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# Negotiation Games: Application of Game Theory in Negotiations

SUNIDHI AGRAHARI[1]

## ABSTRACT

*The omnipresence of negotiations is, without a doubt, ubiquitous. From daily life transactions with auto-rickshaw drivers or grocers to international trades and wars, every individual engages with negotiations. Negotiations are interactions between different parties holding diametrically opposing stands along with certain intersecting interests, wherein they attempt to reconcile their conflicts and procure a feasible settlement. All negotiations are essential 'games' in as much, all parties or 'players' must make choices or 'strategies' to reach a desirable agreement or 'outcome'. Since all negotiations can be simplified into game models- they can be dismantled and regulated by the 'game theory'. In this article, the author attempts to explore how principles of game theory may be applied in negotiations and the advantages of such application. Specifically, the author tries to illuminate how parties may use game theory to anticipate the other party's possible strategies and possible outcomes of negotiation and, in turn, enter the negotiation with strategical advantages.*

## I. INTRODUCTION

Game theory is a mathematical discipline "designed to treat rigorously the question of optimal behaviour" of decision-makers in strategical situations.[2] Strategical situations are those in which the outcomes depend not only on the conduct of the decision-maker, nor solely on those of nature, but also on the conduct of other parties involved.[3] Since this theory of games provides a powerful set of tools for analysing "interdependent decision situations", it proves to be incredibly relevant to negotiations wherein every player's choices are *interactive* and impinging on everybody else's.[4]

The math involved in game theory is quite convoluted, but the underlying principles of the theory are pragmatic and simple to apply. In this article, the author will try to explain the

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[1] Author is a student at Jindal Global Law School (O.P. Jindal Global University), India.

[2] Oskar Morgenstern, *Game Theory: Theoretical Aspects*, 6 INT. ENCYCL. OF SS 62 (David L. Sills ed., 1968).

[3] *Ib*.; see: 2 ROBERT J. AUMANN, GAME THEORY, THE NEW PALGRAVE: GAME THEORY 2 (John Eatwell et al. eds., 1987).

[4] 2 STEVEN J. BRAMS, NEGOTIATION GAMES: APPLYING GAME THEORY TO BARGAINING AND ARBITRATION 271 (Christian Schmidt ed. 2005).

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principles with limited mathematical details. The aim here is to not dwell on the general introduction to the game theory but to elucidate some of its basic principles that can assist one during negotiations and conflict resolutions. Further, though negotiations may have multiple players and game theory can be applied to multi-party negotiations, the author will be narrowing down her research to two-party negotiations for simplification. The prime focus of this article will be on the two most frequently used principles, namely, 'Chicken'[5] and 'the Prisoners' Dilemma'[6], both of which will be explained in the later sections of the article. I will be using the said principles to reconstruct the narrative of the Cuban missile crisis of 1962 ("**the Cuban crisis**") and the Yom Kippur War crisis of 1973 ("**the 1973 crisis**"), respectively, to illuminate the advantages of game-theoretic strategies in negotiations.

## II. BASIC ELEMENTS OF GAME THEORY

In simple words, game theory is a collection of elaborate and diverse mathematical methods that analyse decision making processes in interactions between two or more 'rational' players, wherein the decision of one party involved has an impact on all the other parties involved. Players are assumed to be rational vis-à-vis them striving to maximise their interests and their assumption that the other players aim to achieve the same.[7]

In-game theory, a "game" is described as "any interaction between [players] that are governed by a set of rules specifying the possible moves for each participant and a set of outcomes for each possible combination of moves".[8] Each set of outcomes is called the players' *payoffs*. A payoff may simply rank the desirability of the outcomes. Or it may be the values accrued by a player and may refer to the player's gains or limitations on losses.[9] These games are mostly modelled in two principal formats, namely, the *normal (or strategic) form* and the *extensive form (game tree)*.

The author will be focusing on the normal representation of a game for simplification. A normal form of a game is represented by the outcome or payoff matrix, which draws out the payoffs of each player for each combination of strategies. This form is most-suited for games where decisions are made simultaneously as opposed to those games that involve sequential moves.[10]

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[5] For general introduction, see: BRAMS, *supra* note 3, at 105.
[6] For general introduction, see: BRAMS, *supra* note 3, at 119.
[7] DREW FUDENBERG & JEAN TIROLE, GAME THEORY (MIT Press ed. 1991). You may refer to this for a general introduction to GAME THEORY as well.
[8] Moshe Hirsch, *The Future Negotiations over Jerusalem, Strategical Factors and Game Theory*, 45 CATH. U. L. REV. 699, 704 (1996).
[9] Kenneth H. Waldron, GAME THEORY and Its Application to Divorce Settlement Negotiations, 37 FAM. ADVOC. 40 (2015).
[10] *supra* note 7 at 703.

Breaking down every game into its normal or extensive form assists the players to zone down on a 'solution' of the game. Having a clear sight of the solution is quintessential for two major purposes:

"First, a normative goal, as it may guide us to the best strategy a rational player may adopt; and second, a predictive aim, as it may indicate how rational players are likely to behave in such situations."[11]

For example, the solution of a game helps in explicating the '*dominant strategy*'[12] of a player or in recognising the '*Nash equilibrium*'[13]. This will become clear in the next section of the article.

## III. GAME THEORY APPLICATION

Both the Cuban crisis and the 1973 crisis are well-known as they involved the superpowers of the world (the USA and the USSR). The events of both the crises have by several scholars been analysed and scrutinised. However, the author in this article will attempt to deconstruct the events of both crises by using game theory to elucidate the strategic choices made by the two countries (more specifically by their leaders) in hopes to make the advantages of using game theory in negotiations more lucid. For this purpose, the author will prominently be using the games of Chicken and Prisoners' Dilemma.

The game-theoretic principle of Chicken is derived from an ancient 'sport' where two cars drove on a narrow road towards each other. The drivers of the cars had two options: to either swerve and avoid a collision (cooperate with the other party) or drive head-on towards the collision (not cooperate with the other party).

The game-theoretic principle of Prisoners' Dilemma is derived from A.W. Trucker's story of two prisoners who are suspected of being partners-in-crime and are arrested and placed in different holding cells with no means of communicating with one another. The district attorney, in an attempt to extract an incriminating confession from at least one of the prisoners, presents three consequences before each of the suspects:

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[11] *supra* note 7.

[12] A player's strategy is considered strictly dominant when it is the best choice available to him, and therefore, he would prefer that strategy irrespective of the other players' strategies and decisions; see: DOUGLAS G. BAIRD ET AL., GAME THEORY AND THE LAW 50 (1994).

[13] The Nash equilibrium was first theorised by John Nash. This is a stable outcome which is the result of a set combination of strategies of every player involved. This is a unique outcome since any unilateral deviation of a player from his choice that led to equilibrium will result in no improvement in his payoff and will generally result in him being worse-off, which is why no player will have any incentive to depart from the equilibrium; see BRAMS, *supra* note 3 at 34.

1) if one suspect confesses while the other does not, the suspect who confesses will be released with no sentence for cooperating with the state while the other suspect would get a 10-year sentence;
2) if both suspects confess, both will get a reduced sentence of 5 years each;
3) and if neither suspects confess, then both would be imprisoned for a year on lesser charges due to the lack of evidence for other charges.

Under the limiting circumstance, both prisoners faced a dilemma as they were forced to make a pre-emptive choice to either confess (not cooperate with the other party) or remain silent (cooperate with the other party).

In both the games of Chicken and Prisoners' Dilemma, the players have a distinct choice between the two strategies of 'cooperation' (C) or 'non-cooperation' (D). Such games are called 2x2 games. Their choices of a strategy generate a permutation of 4 outcomes or payoffs, and each player can ordinally rank each outcome from 'best' (4) to 'worst' (1).

Both games are *variable-sum* or *games of partial conflict*, as the sum of the payoffs (or ranks) at every outcome is variable and not constant, and thus one player's 'win' does not necessitate the other player's 'loss'.[14] Therefore, both players can simultaneously do better at some outcomes and worse at other outcomes. By contrast, '*zero-sum games*'[15] or '*games of total conflict*' wherein one player's gain is equivalent to another player's loss. Thus, the benefits of one player invariably hurt the other.[16]

To illustrate:

Figure 1

| Chicken | | | |
|---|---|---|---|
| | | **COLUMN** | |
| | | C | D |
| **ROW** | C | 3, 3 | 2, 4 |
| | D | 4, 2 | 1, 1 |

| Prisoners' Dilemma | | | |
|---|---|---|---|
| | | **COLUMN** | |
| | | C | D |
| **ROW** | C | 3, 3 | 1, 4 |
| | D | 4, 1 | 2, 2 |

[14] BRAMS, *supra* note 3 at 103.
[15] Based on the first type of GAME THEORY known as the 'minimax theorem' developed by John von Neuman; see: JOHN VON NEUMANN & OSKAR MORGENSTERN, THEORY OF GAMES AND ECONOMIC BEHAVIOR (3d ed. 1953).
[16] BRAMS, *supra* note 13.

Key:

The first number in the ordered pair (x, y) that defines each outcome is assumed to be the ranking of the row player; the second number is the ranking of the column player. Thus, (x, y) = (rank of row, rank of column).

4= best; 3= next-best; 2= next-worst; 1= worst. Thus, 4>3>2>1 ordinally.

C= cooperation, D= non-cooperation.

Circled outcomes are Nash equilibria. It will be explained ahead.

In Prisoners' Dilemma, the circled outcome is also the dominant strategy for both players. It will be explained ahead.

As seen in figure 1, in both games, when both players compromise (choose C), both arrive at their next-best outcomes (3, 3), but either player by defecting unilaterally can achieve his best outcome, which is a strong incentive to choose D when the other player chooses C. However, if both fall prey to greed and choose D, they will consequently arrive at their worst outcome (in Chicken) and their next-worst outcome (in Prisoners' Dilemma).

**(A) The Game of Chicken**:

As seen in figure 1, in the game of Chicken, there are two Nash equilibria, (4, 2) and (2, 4), and both are Pareto-superior for row and column, respectively, because no other outcome is better for either player. The trick here is that if either player chooses D to arrive at the Nash equilibrium that favours him, he risks arriving at his worst outcome perchance the other player decides to choose D as well. Since the unstable option of mutual compromise (3, 3) is unappealing and neither player can perceive a strictly dominant strategy, it can be extrapolated that one player's better strategy choice will be dependent on the other player's strategy choice. This interdependence in the game of Chicken leaves room for one player to choose D in hopes of coaxing the other to choose C, meanwhile establishing a clear path to attain his own Nash equilibrium.[17]

- **The Cuban Missile Crisis as a Game of Chicken:**

This crisis began when the Soviets in October 1962 started installing nuclear-armed ballistic missiles that could target and hit a large area of the USA.

Assuming that the USA's main goal was the immediate removal of the Soviet missiles, it had

[17] *Ib*. at 104.

two strategic courses of action:

1. Naval Blockade to intercept future transportation of missiles to Cuba.
2. Air Strike to destroy those missiles that were installed.

While Soviets could either:

1. Withdraw their missiles, or
2. Maintain their position.

The USA and the Soviets were face-to-face on a collision course just like the players of a game of Chicken, as illustrated below:

**Figure 2:-**

| | | USSR | |
|---|---|---|---|
| | | Withdraw | Maintain |
| US | Blockade | 3, 3<br>Compromise | 2, 4<br>Soviet victory |
| | Air strike | 4, 2<br>US victory | 1, 1<br>Nuclear war |

Interestingly, unlike most games of Chicken wherein ‘rational’ players almost never settle on the unstable strategy to cooperate, the Cuban missile crisis ended with the U.S. initiating blockade and the USSR withdrawing its missiles (3, 3). This aberration may be attributed to various reasons.

For starters, even though both players had only two strategic choices each, there were many variations of those choices. For example, the USA’s choice of the blockade could have been followed by other means necessary to coax the Soviets to withdraw the already-installed missiles; or their choice to strike could have been followed by Cuban invasion. Similarly, if the soviets’ choice to withdraw was followed by a pre-emptive strike on the USA to prevent an airstrike, it would have led to the same outcome (nuclear war) as if they had decided to maintain their position.

Further, there is a possibility that both nations wanted to avoid nuclear war at all costs and thus could not risk taking an irreversible step that could lead to that disastrous outcome.

Moreover, the normal representation of the game models suggests that both players made their decisions simultaneously. However, in this case, the two players had been making their decisions sequentially, and thus the interdependence of their strategies left room for each player to manipulate the game through psychological warfare, such as deception or threat.[18]

**(B) The Game of Prisoners' Dilemma**:

As seen in figure one, the strategic choice of non-cooperation is strictly dominant for both players as independent of the other player's choice of C or D; each player will be better off choosing D. The dilemma here is that if both players choose D, they consequently arrive at an outcome which is Pareto-inferior (2, 2) than the unstable choice (3, 3). Notably, this outcome is the unique Nash equilibrium as neither of the players will have an incentive to deviate unilaterally from it because they would be risking doing worse-off. Thus, it can be extrapolated that rational players would opt for the Nash equilibrium, despite there being possibilities for better outcomes.

- **The 1973 crisis as a game of Prisoners' Dilemma:**

In October 1973, the U.N. Security Council had initiated cease-fire protocols when the tension caused by the Yom Kippur War (Israel vs Egypt and Syria) had been aggravated. However, the protocol was to no avail as the fights continued.

Meanwhile, the U.S. President, Richard Nixon, had sent out an order to the U.S. military to be on a 'precautionary alert' in response to the USSR's covert threat of intervention in the Yom Kippur War. However, this alert was later rescinded in an effort to enforce the cease-fire.

According to Frank Zagare, the possible courses of action for both superpowers can be illustrated as below[19]:

**Figure 3:-**

| | | USSR | |
|---|---|---|---|
| | | Seek diplomatic solution | Intervene in war |
| USA | Cooperate with Soviet initiative | Compromise; Cease-fire established and resolution of Middle-east conflict attempted **(3, 3)** | Soviet victory; soviet military presence in Middle-east re-established; possible joint Soviet-American peace keeping force. **(1, 4)** |
| | Frustrate Soviet initiative | Israeli (supported by USA) victory; possible occupation of Egypt, Syria and Jordan. **(4, 1)** | Superpower confrontation. **(2, 2)** |

[18] For elaborate explanation, see: BRAMS, *supra* note 3 at 110.

[19] See: Frank Zagare, *A Game-Theoretic Evaluation of the Cease-Fire Alert Decision of 1973*, J. of Peace R. 73–86 (1983).

Interestingly, even this crisis ended with the amicable outcome of (3, 3), even though the Nash equilibrium and the dominant strategies of both players indicated that rationally it should have ended with (2, 2). This anomaly may have been caused due to a misconception on the Soviet's side about how willing the U.S. may have been to face military confrontation. Though Nixon had put out an alert to prepare for confrontation, frustrating the Soviet initiative may not have been his dominant strategy.[20]

## IV. Cause of digression

Brams propounds that in both crises, the superpowers digressed from their stable Nash equilibrium simply because Nash equilibria are short-term stable outcomes or "myopic outcomes" that disregard the long-term repercussions of digression.[21] By contrast, the principle of "nonmyopic calculation" was advanced, which considers not only the immediate effect or advantages of the outcomes but also the consequences of the other player's probable long-term response to one's digression, in addition to other long-term advantages.[22] The authors recognise an outcome from which no long-term advantage may be perceived in the case of digression as a "nonmyopic equilibrium", and in both the crises, the rational and long-term stable nonmyopic equilibrium was cooperation between the two superpowers.

## V. Conclusion

In this article, I have attempted to demonstrate how by using models of game theory, one can model and predict the other parties' reactions and strategic choices and, ultimately, the outcome of the negotiations. I have illustrated the benefits of game-theoretic strategies by using examples or 'model negotiations' by reconstructing the two major political events of the world, the Cuban crisis and the 1973 crisis, using game theory. Further, I have attempted to untangle the rationale behind why players act in a certain way in the face of conflict and how game theory can be used to bridge all lacunae present in negotiation and help the players to break out of a deadlock.

Though the examples used have been political in nature, the principles of game theory can be used in any field ranging from economics to law. Players can choose and use the various principles of game theory available to them to not only recognise the dominant strategy of the other party but also understand the rationale behind the other party's actions and reactions (the use of deception, psychological warfare, and positional pressure tactics) to outcomes, which

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20 For elaboration, see: BRAMS, *supra* note 3 at 117.
21 BRAMS, *supra* note 3 at 120.
22 Steven J. Brams & Donald Wittman, *Nonmyopic Equilibria in 2×2 Games*, 6 Conflict Manage. and Peace Sci., 39–62 (1981).

may have initially seemed irrational to them. Ultimately, game theory helps predict the outcome of negotiations even before the players have taken their seats at the negotiation table by illuminating the strategic issues of a conflict. And that, in my opinion, is an advantage no rational negotiator should forsake.

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