reform will be distributed fairly, or to think what contracts will serve the common interest of both sides and then how much the side that got more than they are entitled to should compensate the other side. By this, we take from Shapely some ideas, but not his utopian approach, and not his criterion of fairness. We do not see the question of what is fair as one that should be closed, but as one that should be open for discussion. The theory should not be a mathematical one, but a social one. See [32, 33].

⁵⁶ The project of Shapley is ambiguous. He tried to find “the value of a game” but was unclear what this is. He said about solutions in game theory (Shapley 1968):

A number of qualitatively different definitions of “solution” exist in the literature of n-person game theory. An explanation for this multiplicity may be found in the essential ambiguity of decision making in the presence of several independent “free wills”.

He was right that there is ambiguity that should be clarified. He was also right that in order to handle the problem, we should apply social sciences:

Determinateness (namely, uniqueness of outcome) may be desirable in a solution, but it can generally be obtained only at the price of oversimplifying or ignoring the observed tendencies toward organized cooperation (e.g., markets, political parties, cartels, etc.) when real people cope with the indeterminacy of real-life multilateral competition. Such social, political, or economic institutions, often highly abstracted, are at the heart of many of the best-known solution concepts.

However, what he did was this: he disconnected his theory from social science. This made it highly arbitrary and unclear:

In this note, however, we shall be dealing only with the simplest kind of solution concept, which seeks to reduce each game to a single vector of payoffs, known as the value of the game. From what has just been said, it should be clear that a “value” concept is not the only possible capstone to a well-built theory of games.

⁵⁷ Aumann and Maschler dismissed the claim that human beings do not accept completely unfair contracts. The Talmud tells a different story (Gittin 54b):

And so Aumann and Maschler may be challenged by the observation that in many bilateral bargaining situations sides reject contracts that seem to obey their rule, namely, proposal that accepting them will improve their situation relatively to no agreements.⁵⁸

In this paper we are interested in investigating how cooperative game theory can be applicable in law and politics, particularly in preventing war. We argued that different game theoreticians see different purposes for cooperative game theory, and they give different interpretation for the solution concept. We presented the view of Nash. Let us now present interesting criticism about his theory: Rubinstein, Safra and Thomson claimed about the most important work in cooperative game theory, the Nash Bargaining Solution: “the solution lacks a straightforward interpretation”.⁵⁹ Lorenzo Bastianello and Marco LiCalzi (<https://econpapers.repec.org/RAS/pli55.htm>) claimed recently about Nash Bargaining Solution: “It is difficult to advocate a solution that the bargainers cannot make sense of”.⁶⁰ We add that the problem rests on the lack of clarity as to the goal of Nash’s bargaining theory and as to the conditions for the advisability of the application of this theory. This is the case even when we come to apply Nash bargaining theory to the simplest situations in which there is full information regarding every relevant aspect of the game, and the situation itself is absolutely clear. The problem is not in identifying the Nash bargaining solution, but in what one may study from this, what one may conclude from knowing what the Nash bargaining solution is? What is the benefit from knowing that x is a Nash Bargaining Solution? Currently, game theoreticians note that the shoe pinches, but it is still not clear enough where.

We will present now another view of the applicability of cooperative game theory to law and politics. Some game theoreticians recommended viewing solutions of the cooperative games as something an arbitrator in the negotiation will decide. They accept arbitration elegantly by recommending that some impartial arbitrator

... a certain Arab woman brought a sack of phylacteries to Abaye. He said to her: Would you give me each pair for a palm-date? She got angry and threw them to the river. Said he, I should not have belittled them so much in her presence.

⁵⁸ Take for example the ultimatum game in which a person proposes another person how to divide 100\$, and they will get the money according to the consented distribution if the other person accept the proposal, but each one gets nothing if the referee rejects the proposal. We know that people reject insulting proposals. (See [34]). If the participants in the ultimatum game experiments acted according to the rule of Aumann and Maschler, they would accept the insulting proposal that they reject. Aumann and Maschler dismissed that in order to achieve stability it’s not enough that every player will be better off relatively to no-cooperation, but that keeping the honor of every player is also needed. In the arena of International Relation, in order to have stable peace, it is not enough that peace will be better for every player than war, but mutual respect is also needed. It will be a great mistake for statesperson to think that it is enough that they deter sufficiently the other party or that they incentivize the other side enough; it is also demanded to respect the other side in order to have peace.

⁵⁹ See [35].

⁶⁰ They claimed: “We revisit the Nash bargaining model and axiomatize a procedural solution that maximizes the probability of successful bargaining”. See [36].

will act on a permanent basis [37]. Unfortunately, they do not discuss this in any detail.⁶¹ We claim that this amounts to the view of the arbitrator as a permanent player.⁶² If we assume that we have an arbitrator, we should have a discussion of the difference between arbitration and government; if we assume fair division, we should have a philosophical discussion about fairness, since it is not obvious at all what is considered and what should be considered fair. (Such a discussion was started in earnest by a philosopher, John Rawls, who is known by his slogan justice as fairness [38]. His project was stuck on a reef.) Both Shapely and Nash ignore this: if the game (or the regime) is unfair, the parties will come to unfair contracts if they adopt their recommended rule of fair and efficient division of profits.⁶³ One of their weaknesses is that they take the game as given: they think about fair distribution in the game that is played and not discuss what unjust games should be avoided.⁶⁴ Usually, the excessive unfair divisions are due to rules that lead to unfair games. We raise the possibility that Shapley and Nash confused between power and fairness. Let us take this example: if there is a bargaining between the trade union and the firm, Nash and Shapley will lead us to one result, more or less one that divides the surplus created by the work of all the employees between the firm and the employees, while if there is no trade union, but a free competition, they will lead to a dramatically else division of the surplus created by the work of all the employees between the firm and the employees [39] In the game of free competition, the worker will get only their marginal contribution regardless to the average contribution of the workers.⁶⁵ It seems both Nash and Shapley would deem both contracts fair.

In the interest of the application of cooperative game theory to law and to politics, let us mention one important achievement in applying game theory to (Jewish) law.

⁶¹ Shapley (1953) identified the problem, the one that his theory “has failed to suggest a bargaining procedure” for and then made it much worse by making the game much more arbitrary by proposing a new arbitrary procedure.

⁶² Maschler, Peleg and Shapley wrote about (another) “solution concept” in game theory: “gives a clue to an operational procedure that may lead the arbitrator to select the nucleolus. An arbitrator may wish to regard the excess of a coalition at a solution point x as a measure of dissatisfaction of that coalition from x . He might therefore wish to select an imputation such that the maximum excess is minimal. If he has several choices, as is often the case, he will “tell” some coalitions that he is unable to satisfy them any further, but he will still attempt to satisfy further the other coalitions, by looking at outcomes that, in addition, minimize the second highest excess. He will continue with this procedure until he is left with the lexicographic center, namely, the nucleolus”.

⁶³ For example, if there is legal uncertainty and a litigation between a poor side and a rich side, the parties will adopt their recommended division, the poor party will get much less than they deserved by the law. See [13].

⁶⁴ Von Neumann and Morgenstern wrote: “This is, of course, a very essential feature of the most familiar forms of social organizations. It is also an argument which occurs again and again in the criticism directed against these institutions, most of all against the hypothetical order based upon “Laissez-faire”. It is the argument that even an absolute, formal fairness symmetry of the rules of the game does not guarantee that the use of these rules by the participants will be fair and symmetrical. Indeed, this “does not guarantee” is an understatement: it is to be expected that any exhaustive theory of rational behaviour will show that the participants are driven to form coalitions in unsymmetric arrangements”.

⁶⁵ *Id.*

What cooperative game theory is already able to achieve is a strategic equivalence between different rules of division of profits. O'Neil [40], Aumann and Maschler [41] found equivalence between a common method of division in the Jewish law and a particular division proposed by a rabbi in a particular Talmudic text that discusses a concrete problem of division. By this means they used game theory in order to clarify a text that was completely mysterious. One may study a general moral from the important achievements of O'Neil, Aumann and Maschler" Cooperative game theory may thus help compare different legal systems or sets of rules within one and the same legal system. The possibility of different sets of rules leading to the same results is quite general. The paradigm case is that of the set of natural numbers once with each number doubled and once with odd numbers omitted. In both cases we obtain the set of all even numbers.

In order to achieve more, cooperative game theory must be made part-and-parcel of game theory proper, and this requires placing them both within the general framework of the social sciences.

11.5 Conclusions

First, we propose to study cooperative games as a part of the great picture. It is one hypothetical pole of a scale that places games between it and the pole of one-time non-cooperative games without an option of communication between the players. Second, we propose to discuss the goals of the different theories and the so-called "solution concepts" in cooperative game theory. Different game theoreticians had different goals; Von Neumann and Morgenstern were interested in stability in which "a defeated player is in general not 'exploited' completely". Aumann and Maschler were interested in recommending a rule that would lead to a contract, whereas Nash and Shapley were interested in fairness (without discussing sufficiently what is fair). It seems that in international relation the search is mainly for stability, whereas within a national market, at least with friction, stability is taken for granted and the search is for fair and efficient contracts (If there is no friction in the marketplace, then according to the mainstream economic theory there is a market price, and there is no room for bargaining and for fair division). Some leading game theoreticians deviated carelessly from the liberal tradition developed by Locke and Smith and introduced theories of "Fair Price". Third, we propose to make cooperative game theory a more strategic theory: we propose to recognize in the option that coalitions will have strategies. We propose to introduce Nash Theory to cooperative game theory with one important difference: it does not suffice to expand the theory of VNM to a non-zero-sum games in which coalition can be formed, as was proposed by Nash, but game theoreticians should rebel against VNM's assumption that coalitions cannot have strategies. Based on this we will propose new equilibria, that can solve differently the most fundamental game in cooperative game theory.

References

1. Aumann, R.J., Maschler, M.: The bargaining set for cooperative games. In: *Advances in game theory*. Annals of Mathematics Studies, Princeton University Press, Princeton (1961)
2. Nash, J.: The bargaining problem. *Econometrica* **18**(2), 155–162 (1950)
3. Nash, J.F.: Chapter 8. Two-person cooperative games. In: *The essential John Nash*. Princeton University Press, Princeton. *Econometrica* **21**, 128–140
4. Roth, A.E.: The theory and practice of market design. Prize Lecture. The SverigesRiksbank Prize in Economic Sciences in Memory of Alfred Nobel (2012)
5. Gale, D., Shapley, L.S.: College admissions and the stability of marriage. *Am. Math. Mon.* **69**(1), 9–15 (1962)
6. Nash, J., Jr.: Non-cooperative games. *Ann. Math.* **54**(2), 286–295 (1951)
7. Machlup, F.: Monopoly and competition: a classification of market positions. *Am. Econ. Rev.* **27**(3), 445–451 (1937)
8. Lipsey, R.G., Lancaster, K.: The general theory of second best. *Rev. Econ. Stud.* **24**(1), 11–32 (1956)
9. Smith, A.: The wealth of nations[1776]. In: *An inquiry into the nature and causes of the wealth of nations*, pp. 12–15, 400–401, 436–437 (2000)
10. Aumann, R.J.: War and peace. In: Grandin, K. (ed.) *Les Prix Nobels 2005*. The Nobel Foundation, Stockholm, pp. 350–358 (2006)
11. Weiss, U., Agassi, J.: Game theory for international accords. *S.C. J. Int'l L. & Bus.* **16**, 1 (2019–2020)
12. Posner, R.A.: *Economic analysis of law*. Wolters Kluwer Law and Business (2014)
13. Weiss, U.: The regressive effect of legal uncertainty. *J. Disp. Resol.* **103**, 149. <https://scholarship.law.missouri.edu/jdr/vol2019/iss1/13> (2019)
14. MLA style: Eric S.Maskin – Facts. In: *nobelprize.org*. Nobel Prize Outreach AB 2021. Accessed on 8 Sep. 2021. <https://www.nobelprize.org/prizes/economic-sciences/2007/maskin/facts/> (2021)
15. Maskin, E.: How can cooperative game theory be made more relevant to economics?: an open problem. In: Nash Jr, J.F., Rassias, M.T. (eds.) *Open Problems in Mathematics*. Springer International Publication, pp. 347–350 (2016)
16. Schelling, T.C.: An essay on bargaining. *Am. Econ. Rev.* **46**(3), 281–306 (1956)
17. Ellsberg, D.: *The theory and practice of blackmail*. The RAND Corporation, Santa Monica, California (1968)
18. Rousseau, J.-J.: *The social contract* (1762), p. 43 (1964)
19. Becker, G.S.: *The economics of discrimination*. The University of Chicago Press, Chicago (2010)
20. Friedman, M.: Chapter 7: Capitalism and discrimination. In: *Capitalism and freedom*. The University of Chicago Press, Chicago (2020)
21. Arrow, K.J.: What has economics to say about racial discrimination? *J. Econ. Perspect.* **12**(2), 91–100 (1998)
22. Arrow, K.J.: Introductory remarks on the history of game theory. *Game. Econ. Behav.* **45**(1), 15–18 (2003)
23. von Neumann, J., Morgenstern, O.: *Theory of games and economic behaviour*. Princeton University Press (1953)
24. Michael, M.: In: *Proceedings of the stony brook game theory festival* (2006)
25. Myerson, R.B.: *Game theory: analysis of conflict*. Harvard University Press, Cambridge (1991)
26. Nash, J.F.: Chapter 4. The bargaining problem. In: *The essential John Nash*. Princeton University Press, Princeton, pp. 37–48 (2016)
27. Popper, K.R.: *The open society and its enemies*. Princeton University Press (2020)
28. Neumann, J.V., Morgenstern, O.: Reviewed work: theory of games and economic behavior. Reviewed by Wald, A. *Rev. Econ. Stat.* **29**(1), pp. 47–52 (1947). In: JSTOR. <https://doi.org/10.2307/1925651>, <https://www.jstor.org/stable/1925651>. Accessed 13 Sept. 2021

29. Machiavelli, N.: The prince [1513]. The prince and other political writings. In: Milner, S.J. (ed.) (1995)
30. Shapley, L.S.: Utility comparison and the theory of games. Cambridge University Press (1968)
31. Shapley, L.S.: A value for n-person games. In: Contributions to the theory of games. Ann. Math. Stud. vol. 28. Princeton University Press, pp. 307–317 (1953)
32. Coase, R.H.: The problem of social cost. In: Classic papers in natural resource economics. Palgrave Macmillan, London, pp. 87–137 (1960)
33. Posner, R.A.: Ronald Coase and methodology. J. Econ. Perspect. **7**(4), 195–210 (1993)
34. Thaler, R.H.: Anomalies: the ultimatum game. J. Econ. Perspect. **2**(4), 195–206 (1988)
35. Rubinstein, A., Safra, Z., Thomson, W.: On the interpretation of the Nash bargaining solution and its extension to non-expected utility preferences. Econometrica J. Econometric Soc. **60**(5), 1171–1186 (1992)
36. Bastianello, L., LiCalzi, M.: The probability to reach an agreement as a foundation for axiomatic bargaining. Econometrica J. Econometric Soc. **87**(3), 837–865 (2019)
37. Maschler, Z., Solan, Z., Zamir, S., Solan, E.: Game theory/Maschler Michael, Eilon Solan, Shmuel Zamir; translated from the Hebrew by Ziv Hellman; English editor, Mike Borns. Cambridge University Press, Cambridge, vol. xxvi, pp. 979 (2013)
38. Rawls, J.: Justice as fairness. Philos. Rev. **67**(2), 164–194 (1958)
39. Weiss, U.: About suffering and law in the labour market. J. Corp. L. **46**, 385 (2020)
40. O'Neill, B.: A problem of rights arbitration from the Talmud. Math. Soc. Sci. **2**(4), 345–371 (1982)
41. Aumann, R.J., Maschler, M.: Game theoretic analysis of a bankruptcy problem from the Talmud. J. Econ. Theor. **36**(2), 195–213 (1985)

Chapter 12

A General Theory of Choice



Game theory recommends the preference of a strategy over an action; instead, we propose to precede to this the very choice to play or not to play any given game. This renders game theory applicable to real situations. We recommend a combination of Abraham Wald's recommendation to choose between different potential errors with Herbert Simon's recommendation considering our acceptance of any offer we find sufficiently satisfactory. This renders what is found satisfactory revisable and thus it renders Simon's proposal more realistic.

12.1 Theory of Choice

12.1.1 Preface

Economic theory, decision theory and game theory, they all comprise recommendations: how to choose, and on what conditions to accept what proposal. This essay comprises an attempt to combine their recommendations and thus also to improve upon them. The greatest practical achievement of traditional economic theory is its discussion of opportunity cost and recommendation to examine it as a guide for decisions. To this we add the following obvious item: making any move, any particular choice, is the loss of the ability to make it; choosing what game to play one loses the ability to choose that very game: what is done is done. For example, before choosing a spouse one may consider choosing to get married in the first place. Taking this into consideration, we argue, alters deliberation significantly.

Standard game theory recommends (tacitly) to choose (whenever possible) not an action but a strategy, namely, a plan for actions; instead, we propose to recommend first to choose the game, and thus by implication to choose what games not to play. This, we argue, improves game theory dramatically and renders it felicitously applicable to real situations.

The greatest achievement of decision theory is the recommendation of Abraham Wald to choose between different potential errors. We recommend a combination of Wald's idea with extant alternatives to it. Herbert Simon's recommendation [1] to accept a proposal when it is found sufficiently satisfactory (even when it is not optimal) is unsatisfactory as he has overlooked the loss of easily achievable opportunities: even when a proposal is satisfactory, any sufficiently easily attainable better option ousts it as a matter of course. Simon made his suggestion in order to render theoretical options more realistic: an option reasonably close to the best option available people consider close enough; this is often true, but not always; the option here described, when available, is even more realistic. Moreover, whereas this correction of Simon's proposal deals with special cases, our proposal to make as a prior choice the degree of accessibility of a better option a part of any game is general, and it renders his proposal very useful for real decision-making, the more openly so, the more so. This openness is a general, most advantageous feature of decision-making in businesses in democratic regimes: by making strategies visible, any party creates incentives for other parties to follow suit. This is how free societies achieve desirable equilibria with greater ease than dictatorships.

12.2 Introduction

12.2.1 *When to Accept a Proposal?*

Let us consider opportunities, say, a job offer, a proposal for a deal or for merger, or a marriage proposal. How should/do people decide in response?

Let us consider an easier case. Facing a proposal to sell your home for a given price. If it is too low, you will reject it. Now you may or may not have the opportunity to make a counter proposal. If making a counter-proposal is available and costless, then it is recommended: whenever possible, it is advisable to make a counter-proposal of some exorbitant price as a way of rejecting a proposal. For, it just may be accepted. Suppose it is. What then?

Let us consider a market/game with perfect competition, and one in which any one action of any entrepreneur/player is too small to influence prices noticeably. The standard theory of perfect competition assumes that every participant has costless access to all the relevant information and perfect costless computational capacities. This market/game, the theory asserts, is in equilibrium or reaches it in a short time. And then, the sale of your home is possible only at its market price. If you do decide to sell it, then it is because you judge its opportunity cost too high. There is obviously a huge difference between a transaction/game in which every potential buyer/player has full information, rationality and calculation capacities, and a transaction/game in which some buyers/players are uninformed—even if they are few. (This is the innovation of the marginalist revolution). There is also a huge difference between a market in uniform products and specialty markets. (The vast majority of items that

are sold via auctions are special ones, i.e., ones with no market price). The purchase of a home, for example, can belong to either market. In the specialty markets, an entrepreneur/a player may prefer to wait for a lucrative deal. (Galleries and e-bay traders may benefit from buying at auctions and waiting to enthusiastic buyers with capacities to pay). This is so regardless of how near-perfect the market is.

Add to the market/game a few buyers/players who are ready to pay for a given commodity more than its market price. If their number and the difference in price that they offer are significant, it may become rational for sellers to wait for such potential buyers.¹ This depends on the cost of waiting for a better deal. If it is a special home for someone, then there will be a game of negotiation, or a game of auction. John Nash defines negotiation as the parties' opportunity to choose an option from at least two options that create improvement for both parties: "A two-person bargaining situation involves two individuals who have the opportunity to collaborate for mutual benefit in more than one way".² Negotiations involve a mix of both shared and conflicting interests. The game of negotiation has particular transaction costs, the danger that the negotiation will be broken without a deal and that may even block future negotiation.

Players in a significant negotiation want a deal to close, but this does not make any of them accept any offer: each may make a counter-offer. Take-it-or-leave-it offer is thus an erroneous move unless one party/player assumes that the other may accept it, no matter how reluctant. In an ideal negotiation/game, then, one with the capacity to make a take-it-or-leave-it proposal may propose to the other party/player the highest price still acceptable to that party/player. This happens seldom, merely for want of information. Negotiators, particularly regarding unique items, navigate between two potential errors, settling for a demand that is too small and insisting on demand that is too excessive. Much less likely is the alternative situation/game in which the parties possess perfect information, yet this situation is postulated in many models in economic theory: classical economic theory presents a perfect competition as the default option to study; this is much less problematic than in situations of negotiation or auction, since every player takes the market price as given and they cannot benefit from knowing what is the value of the traded asset for others; nor is it important, since if the seller demands more than the market price, then the buyer may make a counter-offer or buy from another seller—regardless to the market price.

The picture is changed dramatically with the introduction of asymmetric information regarding what is proposed for sale (including the tendency of the insured person to use the insurance). Consider the case of a one-sided perfect information. It involves two options: the one-time and the repeated transaction/game. The one-time case of this transaction, says Akerlof [3]³ may be blocked even if it is beneficial all round: it may happen that the seller is ready to sell for a low price and the buyer

¹ The Talmud blocks this: it decrees void transactions with payments in excess of 1/6 above the market price.

² See [2].

³ Another moral from Akerlof [3] may be that freedom of information is essential for a successful economy. The free market includes property rights, freedom of contract, and freedom of information and of speech.

suspects that the product is still not worth it (unless the price offered is the lowest possible). Obviously, every negotiation/game can slide to such a condition (even in an auction, where suspicion of forgery may lead to cancellation). Also, it may involve one seller and more than one buyer. The negotiation game can be anywhere between bilateral negotiation and almost perfect competition. More precisely, both perfect competition and zero-sum games are ideal situations (Utopian and dystopian respectively); in real life both usually give way to negotiation. The exception is the prisoner's dilemma game;⁴ in this game it is a dominant strategy to defect. In the prisoner's dilemma every possible agreement is no more than cheap talk. Otherwise, what is described is not a prisoner's dilemma: to enable parties to cooperate for mutual benefit, the imposition of honoring contracts (contract law) has to be introduced, so as to block it. Real systems of negotiations dominate markets/available game-systems; this still allows for the prisoner's dilemma as a one-time transaction/game. As this renders the prisoner's dilemma important, we see here that the theory of games as trade is more general than standard economic theory. Game theory also covers non-cooperatives, namely, games in which there is no legal mechanism to enforce agreements. At times, but not always, agreements will be effective in those games. Game theory also covers situations in which communication is impossible, so that the parties will not have the opportunity to realize the potential opportunity to achieve agreement that may lead to mutual gain. The prisoner's dilemma is a game in which all opportunities to achieve mutual gain are blocked, not because it yields no profit (the status quo is already in Pareto optimum) and no mechanism to enable cooperation. The reason for this may be the absence of means to impose contracts. (*Realpolitik* declares all negotiations useless for this very reason). It may also be the absence of any mechanism that enables communication. Contract law transforms the rules of the prisoner's dilemma game to those of negotiations; the aim of antitrust law is to transform a negotiation to a prisoner's dilemma game so as to block collusion. The lack of enforcement mechanism is viewed differently by advocates of *Realpolitik* sees and advocates of liberalism: *Realpolitik* is the view that the game of prisoner's dilemma is unavoidable; liberalism is the proposal to take

⁴ Prisoner's dilemma: suppose the police arrest two individuals for possession of illegal weapons near a bank immediately after an armed robbery took place there. The police have strong enough evidence to charge them with the minor infringement that incurs a lenient penalty, but not enough evidence to charge them with the severe infringement that incurs a severe penalty. To achieve that the police isolate them and propose each of them a plea-bargain. The options that the game offers are then as follows. If they both betray each other, they will both receive a medium penalty; if they cooperate with each other and keep silent, then they will both receive the lenient penalty. If only one betrays the other, then that one will walk, and the other will receive the severe penalty. The outcomes then are A (freedom), B (lenient penalty), C (medium penalty) and D (severe penalty):

	Cooperate	Defect
Cooperate	B, B	D, A
Defect	A, D	C, C

the opportunity to communicate (even in the absence of communication) and try to negotiate. Considering international relations as repeated interactions, game theory sides with the liberals. Considering a business transaction/play as a one-time prisoner's dilemma, amounts to the proposal not to cooperate; the moral from this is that playing repeated prisoner's dilemma repeatedly is preferable to playing a one-time prisoner's dilemma, since the repeated game allows for cooperation. Consider, for example, the following strategies: the first move of each player is in cooperation and in every other move each player imitates the other's last move. That case creates mutual cooperation with no incentive for either party to change their strategy. In the absence of a legal mechanism to enforce agreements in games in which cooperation is possible due to agreements, says Aumann [4], repetition acts as an enforcement mechanism. Let us add: cooperation may be possible due to agreements in settings in which the received norm is that agreements matter.

Zero-Sum-Games are different: there, when a particular transaction is better than no transaction for one player, then the opposite is the case for the other player: by definition, a transaction that for the two players is better than no transaction is not a zero-sum game. Thus, trade is impossible in a zero-sum game (except when one player takes advantage of the error of the other).⁵

The most important moral from the discussion of economic transactions/games is not so much what transaction to undertake/not how to play a given game, but what transaction to avoid/what game to play and what game to avoid playing. Economics deems this moral a trivial corollary to the postulate of rationality; the theory of games deems the situation less obvious. It is all too easy to see that playing zero sum games is useless for any entrepreneur: it is never advisable to strike deals with people who insist on causing loss to others. Those who consider business zero-sum games are of this ilk; those who deem trade as a game in which one wins what the other loses sound like philanthropists but they are misanthropists. Even robbery is not a zero-sum game, since the two parties prefer that the asset will go to the robber without bodily harm. Therefore, we should distinguish between two kinds of negotiations/games: there is the Nash negotiation/game, namely "a two-person bargaining situation involves two individuals who have the opportunity to collaborate for mutual benefit in more than one way" [2], and there is a Smith-style negotiation game: "Trade which, without force or constraint, is naturally and regularly carried on between any two places, is always advantageous, though not always equally" (*Wealth of Nations*, Bk. 4, Ch. 3, Pt. 2). The game of negotiation that Smith has discussed is not imposed; it resembles

⁵ It was Adam Smith who discovered that trade is no zero-sum game. David Ricardo took this for granted. As Karl Marx called added value robbery, his economic theory was a relapse. Does Smith's idea hold for collective bargaining? Consider it a two-player game between employers and workers. As Smith disapproved of collusion between employers, he might have viewed (the game of) collective bargaining a corrective. For, it solves the problem that any single worker may face: to play or not to play the game of strictly individual bargaining?

The answer to this question depends on the status of labor unions. The possibility of including it in game theory depends on the inclusion of economics in game theory—as von Neumann and Morgenstern have initially conceived it. This, we add, depends on the possibility to play the fore play (of to play or not to play) that we propose to consider as a condition for playing any game that game theory considers.

the game that Nash discussed that is without constraint. To be precise, the set of the Smith-style negotiations/negotiation-games is a subset of that of the Nash-style ones. Nash expands on Smith's theory: constraints on trade/games do not preclude all opportunities to collaborate for the benefit of all participants. By refusing to bargain with terrorists, one may block negotiation/playing with them at the cost of loss of opportunity for mutual gain. Here the difference between a one-time game and a repeated game is most conspicuous, since the objection to cooperation with terrorists is that it encourages repetition.⁶

Consider the choice to bargain or not to bargain with terrorists. Wald's decision theory combined with game theory can help decide what price one may pay for the choice to bargain or not to bargain with terrorists or kidnappers. Consider kidnapping. The way it is played is beneficial to one party and disastrous for the other, and so it provides dramas of battles of wits. The same holds for the prohibition of blackmail, the prohibition of the demand for payment in return for not revealing damaging information. Even in Smith-style negotiations/bargaining-games, limited freedom of contract, such as by protective labour law, may be beneficial to one party.

All these cases comprise practically significant cases of enrichment of standard economic theory that stem from the addition of game theory to it.

The possibility of error-based expectations invites examination too. This possibility raises the question, assuming that the current transaction is a mistake, what is the price of that mistake? In particular, assuming that it is a mistake, will it cause a total disaster? Since insurance is meant to block the potential damage, say, due to a mistake, it translates this question to, is it advisable to insure the current transaction? Clearly, for those who wish to stay in business, insurance against total loss, against the loss of the capacity to stay in business, is always advisable. Indeed, in face-to-face societies, where no insurance companies exist, individuals are insured by their neighbours against any disaster that can be averted. In modern societies, contract law and insurance are meant to render trade between strangers possible. Still, some characteristics of face-to-face societies survive: bad reputation may cause the loss of the capacity to act in the market / play the economic game, and good reputation still counts as beneficial to business: a necessary condition for success is to be *bona fide*.⁷ In its original version it does not; in our extended version it does, since it adds to any game the opening game of choosing a game to play.

Famously, generosity is profitable.⁸ The Marshall plan saved the US much money. Already after world-war I Keynes advised (1919, 1921) the USA to offer Europe financial help on the condition that it should promote peace and democracy. The rejection of his proposal was one of the most expensive mistakes. The same holds for private entrepreneurs. Generosity is profitable as it provides reputation, thereby enabling it to extend its trade and to signal that it is confident in its financial capacities

⁶ Jewish tradition recommended purchasing Jewish captives and setting them free, yet it recommended against doing so while exceeding their value in the slave market.

⁷ In agreement with game theory, the Talmud says, the way to become rich is to engage much in business and deal honestly (*Nida*, 70b).

⁸ Standard economic theory considers corporate philanthropy a form of advertising [5].

and thus in its products. Similarly, granting another firm a long period of time to decide whether to accept a proposal, signals confidence in the ability to compete.

The idea is general: the choice of a field of choice is standard: of the market in which to operate, of the kinds of auctions to participate in, of the partner to work with or to compete with, and of blocking the games of asymmetric information by disclosing inside information. It is also possible to choose to repeat or not to repeat a game with a given player—for expected gain or in order to enhance reputation. The choice of the game to play is obviously important, but the very act of choice is unclear, since every game is dependent on so many components. It is much easier to block games, and to choose a group of games to choose from. Negotiation is a game that comprises groups of many games. It is usually impossible to choose which kind of negotiation game to play, as it is much easier to choose a group of options.

Let us now make another distinction between two kinds of negotiation games. As we see above, Nash proposed such a definition for bargaining: “a two-person bargaining situation involves two individuals who have the opportunity to collaborate for mutual benefit in more than one way”. There are two kinds of such situations: the first is that the most desirable result by one player is not the most desirable result by the other player. This is the game between a buyer and a seller, who may cooperate for the benefit of both of them, but the buyer wishes to pay the lowest sum that is still accepted by the seller, and the seller wishes the buyer to pay the highest sum that is still accepted by the buyer. The other kind of negotiation is one in which the most desirable result by one player is the most desirable result by the other player. This is for example the case in the Stag Hunt game, that [6] calls a two-person game with common interests.⁹ Those are two kinds of negotiation, but even in the first kind of negotiation, there are situations that are closer to the second kind of negotiation. There are situations in which the difference between the payoff of each player in the case of no cooperation and their payoff in the case of the most desirable cooperation by the other is much more significant than the difference between their payoff in the case of the most desirable result by them and the most desirable result by the other. In such situations it is clearly not worth risking achieving the agreement by being a tough bargainer. For example, we argue that the difference between the payoff in Israel from war and the payoff of Israel from peace in which the Palestine hold the holy places in Jerusalem is enormous, while the difference between the payoff of Israel from a situation in which there is Peace in which Israel holds the holy places and a Peace in which Palestine holds the holy places is neglected, even if we recognize that there is a positive net benefit to Israel from the holy places. A more rational analysis will also say: since maintaining the holy Muslim mosque by Israel destabilizes peace, it is a common interest game, since the best interest of Israel is a stable peace without occupying holy places. One of the advantages of the liberals is that they play much more common interest games. While the pre-Zionist Jewish tradition bans on Jews to visit the holy Muslim place, despite the belief that it is the

⁹ A game with common interests is defined, by Aumann, as a game in which there is one payoff pair that strongly Pareto dominates all other payoff pairs.

place of the Jewish temple, the Jewish tradition prevented the risky game on the holy places, and make it to be a common interest game.

12.3 How to Choose?

In this subchapter we repeat on things we said in the former chapter, when we discussed “opportunity cost”:

Economic theory offers one standard reply to the question, how are we to choose: maximize profit: for a decision to be rational, it has gone for the most profitable among the set of available options. The application of this answer must include considerations of the price of the decision itself (such as the cost of the trip to the place where a desired commodity is available at the lowest price). Institutional economist Frank Knight [7] wrote (1921):

It is evident that the rational thing to do is to be irrational, where deliberation and estimation cost more than they are worth. That this is very often true, and that men still oftener (perhaps) behave as if it were, does not vitiate economic reasoning to the extent that might be supposed. For these irrationalities (whether rational or irrational!) tend to offset each other. The applicability of the general ‘theory’ of conduct to a particular individual in a particular case is likely to give results bordering on the grotesque, but en masse and in the long run it is not so. The market behaves as if men were wont to calculate with the utmost precision in making their choices. We live largely, of necessity, by rule and blindly; but the results approximate rationality fairly well on an average.

Thus, rationality in market activity/playing a game need not be the same as rationality in bilateral negotiation/decision of a player. Traditional game theory overlooks this observation, as it overlooks the very possibility of error (be the error reasonable or irrational). It was Abraham Wald who first incorporated consideration of it in his decision theory.

As Kenneth Arrow has observed (2008), after World War II economic theory developed in new directions:

That economic decisions are made without certain knowledge of the consequences is pretty self-evident. But, although many economists were aware of this elementary fact, there was no systematic analysis of economic uncertainty until about 1950. There have been two developments in the economic theory of uncertainty in the last 60 years, which have had opposite implications for the radical changes in the financial system. One has made explicit and understandable a long tradition that spreading risks among many bearers improves the functioning of the economy. The second is that there are large differences of information among market participants and that these differences are not well handled by market forces. The first point of view tends to argue for the expansion of markets, the second for recognising that they may fail to exist and, if they do come into being, may fail to work for the benefit of the general economic situation.¹⁰

¹⁰ See [8].

12.4 Opportunity Cost Theory and a Proposal for Improvement Upon It

When deliberating about a choice of an option, one may wonder what the alternatives to it are. The most pertinent one is the next best option. Generally, the question is, What is the loss that making a particular choice incurs? It has a traditional answer: the loss due to the implementation of a choice is the next best option that was available before it was made. This next best option is known as the opportunity cost. Thus, if a business choice leads to profit a while foregoing the next best option with the smaller profit b , then (all other things being equal) the opportunity cost of the choice of profit a is the profit b . Similarly, when one gets married, the opportunity cost of that marriage is the option of marrying the next desirable candidate who was previously available and whose availability the choice has annulled. This is the standard opportunity-cost theory. We propose a slightly but significantly different idea: by making a particular choice, one loses the ability to make that choice: one loses the ability to play the game that one has played (since what is done cannot be undone). For example, when a person chooses a spouse, the opportunity cost of that choice is narrower: it is ceasing to be a bachelor, it is ceasing the very search for a spouse; playing a move in a game is the opportunity to choose between the possible moves; in that case, the game of choosing a spouse.

One may raise an objection: one may suggest that the standard idea of opportunity cost includes the item we have just suggested. We will not contest this. We would argue then that the standard literature on opportunity cost overlooks the import of that item. For, whether we present the standard idea of opportunity cost correctly or not, clearly there are two versions of it, the one we call the standard and the one we call our innovation.

That the two ideas differ is obvious. That the difference signifies we have to show. The easiest way to show this is the case of opportunity cost in which only the first item obtains, but not the second. In that case the first item cannot follow from the second, since as yet the second item does not exist. We should show that such cases exist and that they signify. Such a case is, for example, when one has decided to play but not what move to make, say, because one has not yet decided on one's preferences, say, because one is still seeking all the relevant information available. This is the case when one has decided to get married but has not yet chosen a candidate to propose to; it is likewise the case when one has not finished calculating the results of all the considerations necessary for the decision: the standard opportunity cost theory is indifferent to the availability of the information and to the imperfect calculation capacities and cognitive abilities. The standard opportunity cost theory overlooks the difference between the cost of marrying in a system in which divorce is impossible, and in a system in which it is cheap to divorce. That is an error.

The theory of opportunity cost is a useful tool to study how to design successful mechanisms. In other words, which incentives should one player or one planner provide to other players in order to promote the chosen goals. Players or social planners may provide incentives that affect behaviour. What influences behaviour

is not its nominal cost or its cost in real value, but its opportunity cost. For, the assessment of the incentive depends on the estimate (not the opportunity cost but) the addition to the opportunity cost that the designed incentive is expected to create, that is much more practical than the size of the designed opportunity cost. To show that the difference signifies, let us contrast our suggestion with what [9] has said of these assessments. He said, successful social planning is impossible since designers of incentives have no information about the preferences of the players whom they wish to influence. Consider some examples. A liberal state will increase the opportunity cost of criminal activity with the intent to render it less appealing and to render its alternative more appealing: the conduct of a state is liberal if its legislators try to render alternatives to the life of crime more agreeable than it. The state may also raise heritage tax in order to reduce the opportunity cost of consumption in order to raise consumption [10]. The state may raise the punishment for threats in efforts to decrease the opportunity cost of performing them (Weiss [11]). And the state may subsidize public transportation so as to increase the opportunity cost of using private cars so as to raise the opportunity cost of pollution.

Knight [12] wrote,

The cost of any alternative (simple or complex) chosen is the alternative that has to be given up; where there is no alternative to a given experience, no choice, there is no economic problem, and cost has no meaning.

This claim of Knight's is sheer common sense. It is obviously impossible to integrate a discussion of privileged knowledge into a theory that assumes perfect knowledge of all actors. The error in the theory of perfect competition in equilibrium that the assumptions of perfect knowledge and equilibrium cause is considered negligible.¹¹ In a system with excessive imperfect information and computational abilities or rationality the theory does not apply before we answer the question: is opportunity cost the loss of a real alternative, or is it the loss of the best alternative to take under perfect conditions? Knight's presentation cited above leaves this question open. Saying that opportunity cost is what decision-makers would take in situations of perfect knowledge renders the theory impracticable except when the imperfection of the information available is judged insignificant. Obviously, at times it is judged highly significant. The paradigm case is the information that makes inside trading so successful as to render it illegal.¹² (The opportunity cost of foregoing crime is highly

¹¹ This claim, that the lack of perfect information and equilibrium has negligible effects, is labelled "friction", in allusion to the deviation of Galileo's law of gravity from observation that friction causes. Now just as friction is negligible in calculations of the free fall of a stone but not of a feather, so friction is negligible in considering the behavior of the market in equilibrium but not in the cases of privileged information and of opportunity cost.

¹² This holds for other common presentations such that of James Buchanan; he says [13],

Opportunity cost is the evaluation placed on the most highly valued of the rejected alternatives or opportunities. It is that value that is given up or sacrificed in order to secure the higher value that selection of the chosen object embodies.

under-determinate; liberalism is the proposal to reduce it drastically). We would go so far as to say that in a system with perfect information Hayek's argument against efforts to alter a popular system of preferences does not hold.

Economic theory should be part-and-parcel of social science. To that end it should attend to contexts. Decisions are made in context, and games are played in context; and the theory should also embrace the context and the possibilities to choose or change it. This is particularly necessary in the theory of opportunity cost, since opportunity cost is highly context-dependent. The traditional theory is the study of the opportunity cost of a choice that an omniscient decision-maker would make in utter regard for the possibility of the decision-maker to alter the situation first. Progress in technology often occurred when an entrepreneur realized that a small change in circumstances may render a second-best option into an option by far superior to any extant one. This is a well-known complaint: standard economic theory overlooks innovation. We contend that for some situations game theory can help overcome this difficulty.

We find game theory useful in replacing or enriching the concept of opportunity cost, particularly since game theory can recommend what game not to play and since the game may be the context. We propose to view the real cost in opportunity cost not as the loss of the option or alternative not chosen, but as the loss of the game chosen not to play. Tradition represents the opportunity cost of accepting a job the next best job dismissed by that choice (on the supposition that the preferences are fully known), whereas we represent as opportunity cost the opportunity to accept or dismiss alternative jobs (with or without knowledge). By this we are similar to the Search theory but with significant differences. Let us explain the approach of the search theory, and then the difference and then the source of the difference: we adopt the method of Wald's decision theory [14, 15], while they adopt the method of Expected Utility Theory. Consider the case of labour economics that is discussed by search theory: a worker's reservation wage is the lowest at which that worker would be willing to accept a particular proposal. The reservation wage is how the lottery of continue searching is worth it for them. Therefore, according the Search Theory, their reservation wage, when they are risk neutral, is their expected wage if they dismiss the proposal; and when they are risk averse (or risk lovers), the reservation wage is how the lottery of continue searching is worth for them given their preferences and their beliefs regarding their alternatives. Decision makers accept proposals if they prefer accepting them to continuing negotiations. At times, decision-makers cannot calculate their own reservation wages, but they can decide the worth of the game for them. Search theory should allow for such cases our approach follows Abraham Wald and not [16] in that we do not assume utility theory, but recognize the junction in which players choose to bargain or make personal decisions whether to choose between three options: accepting an offer, continuing to bargain, and stopping bargaining.

Similarly, during negotiations, often one party does not know whether continuing the negotiation is useful or not. If one party does not have a preference between accepting the latest offer and no-deal, and if the cost of continuing to bargain is negligible, then it is preferable for that party to make a counter-proposal rather than

to accept the last offer. Recommendations about such no-lose strategies can be much more advantageous than recommendations based on ignorance.

Another development in economic theory is the expansion of the principle of traditional economic theory to analyzing decisions by one agent (particularly by decision theory), and to analyzing non-market situations, particularly by game theory. In decision theory the decision maker is not used to ask how their choice will influence the choice of the other, while it is the heart of game theory. Therefore, incentives are so important in game theory and not in the mainstream decision theory that imagines a world of Robinson Crusoe. It should be said that also before game theory economic theory analysed the situation of competition in a duopolistic marketplace, however economic theory did not have the tool of Nash equilibrium that developed a lot the field of industrial organization. (A game is in Nash Equilibrium if no player has an incentive to unilaterally change their strategy [17]). Nash theory is also very applicable to mass actions, which are the social parallel of the marketplace.

12.5 Game Theory

Let us take this example: litigation will win one party 100 and cost 20. The same litigation will cost the other party also 20. Thus, the bargaining range is a settlement between 80 and 120. Now, the other party proposes a settlement of 85 as the last offer. What is the rational reaction to this offer? It is better to accept this proposal than rejecting it, as it will accrue 85 instead of 80. However, the choice of a policy of accepting every such an offer will comprise incentive to the other party to make your minimal proposal acceptable to you. On the other hand, if you choose a strategy of rejecting insulting proposals even if accepting them gives you more money, and the other party knows this, they will have the incentive to propose to you more.

Viewing any business transaction as a one-time game leads to the choice that advocates of *Realpolitik* recommend for all activities in international relations: seize the day; ignore the long-range consequences of your action. Viewing any business transaction as a repeatable game, however, viewing it as an opportunity to accumulate reputation that will influence the other players, leads to the choice of a strategy, of a plan for actions, for what to do in different possible business situations/games. This is possible only if business is transparent. A secret strategy cannot influence other entrepreneurs/players, and so it has no advantage. This is the big advantage that firms in democratic regimes have over firms in undemocratic regimes. If the press is free to cover a business establishment, then it has the opportunity to develop a reputation and to improve the effectiveness of its strategy.

The main advantage of transparent strategic decision is that it may influence the behaviour of the other player; it may change their actions; the strategic player may incentivize the other player; they may lead the other player to believe that it is in the other player's interest to choose actions the are the desirable by the strategic player. Let us come back to our example of litigation. A strategic player may lead the other player to believe that they will not settle for less than a certain amount.

This discussion challenges the undemocratic capitalistic systems. In the Neo-Liberal new order several countries attempted to adopt capitalism without political liberalism. Can it work? One may say: it is enough that the country is a repeat player that enables free trade, respects property rights and enforces contracts. Smith [18] said: “That security which the laws in Great Britain give to every man that he shall enjoy the fruits of his own labour is alone sufficient to make any country flourish”. Can undemocratic regimes permit this security? Can they decide that they will be a repeat player that gives this security but do not respect political rights and human rights? We say: even if they make such a decision, the other players may not believe them since the local media and academia cannot refute this belief! The undemocratic state cannot have a transparent strategy, and therefore cannot have a visible strategy. Therefore, in order to influence the behaviour of their citizens they must maintain a terrorist policy against them. The incapacity of choosing a strategy and making it visible in undemocratic regimes interrupts the national economy, but also the capacity of the firms of these nations to make business.

Schelling [19] has contributed to our understanding of negotiation by developing the concept of commitment. In a bargaining situation it may be beneficial for a person to limit their initial set of options. The qualities of being more intelligent, or more skilled in debate, or having more financial resources, more physical strength, more military might, or more ability to withstand losses, are by no means universal advantages in bargaining situations, they sometimes have a negative value. For example, in the abovementioned example of litigation, if the party commits themselves not to settle for less than 100, it will be irrational by the other side to make them a lower proposal. Schelling proposed some examples of such commitments: by sending an agent with a bounded legal power, by developing a reputation that makes it more expensive for you to accept lower offers, by taking an oath. Self-respect alone may also serve as a cause for commitment. Ellsberg [20] proposed a similar theory, one with two great advantages: first, he added to Schelling’s discussion serious considerations of the dangers that the making of a commitment may invite and of means for reducing them. A commitment may lead to the failure of negotiations. In international relations this may lead to war. Instead of the USA making a commitment that an attack by the USSR with nuclear weapons should lead to a similar retaliation, it should undertake to retaliate with a sufficiently high likelihood to act as a deterrent. Those recommendations of Ellsberg are applicable to the market: as the choice to make an ultimatum in negotiation may lead also to the collapse of a negotiation, it is preferable to examine the price of such an ultimatum and to choose the one that costs less.

All this concerns the choice of a way to negotiate/play. But, to repeat, the most important choice is what transaction to consider/game to play, and what to avoid, and only then to choose how to act. This is a reversal of the theory of information acquisition and efficient mechanism design that is the study of the question, which game is advisable to design in order to achieve specific desirable goals [21]. Of this Maskin [22] said in his Nobel lecture,

We begin by identifying our desired outcome or social goal. We then ask whether or not an appropriate institution (mechanism) could be designed to attain that goal. If the answer is yes, then we want to know what form that mechanism might take.

The current theory of efficient mechanism design may be too Utopian to be profitably applicable to political science or the study of business management, except for very specific games, such as the design of a bidding mechanism.¹³ Hence, a preliminary discussion may be useful here. As Karl Popper [23] has recommended, we propose to view applied social science as means for social engineering (1945):

The piecemeal engineer will, accordingly, adopt the method of searching for, and fighting against, the greatest and most urgent evils of society, rather than searching for, and fighting for, its greatest ultimate good.

The most significant achievement of game theory is not in the design or in the applications of games but in the suggestions of what games it is unwise to play. Indeed, entrepreneurs shun bad games, or else they are cognizant of the risks that they take. Prevention is also much easier to work out than application, since every game requires some conditions for its very applicability, and these are never too clear and seldom parts of game theory proper. Additionally, given an aim, it is much easier to choose a group of games than a particular game.

12.6 Decision Theory

Abraham Wald asked a simple question: if you do not know whether it is going to rain, what should you do? He had a simple answer, but one that changes the theory dramatically: you need to choose between two potential mistakes: that you will not take the umbrella and want to use it, and that you will take it and not use it. Clearly, you can decide what mistake is more expensive. Let us now use this idea to the satisfaction model of Simon. Simon said, people have thresholds for the level of profit that will entice them to be active in the market. People accept proposals for deals if and only if they are satisfied with the expected profits from them. This seems eminently rational. For example, it is impracticable to check all available work opportunities before taking a job, and it is impracticable to date all the potential partners before choosing a spouse. Nevertheless, the model of Simon is unsatisfactory in the following situation.¹⁴ When a satisfying choice is made and a better proposal comes along while the cost of transition between options is negligible, Simon's satisfaction model ignores the fact that this situation leads to a change for the better. Possibly, this is a misunderstanding of Simon: possibly he meant to endorse the optimization model while limiting its applicability but not all the way. That is to say,

¹³ Robert J. Aumann proposed in a private conversation with Uri Weiss that game theory is applicable particularly to well-structured situations, such as auctions, and we thank him for it.

¹⁴ Robert J. Aumann proposed such kind of criticism on Simon in a private conversation with Uri Weiss, and we thank him for it.

perhaps he assumed that the choice of the threshold is not a part of the competitive model. Not so: the aim of Simon's satisfying model is to extend the competitive model, not to limit it, and so he was understood—and he still is. As people change their thresholds in accord with their circumstances, and as this is eminently rational, Simon's enrichment of the classical framework to include satisficing should indeed comprise a great improvement, and it does when properly worded. Thus, the right way to implement Simon's model is by enabling the update of the threshold. In that case Simon's model becomes a special case of the forgotten Abram Wald decision-making model.

This improves on Simon's satisfaction method by considering the decision maker's limited information and computation abilities, especially as it takes into consideration the obvious fact that the improvement of knowledge may lead to improved decisions.

References

1. Simon, H.A.: A behavioral model of rational choice. *Q. J. Econ.* **69**(1), 99–118 (1955)
2. Nash, Jr., J.F.: The bargaining problem. *Econometrica* **18**(2), 155–162 (1950)
3. Akerlof, George A.: The market for “lemons”: Quality uncertainty and the market mechanism. *The quarterly J. Econ.* **84**(3), 488–500 (1970)
4. Aumann, Robert J.: War and peace. *Proceedings of the National Academy of Sciences* **103**(46), 17075–17078 (2006)
5. Fioravante, Philip L.: Corporate philanthropy: A strategic marketing consideration. *J. Appl. Bus. Econ.* **11**(3), 91–96 (2010)
6. Aumann, R.J., Sorin, S.: Cooperation and bounded recall. *Game Econ. Behav.* **1**(1), 5–39 (1989)
7. Knight, F.H.: Risk, uncertainty and profit. Houghton-Mifflin, Boston (1921); reprinted Sentry Press, New York (1964)
8. Arrow, K.: Risky business. In: *Guardian* (2008)
9. Hayek, F.A.: Planning, science, and freedom. *Nature* **143**(3759), 580–584 (1941)
10. Keynes, J.M.: The general theory of employment, interest and money. Macmillan, London (1936)
11. Weiss, U.: The robber wants to be punished. *Touro L. Rev.* **37**, 267 (2021)
12. Knight, F.H.: Notes on utility and cost (1935)
13. Buchanan, J.M.: Opportunity cost. In: *The world of economics*. Palgrave Macmillan, London, pp. 520–525 (1991)
14. Wald, A.: Statistical decision functions which minimize the maximum risk. *Ann. Math.* **46**(2), 265–280 (1945)
15. Wald, A.: Statistical decision functions (1950)
16. von Neumann, J., Morgenstern, O.: Theory of games and economic behaviour. Princeton University Press, Princeton NJ (1944)
17. Nash, Jr., J.F.: Non-cooperative games. *Ann. Math.* **54**(2), 286–295 (1951)
18. Smith, A.: The wealth of nations [1776] (1937)
19. Schelling, T.C.: The strategy of conflict. Harvard University Press, Cambridge, MA (1960)
20. Ellsberg, D.: The theory and practice of blackmail. No. RAND/P-3883. The RAND Corporation, Santa Monica, California (1968)
21. Krishna, V., Perry, M.: Efficient mechanism design. Available at SSRN 64934 (1998)
22. Maskin, E.S.: Mechanism design: how to implement social goals. *Am. Econ. Rev.* **98**(3), 567–576 (2008)
23. Popper, K.R.: The open society and its enemies. Routledge, London (1945)

Chapter 13

Toward Optimistic Future



In this book we have presented an extended version of game theory and its possible application to international relations. Game theory presents games as given; mechanism design theory presents the social planner as one who attempts to acquire complete information and then to decide in its light what game to play; by contradistinction, extended game theory rests on the supposition that a player makes the most important strategic decision when deciding what game to play. This includes, particularly, the decision what game not to play and, more particularly, what group of game to play (for example, a kind of trade), and with whom (for example, in what market). Obviously, it is much easier to choose what game not to play than what game to play. For, the readiness to play may depend on a few independent conditions, whereas for the readiness to avoid playing that game suffice it to cancel one of them.

We recommend a methodology that renders game theory part-and-parcel of social science. Also, we distinguish pure game theory which is a branch of mathematics from applied game theory which is a part of the social sciences. Pure game theory is certain and does not refer to reality, whereas applied game theory refers to reality and is uncertain. Particularly uncertain is the answer the question what game is being played in a specific real situation. It is advisable to make it clear whether a given discussion belongs to pure or applied game theory. It is a big and harmful mistake to confuse them. The claim that a theory about society has the status of mathematics makes it closed for empirical testimonies, and then it is pseudo-scientific; it is particularly pernicious when used as a platform for recommendations that are against the public interest, including recommendations to make war.

The interest of this book is in peace. We resist the aggressive recommendations that leading game theoreticians make, and even repeatedly. Some hawkish recommendation rest on arbitrary or distorted descriptions of real-life situations, and on the tacit assumption that a description is true and that the game in question is unchangeable. Our interest is to diffuse threats of war. To that end we recommend the following strategies. First, analyzing a real-life situation, we should ask, what game is being played. Being a question of fact, this question is not mathematical but social, and we should see to it that it be social-scientific, namely, testable: the answer to it should

always be open for empirical examination. Game theory as social science, we claim, can help see how exactly a cooperative policy is much better in international relations, and why a policy is much better peaceful than aggressive, and how democracies are able to enjoy peace much more than dictatorships, and why freedom of information and transparency and public debates contribute to national security.

Without repeating the main conclusions regarding all this that appear in the different chapters of this book, let us offer an overview of it.

The Chap. 1 is an introduction to this book, and it includes our conclusion—that game theory is most useful when applied as means for recommending what games not to play. Thus, game theory can contribute to the most important question in political science, international relations, and international law: what is the best way to prevent war? The most important advice that game theory can give to peace-lovers is this: in the interest of peace, certain games that may lead to war should be avoided. This choice should be made even unilaterally by any one player. This is achievable by different, independent but interrelated strategies: the unilateral respect for international law; conditionally generosity; making one's strategy transparent and considering trust as the default option, namely, assuming good faith (*bona fide*).

In the Chap. 2 we asked what a strategy is, and what a game is. The traditional reply is that a strategy is a complete plan of action, the complete answer to the question, what should one do in every possible development of the game. This is utopian. For, most strategies cannot even be written. Even in the game of chess, in which situations are much simpler than in daily life, no reasonable strategy can be written fully. Strategy resembles a policy in social science. We say, the most important strategic decision is the choice of a game, and particularly what games not to play. Thus, one's strategy should be one's plan that includes the choices of the games one is ready to play. For example, there is the strategic decision to stop playing with players caught cheating. A game can be chosen even implicitly by choosing preferences. This brings us to the question, what is a game and how it is possible to change a game and who determines the game to play. Von Neumann and Morgenstern considered a game as the sum of its rules. This idea is refuted: what distinguishes a prisoner's dilemma from a stag hunt game is not any rules but the matrix of their payoffs: as the rules do not determine exclusively the payoffs of the game, the definition proposed by von Neumann and Morgenstern overlooks the distinction between these two games that are obviously different. Players who love each other as they love themselves change the prisoner's dilemma game to render it stag hunt. The definition of von Neumann and Morgenstern leads us to an absurd conclusion: the word 'rules' should include the preferences of the players. It should be noted that Nash proposed a different definition: *a game is the sum of a few sums*: of the players or of their positions, of the possible strategies of each player, and the payoffs of the potential results from the choices of the chosen strategies. Game theorists often confuse their readers by tacitly switching between two different definitions for a game. John Nash has overlooked this when he presented the difference between games whose players have perfect information about their opponents' choices and those who do not. He thus ignored the difference between the game of selling a used car to buyers with and without perfect information. Furthermore, the definition of Nash of a game as the sum of

the players or positions, the possible strategies and the payoffs takes them—at least implicitly—as given, overlooks the important question that Arrow asks: how are these rules determined? Thus, any attempt to combine the ideas of Nash and of von Neumann-Morgenstern should include considerations of the sum of the game's rules, preferences, set of possible options, and everything else that may affect them. The most important strategic move, the choice of the game to play, may depend on the choice of its rules, preferences, shared information, and so on. Importantly, game theoreticians are not sufficiently aware of the presence in the literature of competing definitions for games in general, and that none of them covers the main differences between different games.

Our Chap. 3 is devoted to the question, how can game theory encourage peace? We discuss the effectiveness of game-theoretical tools as means for preventing wars. First, incentives: to prevent wars, incentives should tend to discourage the choice of aggressive policy and encourage the choice of friendly games. When a state adopts a policy of conditional generosity, it incentivizes its neighbours to adopt friendly strategies. This also changes the payoffs in a way that may transform risky games to friendly games. Second, raising expectations, particularly establishing trust. It is very hard to establish trust where distrust is the default option. Nevertheless, and the prelude to World War II notwithstanding, game theory encourages optimism: the shift from absolute mistrust to minimal trust may change the game dramatically: it gives the opportunity to achieve mutual cooperation. Thus, even a very few pioneer citizens who challenge the demonization of others may signify greatly. Minimal trust enables one's neighbours to refute the belief against them, to take a policy that leads the player who maintains minimal trust to respond cooperatively toward them. In the repeated prisoner's dilemma, when there is an absolute mistrust in the other player, then the player who mistrusts will adopt a strategy of "always defect", which makes it in the best interest of the other player to adopt this strategy. If the trust will be minimal in the sense of being open to refutation, then one's neighbours will have incentive to establish trust by cooperation.

Another tool is information. When we make the game more visible, we raise the likelihood of cooperation. The shift from absolute invisibility to minimal potential visibility may make a huge difference in the repeated game. In the variant of repeated prisoner's dilemma in which the actions of one player are totally invisible to the other, then the invisible player is incentivized to adopt the policy of "always defect" (it is their dominant strategy), and the best response to such a strategy is "always defect". (Of course, if they are both invisible, then the dominant strategy of every player is "always defect"). However, if the game is long enough, then a minimal potential for visibility may incentivize an almost invisible player to adopt a cooperative strategy to the benefit of all players.

In the Chap. 4 we discuss what One may learn from game theory about *realpolitik* and contrast our and the received recommendations. *Realpolitik* is the claim that international agreements are worthless, since the strong player will always do what is in their best interest. This is an error: international agreements may change incentives of players, including those of the stronger. First of all, countries have incentive to keep their reputation as respecting international agreements. Even though we do not

claim—what Aumann [1] does—that repetition replaces lawcourts, we argue that the repetition makes cooperation possible so that international agreements significantly raise the likelihood of achieving mutual cooperation. This is so since international relations comprise repeat games. This is a clear-cut refutation of *Realpolitik* as it dismisses the difference between a one-time game and repeat games and that international relations are repeated games in which mutual cooperation may be a (relatively) stable result. Even in one time game agreement may raise the likelihood of cooperation. Aumann [2] claims that in the stag hunt game agreements may not lead to improvement. His argument is that one cannot conclude anything significant from the agreement of the other player to cooperation in this game, since even if one plans to defect it is in their interest to encourage the other player to cooperate (namely, to encourage the continuation of the stag-hunt game, in order to acquire more rabbits). This way Aumann erroneously ignored the possibility that agreements on cooperation may change the expectations for good. This depends on the context in which a game is played: a context in which promises matter even if they are unenforceable, then the agreements will raise expectations for cooperation, thereby making it more beneficial for all players to cooperate, and that expectation may then be fulfilled. This is the methodological difference between us and Aumann: we analyze this game as a part of social science. Aumann, at least on the face of it, analyses this game as mathematics, although the option of communication is not defined in it. Thus, in order to study the question that Aumann raised, we should deem game theory social scientific. Alternatively, one may study the game as a part of mathematics, but then we should define the option of communication, and how in such a situation communication creates expectations.

In the Chap. 5, we propose to render game theory part-and-parcel of social science. We proposed to adopt the theory of Einstein about the difference between geometry and Physics in order to distinguish between game theory as mathematics and game theory as social science. According to Einstein [3], “as far as the propositions of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality”. Similarly, when game theoreticians propose a set of theorems they contribute to pure game theory, which is a branch of mathematics. However, pure game theory cannot refer to reality. Discussions of reality, and these can belong to game theory as a part of political science, or as a part of law, biology, etc., they do not belong to pure game theory, but to applied game theory. Applied game theory may derive logical conclusions from some assumptions; thus has no mathematical certainty. The claim that a particular situation in real life echoes a particular abstract game, concerns reality and so it should be open to empirical criticism. Assumptions about a game that is played in real life do not enjoy the status of mathematics. Mario Bunge has proposed to ignore game theory, since it makes arbitrary assumptions about games played in real life. We propose to discuss critically the question, what game is being played in real life. Thus, game theory should consist not only of discussions of games, but also of the art of choosing the right games. For, it is usually unclear what game is being played. Thus, we propose two theses. First, game theory is most useful as including recommendations on what game not to play and with whom not to play. We criticize standard game theory that it skips discussion of the choice of

games to play, which is the most important strategic choice so that there game theory is most useful. Second, game theory can be useful in deciding the choice of groups of games to play—for example, trade. Moreover, sometimes we do not know what game is being played, but one may know what game is not being played and what group of games is played. For example, we argue that in international relations the group of games that are played is almost always the negotiation game: the players have the opportunity to enjoy cooperation in more than one way. Moreover, we also argue, it is advisable to seek the appropriate Nash equilibrium so as to stabilize the peace.

In the Chap. 6 we proposed to shift from the *Pax Romana* as the model that game theorists praise to the EU model. While the *Pax Romana* was based on a conditional cruelty: if you wish peace, prepare for war, the EU is based on conditional generosity. The incentives provided by the EU changed not only the strategies, but also the game. Even if one EU country can invade another EU country and win for sure without losses, it seems, their citizens will resist temptation to invade. The EU changed the preferences, and this changed the game. The peace between the EU countries rests not on threat but on trust. The mutual threat to stop the economic cooperation suffices to preserve the peace between the EU countries but it is unnecessary: the preferences change made the EU countries respond to always cooperate by responding in kind. The peace in Europe is now such that the countries have no incentive to arm against each other, which incentive leads to risky games that the EU game prevents. Additionally, the EU game enables peaceful quitting such as Brexit, while the *Pax Romana* rests on blocking the right to quit. The model of conditional generosity can be also found in other historical examples: first, Keynes has proposed an alternative to the Treaty of Versailles: that the US will help Europe financially on the condition that they will maintain peace and democracy. Second, the peace accord between Israel and Egypt is such that the US obliges to transfer huge sums of money to Egypt every year, as long as it keeps the peace.

In the Chap. 7 we compare two games of international negotiations. In one game the inability to resolve a conflict by negotiation leads to war. In the other game, this inability leads to some international courts. The first game leads to negotiations under the shadow of war, whereas the second game leads to negotiations under the protection of international law. There are three important differences between these games. The first difference between these games is the distributive effect: in it each player can threaten the other. This renders negotiations a function of military setups. In the second game, the threat is of litigation in the international court. This renders negotiation a function of international law. The second difference between these games is that the first game provides incentives for armament for each party so as to render threats to attack credible. The third difference concerns situations that follow failures of negotiations. Sometimes parties fail to reach agreement even though potential agreements exist that would make all parties better off. On the face of it, this conduct is not rational. This is impossible in frictionless markets. Yet modern economic theory allows friction to prevent agreement, and game theory of negotiation presents cases in which completely rational parties fail to achieve cooperation. This may happen because asymmetric information. (It may prevent the

game of marketplace and negotiation: although agreeable options exist, players may fail to reach them when they expect better agreements; this explains the importance of love of peace and respect for international law: it prevents reading signals of wish for peace as admission of weakness). Failure to reach agreement may be due to a set of strategies that prevents it, as is the case when every party demands more than the 50% of the surplus created by the agreement. This happens in the Hawk-Dove game when all players follow hawkish strategies. The game of international negotiation in the shadow of litigation replaces the hawk-dove game in which the result of the clash is a war with a hawk-dove game in which the result of the clash is international legal encounter. This is the moral from this book: all trade benefits involve friction, and all wars are due to friction. It is therefore desirable to decrease friction by establishing both freedom of information and trust. Likewise, it is desirable to reduce the cost of friction in international negotiation by shifting from a game in which the failure of negotiation leads to war with a game in which the failure of negotiation leads to litigation.

The above comparison between two games of international negotiations leads to two morals. First, the international community should change the game of international relations. The international community should oblige or at least encourage international arbitration. Beyond the practical challenge that this presents, the trouble is that an international order that rests on international law need not be in equilibrium. This may happen when the international community does not enforce international law. To meet this contingency, we recommend the international policy of conditional generosity. The second, perhaps more important, moral is this. States should unilaterally reduce conflict by preferring the game of negotiation under the shadow of international law over any game played under the threat of war. When a state is committed to international law and is ready to subject itself voluntarily to the international court of justice, then they improve their own security. This is so since they thereby declare that they will not attack their neighbours even when easy victory is assured. The commitment to respect international law reduces dramatically the incentive for playing the game of arms race. We thus recommend every country to adopt the policy of constant honesty, namely, of respecting international law unilaterally and of conditional generosity and of respect for international law. Generosity is the readiness to yield more than the law demands.

In the Chap. 8 we discuss the game played in the cold war, and mainly, what games should be avoided. Bertrand Russell described the game played in the cold war as the game of chicken, the game in which two stupid boys drive their car toward each other in order to gain fame. If no player deviates, they both suffer a catastrophe; if only one party does, then the other party gains fame in the eyes of mutual friends. According to Russell, the cold war is a super-game in which each party can impose a veto on the game that is played. This is a particular repeated chicken game, in which a player can benefit small payoff, but loses a great deal. Thus, even if an empire decides to play a super-game and choose the chicken game, it still has the choice between several variants of the game. It is then easy to prevent the more dangerous variants of the game. For example, they may reduce the cost of the game by making their policy visible.

We raised the possibility that this was the game of the cold war. There was a super game, in which the two states choose if to go to peace or to war. Either they choose to go to peace or to war, they need to choose if to use the nuclear weapon or not. When they are at peace, each of them takes the strategy that they do not use nuclear weapons unless the other side uses them, and this leads to a result that no side uses the nuclear weapon. However, if they go to war, then there is an unelected positive probability that one side will change its strategy and will decide to attack first by nuclear bomb, which will lead to mutual destruction. Therefore, the game in war is much more dangerous than this in peace. There is the super-game that each side needs to take a hawkish or dovish strategy. If they both take a hawkish strategy, then they will play the game of war that may lead to mutual use of nuclear weapons. However, if at least one of them is dovish, there will not be war. Sometimes, they play this super game as a simultaneous game, and sometimes they play it as a sequential one. The simultaneous one is much more dangerous. Therefore, there is also a super-super-game to make the super-game simultaneous or sequential. One prominent way to pass from the simultaneous one to the sequential one is by strengthening the freedom of information. Of course, there is a super-super-super game in which the countries may cancel this game by different mechanisms: establishing a global government, or coming to other sorts of agreements, such as mutual concession of the nuclear weapon or at least reducing the number of bombs.

In the Chap. 9, we discuss the theory of equilibrium and propose to expand this discussion by taking account of some new equilibria that rest on mistakes. Nash proposed a new concept: a game is in Nash equilibrium if and only if no player can benefit from changing their strategy unilaterally. Nash proposed his theory for situations in which players cannot communicate with each other. Mathematicians are enthusiastic about his theorem that ascribes to every game at least one Nash equilibrium; they usually skip discussing its interpretation. Nash equilibrium is a stable norm. However, unilateral change of strategy is possible even in Nash equilibrium, since players may make mistakes. (An incentive for a change of strategy may be the hope that other players might follow this move and change their strategy too). We therefore propose another equilibrium: a game is in a game theoretical equilibrium if and only if no player considers changing their strategy unilaterally beneficial. Thus, the game theoretical equilibrium and the set of all Nash equilibria overlap. Sometimes players do not see incentive to change their strategy even when such incentives exist! We present two types of game theoretical equilibrium that rest on errors, as there are two types of error, irrefutable and refutable—when the players stick to their strategies that creates the game theoretical equilibrium and otherwise; the equilibrium will be much more stable in the irrefutable case, of course. An example of a game theoretical equilibrium that is not a Nash equilibrium is a variant of the prisoner's dilemma in which actions are visible but the strategies are not, when its players adopt the most hostile interpretation for the strategies of their opponents. If each player adopts a strategy of defecting in the first round and then imitate the last move of their opponent (a strategy that does not much differ from the one of tit-for-tat), then those strategies will represent a game theoretical equilibrium in this game, and this leads to mutual defection all the way. Let us explain: since each player

adopts the most hostile interpretation for the moves of their opponents, both players assume that their opponents adopt the strategy of always defecting until their opponents cooperate. However, since both players mistrust their opponents until they see them taking actions of cooperation, neither will make the first cooperative move. This game should be prevented, particularly in international relations, in which mutual defection is very costly and leads to the demonization of neighbours. This game may be prevented by the freedom of information that renders strategies visible. Even minimal visibility will suffice for incentivizing the neighbours to take the minimal risk of cooperating. This game illustrates the great difference between countries that fight but are ready to stop immediately if some conditions are met, and states that take a strategy of always fight. Even minimal room for peace can make a great difference.

In the Chap. 10 we discuss equilibria of choices between games. Nash discussed equilibria in which no player can benefit from unilateral deviation. He showed that a game may be in an equilibrium in which every player will benefit from moving to another equilibrium and nevertheless those equilibria are stable. We conclude from this that the most important strategic choice may be the choice of the game to play to begin with. We argue that (similarly to the Nash theory) the super-games in which players choose the game to play may reach equilibria that are not the best available. Players who play the repeated prisoner's dilemma game and achieve cooperation by playing tit-for-tat may overlook the incentive to shift to the repeated stag hunt game, even though in this game players should not persevere with the threat, as then the peace reached this way will be more stable. Also, results of super-games may be stable because of mistakes. For example, a player may dismiss the option to replace both the game and the strategy in it. For example, a nation may play a war game and have a strategy of war-economy. This may be stable if its national leaders do not notice that moving to play peace enables them to move to peace-economy. If each party maintains a hawkish strategy in which each party strictly demands more than half of the available land, then the incentive to play the game of negotiation may fail to attract them even though it offers them incentives to change their strategies. Thus, we may conclude this. The move from the equilibrium of the game of war or of the refusal to play the game of negotiation to the desirable search for negotiations requires civil courage, freedom of information and of rational discourse. For this liberalization is essential. Game theory suggests a common sense explanation for this.

In this chapter we also ask, what the opportunity-cost of a choice is. It is the loss of the opportunity to play the game in which that choice has not been made.

In the Chap. 11 we discuss cooperative game theory, namely, the theory of games that permit the option of achieving cooperation by agreements that are enforced with assurance, and in which there is no transaction cost for such agreements (to include agreements between several players, namely, coalitions). This theory has been developed by prominent game theoreticians, but it is generally considered having almost no fruitful implementations, thus disappointing the high expectations of leading game theoreticians. We ask how cooperative game theory can contribute to the discussions of the most important question in political science, international relations, and international law, namely, how to prevent war. Our proposals are that cooperative

game theory may be most useful in recommending what games to avoid, and that to this end cooperative game theory should be part-and-parcel of social science. This theory is utopian; to be useful, it should be recognized as such and studied as a part of the big picture. Economics too has utopian models, and they are useful when they are studied as poles within the big picture. The standard perfect competition model and perfect monopoly model are utopian; they are useful nonetheless, since they can throw light on what happens within their range and help choose what games to avoid, by what means and at which price. For example, how is it best to prevent the game of monopoly. (Game theoretical study of the antitrust law suggests that antitrust law should be decriminalized). Cooperative game theory throws light on what happens in the range between one-time games without any means of communication or coordination, and games with perfect means of communication and coordination. To make cooperative game theory more useful we recommend the import the greatest achievement of non-cooperative games into cooperative game theory. Particularly, we recommend the import of strategies to cooperative game theory, as well as the addition to it of Nash theory of equilibria of strategies. As Eric Maskin has pointed out, the problem of free ride may also arise within cooperative game theory: players may refuse to join a grand coalition, preferring to enjoy public goods for free. This may prevent the creation of a grand coalition, which possible move traditional cooperative game theory nonchalantly dismisses. We argue that this is true, but that it may lead to the formation of a grand coalition that should override every player's strategy: they will join the grand coalition if and only if every other player will. (This is Dr. Dolittle's famous monkey-bridge). In liberal democracy, this may lead to an equilibrium situation in which no group will join a coalition that discriminates against some religious or ethnic minority, and to anti-racist constitutional law as well as a democratic culture meant to prevent the creation of the racist coalition.

In the Chap. 12 we discuss choice. We particularly discuss the question, when is it wise to accept a proposal. The most important achievement of decision theory is the opportunity-cost theory: decision-makers should ask if the benefit from an action is greater than its opportunity cost. The opportunity cost is their best available option in the case they will not make that particular choice. We hope that we improve upon this theory: usually, people do not know what their best available option is: they lack general knowledge, specific information, or computational capacity, not to mention the uncertainty embedded in each situation. Of course, an option is acceptable when the benefit from it is greater than the option of continuing playing the game (including the option to choose another option instead). A common error is to ignore the limitation on opportunity-cost theory: it holds only for total systems, not for ones in which a choice may open up new options. In the present discussion, to avoid this error one should not forget that the opportunity-cost depends also on the available alternative games. Thus, the opportunity cost of marrying someone is not losing the other best available potential spouse, since the decision-maker usually does not know who that person is. (This information some initial courtship may reveal). Of course, only (in societies where all marriages are decided by social convention) when one knows for sure that if they do not marry one given person, they will marry another given

person, then there is no difference between the standard game theory and the theory proposed here; but, of course, this is not the default option.

Moreover, the traditional expected-utility theory that game theoreticians apply is usually useless for decisions as to what proposal to make or take since bargainers do not know what probabilities their opponents accept. It is the theory of Abraham Wald that one can implement. It suggests asking oneself which cost and which benefit one expects from following a given hypothesis, once assuming that it is true and once assuming that it is false. In the present case, the possibly erroneous hypothesis concerns the cost and the benefit of any transaction. In international relations the loss due to a dismissal of a peace option is enormous; the loss of another piece of land (or even of a holy place) may be negligible, or it may be the raising of the aggressiveness of one's neighbour. In business affairs, the cost of losing a potential deal is usually the choice of the second-best available deal. It is also possible to combine proposals of Wald and those of Herbert Simon this way. Simon recommended that players decide in advance what proposals would satisfy them. That is to say, he recommended (not to optimize but) to endorse a proposal when it meets the standard they are satisfied with. Yet Simon overlooked the conclusion from his recommendation: players should accept alternatives that satisfy them, even when clearly better proposals are easily available to them. We recommend replacing Simon's proposal with an obvious variant of it, one that takes account of the possibilities of new, better options, and make it a part of the game played. For example, liberal leaders speak in some diplomatic context about settlements that their countries can live with. In matters of peace and war it may be wise to forego the best agreement in order to prevent war. However, if there is a better arrangement for all concerned, it is trivial that they should opt for it. This suggestion gains force when combined with Wald's theory of choice between possible mistakes.

References

1. Aumann, R.J.: War and peace. *Proceedings of the National Academy of Sciences* **103**(46), 17075–17078 (2006)
2. Aumann, R.: Nash equilibria are not self-enforcing. *Economic decision making: Games, econometrics and optimisation*. 201–206 (1990)
3. Einstein, A. *Geometry and experience* ([2005] 1921)