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Mini review

A survey of critical structures in competitive games

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Abstract: One of the biggest problems of human society is facing crises. Origins of many crises go back to strategy selection in the relations between human beings. The international community is faced with many crises, such as poverty and lack of development of a large section of human society, global warming, economic crises, the incidence of infectious diseases, the accumulation of weapons of mass destruction, wars, migration, lack of food and clean drinking water are among the crises that threaten international community. Each of these challenges alone would require measures and facilities that in many cases are beyond the limited resources of the international community. In this article, the crises have been discussed, whose origin is relations between human beings. By defining critical points in 2×2 games, we provide a mathematical model to detect this type of crises, and then by defining a unique compromise point, we offer solutions for this type of crisis. Sometimes the compromise point corresponds to the Nash equilibrium, and sometimes better than Nash equilibrium. We believe that what is presented in this article can help fill the void. Fixing the vacuum in game theory and optimal use of compromise and critical points leads to the development of cooperation–cooperation strategy in the world.

Keywords: critical point; compromise point; Cuban Missile Crisis; cooperation strategy; non-cooperative games
Mathematics Subject Classification: 91A02

1. Introduction

The international community is faced with many crises, such as poverty and lack of development of a large section of human society, global warming, economic crises, the incidence of infectious diseases, the accumulation of weapons of mass destruction, wars, migration, lack of food and clean drinking water are among the crises that threaten international community. The other considerable crises that pose new problems for the international community, such as increase in spending on arms rise in refugees to Europe, increased hunger in developing countries and environmental crises.

The international community and non-governmental international institutions active in disarmament and arms control have focused their attention to the crisis of rising costs of weapons of mass destruction because of the destructive power of weapons of mass destruction, especially nuclear weapons. The deteriorating situation in this area represents a major crisis in the international community that we call it crisis of confidence. Crisis of confidence opens the way for irrational processes. The economic crises have exacerbated this, so that large arm factories, mainly owned by the powerful countries, look for an arena to transfer and stockpile weapons widely and publicly. In fact, the issue of the transfer of conventional weapons is the reason behind some global conflicts and undermines international stability and security. This is while there are no mechanisms to control these weapons.

Military spending in 1970 was equivalent to 235 billion dollars and in 1985 reached about 940 billion dollars. The costs in 2002 reached its lowest level, but since 2002, this figure has been rising again. In 2008, the figure was beyond one trillion, four hundred and sixty-four billion dollars. This trend has continued until the arm cost of the first 10 countries in this regard (America, China, Russia, Saudi Arabia, etc.) has reached the figure over a trillion four hundred billion dollars [30, 31, 32, 33].

The crisis of immigration to Europe reached its highest in 2015 with an increase in the number of asylum seekers and economic migrants from regions like the Middle East (Syria Iraq, Palestine (Africa) Eritrea, Mali, Kambiya, Somalia (Balkans), Albania, Kosovo, Monet Montenegro, Bosnia and Herzegovina, Serbia (And South Asia), mostly from Afghanistan, Pakistan and Bangladesh going to European Union through Southeast Europe and the Mediterranean. According to United Nations High Commissioner for Refugees, by the end of August 2015, seventy percent of refugees were from Syria, Afghanistan and Eritrea. The term refugee crisis became prevalent in April 2015 following the sinking of five boats carrying two thousands of refugees to Europe on the Mediterranean Sea and killing more than 1,200 people [3].

Another crisis in the twenty-first century making the international community suffer is hunger crisis. The main cause of poverty and hunger in the twenty-first century is unfair global economic and political systems. In addition, a minority group usually monopolizes control over resources and earnings power based on military, political, and economic issues and lower classes of society get less of them. Wars are an important factor in the spread of hunger and poverty. Climate changes are known as an influential factor in the spread of hunger and poverty. Increased droughts, floods, changing weather patterns have negative effects on agricultural work and lives of people around the world. According to FAO, now close to 870 million from 7.1 Billion people of the world, i.e. one eighth of the world's population suffers from chronic malnutrition.

Almost all the hungry people live in the developing countries. The number of undernourished people in the Asia-Pacific has reduced to 563 million from 739 million reduced by 30 percent. In Latin America and the Caribbean, 65 million hungry people in 1990–1992 have reduced to 49 Million in 2010–2012. However, the number of hungry people in Africa has increased from 175 million to 239 million people i.e. one out of four in Africa are hungry [12].

What we are seeing now, is the results of hundreds of years of unequal development in the rich world that passed the vast majority of other countries in the world. Therefore, the people not included in this development look for a better life, and this determination has placed disproportionate burden on the boundaries between the world's rich and poor. Poverty reduction in poor countries will solve the problem of refugees, but this will not happen quickly. In the short term, the stabilization of unstable political situation in conflict zones would help [4, 5, 6, 11].

When speaking of the crisis, we must define crisis in accordance with the conditions of the people involved with it. A critical moment is the turning point for better or worse life that is a short but meaningful definition. In general, it should be accepted that offering a clear definition of crisis is very difficult and all definitions are relative. This is because a subject may be a crisis to an individual, organization or society, but not for the other. However, the fact that in critical situations something urgent and serious must be done for the condition not to get more critical is acceptable to all communities. Some crises arise suddenly and abruptly and have sudden effects on the internal and external environment of the organization. These crises are called sudden crises. On the contrary, there are gradual or density crises that start from a series of critical issues and are strengthened over time, continue to a threshold level, and then arise. From the perspective of Parsons, sudden crisis will be gradual and continuous. Sudden crises have no prior warning signs and organizations are not able to investigate them and plan to do away with them. Crises created gradually and slowly can be stopped or restricted by organizational measures. Continues crises may last weeks, months or even years. Strategies to deal with these crises in different situations depend on the time pressure and the extent of control of these events. Mitraf uses two spectra for the classification of crises. One spectrum determines the crises being external or internal: whether crises happen within or outside the organization. Other spectrum determines crises being technical or social.

The first division of crisis can be individual, group, organizational, and social. Social crises are divided into political, cultural, economic, health, natural or a combination of these crises. Usually it is thought that only social crises should be managed, but the fact is that social crisis must be managed first. Facts and figures such as population growth rate, age composition of the population, unemployment rate, growing curve of industry, growth rate, the percentage of dropout at different levels, the capacity of accepting technical and vocational education, the growth rate of some diseases, the growth rate of addiction, suicide rates in the age groups and social status and gender, and many simple statistical results on the one hand show a very special circumstance, and the other hand, represent the inevitable necessity of knowledge management in the public service and management.

Causes of the crisis are very different. A psychological variable, a sudden attack, diplomatic tensions, war, coup, collapse of states, states of turmoil, violent protests, ethnic conflicts, the student movement, non-regulatory challenges of political factions, and so on each one can be a severe and destructive source of crisis.

2. Materials and method

2.1. Game theory

Definition : (Nash equilibrium) The action profile $a*$ in a strategic game with ordinal preferences is a Nash equilibrium if, for every player i and every action a_i of player i, a^* is at least as good according to player i's preferences as the action profile (a_i, a^*_{-i}) in which player i chooses a_i while every other player j chooses a^*_j . Equivalently, for every player i,

$$u_i(a*) \geq u_i(a_i, a^*_{-i}) \text{ for every action } a_i \text{ of player } i$$

Where u_i is a payoff function that represents player i's preferences [26].

Whenever there are several Nash equilibriums in a game and the players have to choose the same strategy, if they are wise, they must find a way to coordinate their beliefs and expectations concerning choice and practice of each other. One of these methods is "focal point". The influential element in convergence of expectations and beliefs depends on culture, rituals, and customs. Thomas Schelling first presented the idea in 1969. In his opinion focal point or focal points for each person mean his expectations about others' expectations of his expectations.

In this article, we will take a new approach in GT to solve many crises in modern societies: crises that GT has not provided any solutions. For example, in chicken game, GT finds a strategy that leads to Nash equilibrium and the most important goal of approaches Nash equilibrium is when one party gives up the other continues. We shall show that in chicken game, there is a better Nash equilibrium point that it is withdrawing from the game by both players, which is called compromise in this article. To illustrate the importance of this new definition, we refer to the famous of prisoner's dilemma game of two prisoners [23, 25, 27, 34] that show Nash equilibrium is not necessarily the best choice and this is when both prisoners choose to "compromise" and get the best out of this collaboration.

2.1.1. Crisis in game theory

Crisis in non-cooperative games: the process or change that disrupts the balance (balances) of the target population gets the community outside of normal state, and takes it towards border of cooperation–non-cooperation (non-cooperation–non-cooperation) is called crisis.

Depending on the definition of crisis and crisis community, crisis can be classified in different ways. Here, we consider the new categorizing of crises as a whole:

(1) Man-made crises - natural disasters
(2) Predictable crises - unpredictable crises
(3) Controllable crisis - uncontrollable crises
(4) Immediate crises - crises over time

Our research is on man-made, predictable, controllable uncontrollable, and over time crises. Our goal is to identify critical points by modeling the structure of the crisis in the community in GT. In the future, with the help of time series and random process, we will have offered statistical models that using the roots of the crisis will have the power of forecasting crisis over time and then we can obtain the target population crisis.

If the crisis is controllable, in the stage before crisis, we control it, and if it is uncontrollable, with the predictions and with the help of crisis management, we provide the ground to minimize the effects of crisis while happening and the consequences after it.

Crisis point: in the game G, if N is the number of players and S_i is set of strategies for player i. The payoff of the show player i with u_i

$$u_i : S \to R \qquad \forall i \in N.$$

$\mathcal{S}$ Cartesian product strategy players: $\mathcal{S} = S_1 \times S_2 \times S_3 \times \ \times S_n$
For example, the payoff of the players the strategy $(s_1, s_1, , s_1)$ is defined as follows:

$$u_1(a^1) = u_1(s_1, s_1, , s_1) \in R$$

$u_2(a^1) = u_2(s_1, s_1, , s_1) \in R$
.
.
.
$u_n(a^1) = u_1(s_1, s_1, , s_1) \in R$

According to the assumptions of the point (points) crisis are defined as follows:

$$C_i(a^k) = (\ u_i(a^k)\ ,\ u_{-i}(a^k)\ ) = \exists i \in \mathbb{N}, \forall k \begin{cases} u_i(a^*) = Max\left\{u_i(a^k)\ :\ a^k \in A_i\right\} \\ and \\ \forall j, j \neq i\ \ u_j(a^*) = Min\left\{u_j(a^k)\ :\ a^k \in A_i\right\} \end{cases}$$

In this case, K is the player crisis making, and $N - K$ is the player crisis-stricken. This kind of crisis is called the first type of crisis. If

$$C_i(a^k) = (\ u_i(a^k)\ ,\ u_{-i}(a^k)\ ) = \exists i \in \mathbb{N}, \forall k \begin{cases} u_i(a^*) = Min\left\{u_i(a^k)\ :\ a^k \in A_i\right\} \\ and \\ \forall j,\ j \neq i\ \ u_j(a^*) = Min\left\{u_j(a^k)\ :\ a^k \in A_i\right\} \end{cases}$$

Here are all the players are crisis-stricken. This kind of crisis is called the second type of crisis.

In the game G, if $N = \{1, 2\}$ number of players, and $S_1 = \{s_1, s_2\}$, $S_2 = \{s_1, s_2\}$ strategy players. u_i payoff of player i is

$$u_i : S \to R \qquad \forall i \in N.$$

$\mathcal{S}$ Cartesian product strategy players:

$$\mathcal{S} = S_1 \times S_2 = \{(s_1, s_1), (s_1, s_2), (s_2, s_1), (s_2, s_2)\}$$

Payoff of players for each combination of strategies are defined as follows:

$$u_1(a^1) = u_1(s_1, s_1) \in R \quad , \quad u_2(a^1) = u_2(s_1, s_1) \in R$$

$$u_1(a^2) = u_1(s_1, s_2) \in R \quad , \quad u_2(a^2) = u_2(s_1, s_2) \in R$$

$$u_1(a^3) = u_1(s_2, s_1) \in R \quad , \quad u_2(a^3) = u_2(s_2, s_1) \in R$$

$$u_1(a^4) = u_1(s_2, s_2) \in R \quad , \quad u_2(a^4) = u_2(s_2, s_2) \in R$$

According to the assumptions of the point (points) crisis are defined as follows:

$$C_i(a^j) = (\ u_i(a^j)\ ,\ u_{-i}(a^j)\ ) = \exists i \in \mathbb{N}, \forall k \begin{cases} u_i(a^*) = Max\left\{u_i(a^k)\ :\ a^k \in A_i\right\} \\ and \\ \forall j,\ j \neq i\ \ u_j(a^*) = Min\left\{u_j(a^k)\ :\ a^k \in A_i\right\} \end{cases}$$

Or

$$C_i(a^j) = (\ u_i(a^j)\ ,\ u_{-i}(a^j)\ ) = \exists i \in \mathbb{N}, \forall k \begin{cases} u_i(a^*) = Min\left\{u_i(a^k)\ :\ a^k \in A_i\right\} \\ and \\ \forall j,\ j \neq i\ \ u_j(a^*) = Min\left\{u_j(a^k)\ :\ a^k \in A_i\right\} \end{cases}$$

In each game, according to the preferences of the players, point of cooperation–cooperation is the compromise point of the game. Compromise point is used to resolve the crisis in the game. Compromise point is a unique in the 2×2 games. Because in the 2×2 games, there is just a house of matrix games that both players choose to cooperate. In some of these games, this point overlaps with Nash equilibrium, and in some games, there is a better choice for players than Nash equilibrium.

By studying the structure of crises, both natural and unnatural, we concluded that crisis and crisis making are in context of games. In other words, we can show with what strategies players create crisis and what the best way to deal with it is what strategy. According to the terms of the game and the preferences of the players, we can define a crisis point in the 2×2 games. Interestingly Stag Hunt game does not have a point of crisis. Stage hunt game is based on cooperation, bilateral trust and patience is built and players who choose to play Stage hunt are aimed at cooperation–cooperation. Choosing strategy in Stage hunt at first glance is very simple. The result of cooperation is more fruitful than fraud (in the language of game theory, betrayal), so we should always consider cooperation and get better results. This is opposite the prisoner's dilemma. This dilemma stems from the fact that regardless of the actions of the other side of the game, the result is always to the benefit of dishonest person. However, what is problematic in stage hunt game is the element of risk. Accordingly, it is clear that in this game there is no crisis.

So far, in GT, Nash equilibrium has represented an unchangeable point for the players, in which collective profit has had priority over individual profit, and at the mentioned point, none of the players want to change their strategy. In this article, we show that there is sometimes a better choice for players than Nash equilibrium. The critical point in each game represents the worst and the most selfish choice for a player and shows that if players choose this point, sometimes they themselves, and sometimes other players incur the lowest possible impact on the game. To compensate for this, the best strategy for players, according to their strategy preferences, is to trust each other and cooperation–cooperation. By recognizing the critical point and the point of compromise in game, one can move players in the direction that they adopt strategy of cooperation–cooperation and trusting each other in the first iteration of the game [21, 22, 24, 26, 34].

2.1.2. Prisoner's dilemma games

The prisoner's dilemma game [26, 34] is based on a lack of trust in the opponent and shows the state where without trusting the opponent players cannot gain more, and in the best state gain Nash equilibrium in GT. While in this game, there is a better option to choose. Recognizing the crisis points of the game and then identifying points of compromise of the game make players achieve cooperation–cooperation with one iteration of strategy.

	C	D
C	R, R	S, T
D	T, S	P, P

$$T > R > P > S$$

Players payoff will be as follows:

$$u_1(a^1) = u_1(C,C) = R \in R \quad , \quad u_2(a^1) = u_2(C,C) = R \in R$$

$$u_1(a^2) = u_1(C,D) = S \in R \quad , \quad u_2(a^2) = u_2(C,D) = T \in R$$

$$u_1(a^3) = u_1(D,C) = T \in R \quad , \quad u_2(a^3) = u_2(D,C) = S \in R$$

$$u_1(a^4) = u_1(D,D) = P \in R \quad , \quad u_2(a^4) = u_2(D,D) = P \in R$$

In the prisoner's dilemma game when crisis occurs when one of the players pursue cooperation, and another defect. The points (C, D) and (D, C), are critical points.

$$C_1(a^2) = (\ u_1(a^2)\ ,\ u_2(a^2)\ )\ =\ (C,D) = \left\{\forall l = 1,3,4\ \ u_1(a^2)\ \le\ u_1(a^l)\ \ \&\ \ u_2(a^2)\ \ge\ u_2(a^l)\right\}$$

$$C_2(a^3) = (\ u_1(a^3)\ ,\ u_2(a^3)\ )\ =\ (D,C) = \left\{\forall l = 1,2,4\ \ u_1(a^3)\ \ge\ u_1(a^l)\ \ \&\ \ u_2(a^3)\ \le\ u_2(a^l)\right\}$$

Critical points of the game, the crisis of the first kind. In other words, the min and max payoff for the players. In this game the best choice against the crisis, choose a point of compromise. This is a strategy of cooperation–cooperation (C, C). It should be noted that in the prisoner's dilemma game, Nash equilibrium can also help to resolve the crisis in the long time. But the compromise, better and more appropriate way. Indeed, if we use the Nash equilibrium to solve the crisis, there is the possibility that players will move towards the crisis point. In this case, the game has to be repeated several times so players go to the compromise point and the crisis will be resolved. As a result, in the prisoner's dilemma game, choosing a compromise point is better than Nash equilibrium.

In the future, with a focus on a compromise point, perhaps a good solution could be found to counter the ZD strategy.

2.1.3. Chicken game

Returning to one-on-one situations, we come to the dangerous game of Chicken. Here it is not as much a matter of assigning specific numerical values to rewards (which can be difficult in many cases) as of looking at how well you might do out of a situation in the order: good, neutral, bad, worst [33]. The structure is designed to start the chicken game in such a crisis. In this game Hawk and Dove to take a prey to compete. Each strategy ahead of them.

	Hawk	Dove
Hawk	X, X	W, L
Dove	L, W	T, T

$$W > T > L > X$$

$$u_1(a^1) = u_1(Hawk, Hawk) = X \in R \quad , \quad u_2(a^1) = u_2(Hawk, Hawk) = X \in R$$

$$u_1(a^2) = u_1(Hawk, Dove) = W \in R \quad , \quad u_2(a^2) = u_2(Hawk, Dove) = L \in R$$

$$u_1(a^3) = u_1(Dove, Hawk) = L \in R \quad , \quad u_2(a^3) = u_2(Dove, Hawk) = W \in R$$

$$u_1(a^4) = u_1(Dove, Dove) = T \in R \quad , \quad u_2(a^4) = u_2(Dove, Dove) = T \in R$$

Nash equilibria are (Hawk, Dove) (Dove, Hawk). The critical point is Game (Hawk, Hawk) because players with a choice of strategy of non-cooperation–non-cooperation to achieve the worst possible outcome. The crisis of the second type and the two rivals are crisis-stricken. In fact, min and min consequences of two players. In interpreting this game if two hawk to seize prey heavily collided with each other to create a crisis where they may both be killed.

$$C_1(a^1) = (\ u_1(a^1), u_2(a^1)\ ) \ = \ (X, X) \ = \left\{\forall l = 2, 3, 4 \ \ u_1(a^1) \le u_1(a^l) \ \ \& \ \ u_2(a^1) \le u_2(a^l)\right\}$$

Or equivalent

$$C_2(a^1) = (\ u_1(a^1), u_2(a^1)\ ) \ = \ (X, X) = \left\{\forall l = 2, 3, 4 \ \ u_1(a^1) \le u_1(a^l) \ \ \& \ \ u_2(a^1) \le u_2(a^l)\right\}$$

In this game, Nash equilibrium cannot be one way to resolve the crisis because the lack of cooperation by one of the players may increase the severity of the crisis. The only and best solution in this game is a point of compromise that (Dove, Dove). It was used to solve the Cuban missile crisis from a compromise point. If they were using Nash equilibrium, disaster would occur. In this game, the compromise point is absolutely superior to Nash equilibrium.

3. Conclusions and discussion

Crisis of irrigation systems: in the article evolution of game theory application in irrigation systems, conflicts and crises emerged over the use of water and irrigation, and put them analyzed by game theory. The first recorded dispute in antiquity took place between the cities of Umma and Lagash in the Middle East over irrigation systems and diversion of water from Tigris and Emphratis rivers. That dispute had lasted for 100 years from 2500 to 2400 B.C. Continuing conflicts over Mesopotamia through passing of years led Hammurabi the king of ancient Babylon in 1790 B.C. to enforce laws prohibiting water theft in irrigation systems, in his famous "Hammurabi's Code" [25]. Crisis and conflicts for water between cities in the value of farmland in eastern California in the nineteenth century, successive conflicts over water rights between India and Pakistan to the brink of war went ahead, the fight over the Jordan River Jordan, Russia and Israel in the 1950s and 1960s, and... All these are examples of crisis and conflicts over water and irrigation in the world that the structure of game theory, the prisoner's dilemma game has been analyzed.

One of the games mentioned in this article groundwater pumping game that was introduced by Madden (2010). In this game, players are going to use the rationality game, to perform non-cooperation with each other. The structure of the game, when the crisis will occur when a farmer PRL strategy and other strategies to adopt PRH and a conflict arises between farmers.

$$C_i(a_{-i}) = (\ (PRL, PRH)\ ,\ (PRH, PRL)\ )$$

Farmer who chooses *PRL* strategy is the crisis and by Strategy *PRH* the farm is crisis-making. There is a better way for the farmer to solve this conflict Nash equilibrium can use it and it is this strategy (cooperation–cooperation) or the same (*PRL*, *PRL*) [25].

Cuban missile crisis: another application of the critical point, which implies the importance and strength of this point, see the article "A Game Theoretic History of the Cuban Missile Crisis".

This study surveys and evaluates previous attempts to use game theory to explain the strategic dynamic of the Cuban missile crisis, including, but not limited to, explanations developed in the style of Thomas Schelling, Nigel Howard and Steven Brams [2]. And shows the existing vacuum is triggered, the Cuban missile crisis by game theory is not well analyzed. A crisis that has been characterized, without exaggeration, as the "defining event of the nuclear age". All of the explanations were judged to be either incomplete or deficient in some way. Schelling's explanation is both empirically and theoretically inconsistent with the consensus interpretation of the crisis; Howard's with the contemporary understanding of rational strategic behavior; and Brams' with the full sweep of the events that define the crisis. Equally troubling is the scant empirical evidence that the Kennedy administration either manipulated the risk of war during the crisis with "mathematical precision", as Schlesinger and some other insider accounts have claimed, or successfully made use of any related brinkmanship tactics that resulted in a clear US victory. The crisis ended only when both sides "blinked". Nigel Howard's meta-game analysis of the missile crisis also fails to provide a compelling explanation. Similarly, the improved meta-game technique of Fraser and Hipel falls short of the explanatory mark. Like Howard [14], Fraser and Hipel find that the compromise outcome is an equilibrium in their dynamic model, but are unable to explain, at least game-theoretically, why it, and not another co-existing equilibrium, ended the crisis [2, 13, 15].

Problem in their conclusions of their analysis on game theory, but there is a major vacuum in the game theory. The vacuum in the Cuban missile crisis as a critical point of chicken game, if occurred, would start a nuclear war in the world and both games were in crisis-stricken. The research was carried out by game theory, the two countries to resolve the crisis were to the strategy of cooperation–cooperation as the only way to solve the critical point in game theory is the compromise point. In order to solve the Cuban missile crisis selected the cooperation–cooperation as the best option. This is a more appropriate choice of Nash equilibrium in the chicken game.

Zero-determinant strategies, extortion: Recently, Press and Dyson have proposed a new class of probabilistic and conditional strategies for the two-player iterated prisoner's dilemma, so-called zero-determinant strategies. A player adopting zero-determinant strategies is able to pin the expected payoff of the opponents or to enforce a linear relationship between his own payoff and the opponents' payoff, in a unilateral way. This paper considers zero-determinant strategies in the iterated public goods game, a representative multiplayer game where in each round each player will choose whether or not to put his tokens into a public pot, and the tokens in this pot are multiplied by a factor larger than one and then evenly divided among all players. The analytical and numerical results exhibit a similar yet different scenario to the case of two-player games: (i) with small number of players or a small multiplication factor, a player is able to unilaterally pin the expected total payoff of all other players; (ii) a player is able to set the ratio between his payoff and the total payoff of all other players, but this ratio is limited by an upper bound if the multiplication factor exceeds a threshold that depends on the number of players [28].

$$\tilde{p} \equiv (-1 + p_1, -1 + p_2, p_3, p_4)$$

Is solely under the control of X; whose third column,

$$\tilde{q} \equiv (-1 + q_1, q_3, -1 + q_2, q_4)$$

Is solely under the control of Y; and whose fourth column is simply f. X's payoff matrix is $S_X = (R, S, T, P)$ whereas Y's is $S_Y = (R, T, S, P)$ [29].

According to the preferences of the players see the player X, the consequences of player Y holds and adjusts the moving with preferences prisoner's dilemma game. But the player Y with changes in preferences so that he knows the plays during the game, the best strategy is cooperation and will receive the greatest consequence of (T) may be in play. However, in contrast to cooperate with defect in prisoner's dilemma games cooperation strategy will get the lowest payoff (S). In fact, this is critical point in game and player X takes the control of the game with using the critical points in the prisoner's dilemma game and strategy pin [1, 16, 17, 18, 19, 20, 28, 29]. In this case, player X is making crisis and player Y is crisis-stricken. Player X due to the crisis that led to his opponent could extortion him.

What is surprising is not that Y can, with X's connivance, achieve scores in this range, but that X can force any particular score by a fixed strategy p, independent of Y's strategy q. In other words, there is no need for X to react to Y, except on a timescale of her own choosing. A consequence is that X can simulate or "spoof" any desired fitness landscape for Y that she wants, thereby guiding his evolutionary path [29].

The question is whether the crisis point we can say there is a ZD strategy for all 2×2 games? If established, would follow this structure?

Given the wide range of game theory in various fields of political, economic, social and international relations, the question raised here is whether game theory is its ability to be as dynamic systems in medical sciences, particularly in the field of used to predict disease?

Can the evolutionary stable strategy (ESS) used in order to prevent the spread of communicable diseases such as Ebola, Zika and types of flu?

Conflict of interest

The authors declare no conflicts of interest in this paper.

References

1. C. Adami and A. Hintze, *Evolutionary instability of zero determinant strategies demonstrates that winning is not everything*, Nat. Commun., **4** (2013), 2193.
2. S. J. Brams, *Game Theory and the Cuban missile crisis*, Millennium Mathematics Project, University of Cambridge, 2001.
3. B. Simon, *Crisis Management Strategy*, NY: Routledge Publication, 1993.
4. L. L. Byars, L. W. Rue and S. A. Zahra, *Strategic Management*, Chicago, Irwin, 1996.
5. A. Deaton, *How to monitor poverty for the millennium development goals*, Journal of Human Development, **4** (2003), 353–78.
6. F. R. David, *Strategic Management*, 7th, Prentice-Hall, 1999.

7. T. E. Drabek and G. J. Hoetmer, *Emergency Management: Principle and Practice for local Government*, International City Management Association, 1991.
8. A. Dixit, B. Nalebuff, *Thinking Strategically: The Competitive Edge in Business, Politics and Everyday Life*, New York: Norton, 1991.
9. J. Dillon and M. Phillips, *Social Capital Discussion Paper*, Unpublished manuscript, Curtin University, Perth, 2001.
10. E. Eng and E. Parker, *Measuring community Competence in the Mississippi Delta: the interface between program evaluation and empowerment*, Health Educ. Behav., **21** (1994), 199–220.
11. C. Fanny, *Economic Theories of Peace and War*, Routledge Studies in Defense Economics, Routledge, 2004.
12. C. Z. Frank, *A Game Theoretic History of the Cuban Missile Crisis*, Economies, **2** (2014), 20-44.
13. M. Goold and J. J. Quinn, *The Paradox of Strategic Controls*, Strategic Manage. J., **11** (1990), 43–57.
14. A. Hesse, *Game Theory and the Cuban Missile Crisis: Using Schellings Strategy of Conflict to Analyze the Cuban Missile Crisis*, Munchen: Martin Meidenbauer Verlagsbuchhandlung, 2010.
15. D. Hao, Z. Rong and T. Zhou, *Zero-determinant strategy: An underway revolution in game theory*, Chin. Phys. B., **23** (2014), 078905.
16. C. Hauert and H. G. Schuster, (1997). *Effects of increasing the number of players and memory size in the iterated prisoners dilemma: a numerical approach*, P. Roy. Soc. Lond. B Bio., **264** (1997), 513-519.
17. N. Howard, *Paradoxes of Rationality: Theory of Meta-games and Political Behavior*, Cambridge(MA): MIT Press, 1971.
18. C. Hilbe, B. Wu, A. Traulsen, et al. *Evolutionary performance of zerodeterminant strategies in multiplayer games*, J. Theor. Biol., **374** (2015), 115–124.
19. C. Hilbe, A. Traulsen and K. Sigmund, (2015). *Partners or rivals? Strategies for the iterated prisoners dilemma*, Game. Econ. Behav., **92** (2015), 41-52.
20. J. M. Smith, *Evolution and the Theory of Games*, Cambridge University Press, 1982.
21. J. Fuka, J. Volek and I. Obrsalova, *Game Theory as a Tool of Crisis Management in a Company*, Wseas Transactions on Business and Economies, **11** (2014), 250–261.
22. J. Fuka, I. Obrsalova and L. Jelinkova, *Game Theory as a Tool of Crisis Management and the Creation of National Security Policies*, International Conference on Economics, 2014.
23. K. Prestwich, *Game Theory*, Department of Biology College of the Holy Cross, 1999.
24. L. Fisher, *Rock, paper, scissors. game theory in everyday life*, 2008.
25. M. V. podimata and C. Y. ponayotis, *Evolution of Game Theory Application in Irrigation Systems*, Agriculture and Agricultural Science, **4** (2015), 271–281.
26. M. J. Osborne, *An Introduction to Game Theory*, Oxford University Press, 2000.
27. J. Mcclure, *Guidelines for encouraging householders preparation for earthquakes in New Zealand*, Report for Building Research, 2006.

28. L. Pan, D. Hao, Z. Rong, et al. *Zerodeterminant strategies in iterated public goods game*, Sci. Rep., **5** (2015), 13096.
29. W. H. Press and F. J. Dyson, *Iterated prisoners dilemma contains strategies that dominate any evolutionary opponent*, Proc. Nat. Acad. Sci. USA, **109** (2012), 10409-10413.
30. Ambassador A. W. P. Gusti(Indonasia), Report of the Coordinator for transparency in Armaments in the Conference on Disarmament, Geneva, 10 March, 2009.
31. S. Deger, *Military Expenditure in the Third World Countries: the Economic Effects*, Routledge and Kegan Paul, London, 1987.
32. S. P. Huntington, *Clash of Civilizations? Foreign Affairs*, **72** (1993), 22–49.
33. S. Gupta, L. de Mello and R. Sharan, *Corruption and Military Spending*, Eur. J. Polit. Econ., **17** (2001), 749–777.
34. J. Von Neumann and O. Morgenstern, *Theory of Games and Economic Behavior*, Princeton University Press, Princeton N. J., 1944.