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The Anatomy of Error in Decision-making of Rationally Behaving Agents from the Perspective of the Theory of Bounded Rationality: Extension for Contextual Games

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Abstract

Tomáš Otáhal, Radim Valenčík: **The Anatomy of Error in Decision-making of Rationally Behaving Agents from the Perspective of the Theory of Bounded Rationality: Extension for Contextual Games**

How can errors in decision-making by rationally behaving individuals be explained? The concepts of bounded rationality proposed by H. Simon and of imperfect information in the complex reality by F. Hayek attack the over-restrictive assumption of perfectly informed individuals or organisms in neo-classical microeconomics. Since this assumption excludes erroneous decision-making, some results must be explained by questioning the rationality assumption. In this paper, we show that erroneous decision-making of individuals and organisms is not necessarily erroneous if we look at the contextual games which individuals and organisms play in the complex reality. This helps to explain errors in the decision-making of individuals or organisms, while maintaining the assumption of rational behavior. At the same time, we show that the errors observed in the contextual analysis of games in the decision-making of individuals or organisms can only be apparent.

Key words

Bounded rationality, complex systems, contextual games, erroneous behavior, rational decision-making

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Introduction

Herbert A. Simon (1955, 1959) contributed to the economic theory with his concept of bounded rationality. The neoclassical microeconomics with its assumption of rational behavior, he argues, is based on overly restrictive assumptions, not reflecting the everyday reality of economic decision-making of humans, or organisms in general. Organisms are not machines. As such, their decision-making cannot be compared with that of robots with programs precisely tuned to the environment they operate in. According to Herbert A. Simon, organisms do not have perfect information about their environment. Even if they had, they could not fully process the information, because the processing is subject to cognitive limits existing deep in their psychology and experience.

Friedrich August von Hayek (1995, 1980) also used similar arguments to present his criticism of the neoclassical assumption of a rational human being. F. Hayek argues that people are unable to fully process information observed in their economic reality, because their mind cannot recognize its precise value in decision making. Such recognition is based on psychological distortion, which in turn is based on previous experience. In accordance with the arguments of H. Simon, this fact is further complicated by the limited ability of the human mind to process information obtained from the observed economic reality. This forces the human mind to form simplifying decision formulas that by far cannot reflect the complexity of the real world.

The critical treatment of the rational behavior of individuals in neoclassical economics by H. Simon and F. Hayek has motivated research aimed at observing real microeconomic behavior of individuals within the complex reality (e.g. Chytilová and Reichlová 2007). In this paper, however, we will not extend their inspiring research. We will rather inspect a somewhat forgotten aspect of the arguments layed down by H. Simon and F. Hayek. Specifically, the notion that cognitive limitations and complicated cognition mechanisms transforming the real world into a world that cannot be fully understood, force real organisms to make decision errors.

Research exploring and extending the problem of limited rationality of individuals or organisms includes Akerlof a Dickens (1982), Shafir and Tversky (1992), Smith (1991), Caplan (2000) or Kahneman (2003). The neoclassical microeconomics and its rationally behaving individual practically rule out decision errors, because the decisions taken by a rationally behaving individual are driven by mathematically precise calculations. This fact, however, does not correspond with the observed reality. Why are real people subject to economic decision errors? Is there an alternative explanation for the errors, apart from the existence of cognitive limitations and the inability of humans to understand the reality in all its complexity? Is it possible that even erroneous individual decisions may show signs of internal logic?

Our goal is to present and analyse the phenomenon of error in economic decision making as a relatively abundant occurrence in the economic reality, using approaches provided by the theory of contextual games.[1] We rely on the theory of limited rationality by H. Simon and the theory of limited knowledge in complex reality by F. Hayek, further specifying and extending their key principles. We do not consider the neoclassical assumption of rational behavior as overly restrictive. On the contrary, we use it as a basis and show that the theory of contextual games can explain the phenomenon of economic decision error in individual decision making, without resigning on the assumption of rational behavior. We only need to use the complete rationality model relatively and generalize some of its assumptions. This allows us to show that the theory of contextual games can explain some important attributes of error, which have not been fully accounted for in the approach of H. Simon and F. Hayek.

The structure of this paper is as follows. First, we will focus on an extended decision model of an individual or organism with limited rationality. The model will use weakened neoclassical microeconomic assumptions to explain the cognitive limits of the limited rationality concept applied to individuals. This explanation will assume real conditions of virtual ”calculations“ in economic decisions (Chapter 1). Subsequently, we will explain how the extended model of decision making by an individual with limited rationality relates to the behavioral analysis provided by the theory of contextual games, while not necessarily contradicting the rationality assumption. The explanation will be based on examples with weakened assumptions of individual rational behavior (Chapter 2). We will then analyse the anatomy of error with limited rationality, where the assumptions of rational behavior will have been weakened. This will demonstrate that the decision errors in human behavior not only stem from the objective cognitive limitations of the human mind (Kahneman 2003), but also from the experience accumulated by individuals in the process of continuously playing contextual games, or their imperfect adaptation to new game contexts (Chapter 3). This theorethical analysis will be supplemented by a new classification of contextual games that have been successfully defined in the form of a mathematical model, or at least a graphically defined concept based on established terminology. Specifically, we will mention game integration using payout matrix summation, connected dilemmas, positional reinvestment of payout from previous games or integration of games by predetermined coalition formation and payout redistribution by a hidden game (Chapter 4). To conclude, we summarize our arguments and provide suggestions for further research.

Explanation of the reasons of errors, as well as the analysis of the processes leading to errors are one of the most challenging tasks for theory. Errors cannot be fully avoided, since they are an inseparable part of the cognitive process, accompanying our ventures accross the borders of generally accepted

[1] This term has been used by Meliers a Birnabou (1983), see also Mintzberg (1995).

and the unknown. As our knowledge expands, however, we can better understand the new sources of error and understand how different kinds of errors emerge. It goes without saying that every new recognized step in the anatomy of error is of high practical value. One of the purposes of creating a theory is to obtain precise recommendations on how to avoid errors.

1. The limited rationality concept

In the following chapter we will explain the extended model of decision making by an individual or organism with limited rationality. First of all, we need to define the term limited rationality in a way that will allow us to explain the decision errors of individuals or organisms, using methods and approaches provided by the the contextual game theory.

The concept of limited rationality in our extended version is based on the following:

1. Rational decision making, i.e. selection of the best alternative given a set of preferences in humans and to some extent in other beings, is not only based on rational thought, but also on other components of our mind, such as:

- memory, which stores past experiences;

- imagination, materialized in confrontation with experiences stored as memories and the context, immediate situations the being is exposed to;

- emotions, or emotional experience mechanism, which also carries out an ”on-line“ selection of the optimal alternative in the conditions of current and accute influence of external sources;

- concept knowledge, used to discover generally valid rules and find long-term, possibly exact support for decisions (this is the closest sibling of what we would label as rational decision making);

- doubt, which allows the individual to cross the boundaries of what is otherwise considered as permanently valid and stable (in terms of existing general rules);

- intuition, allowing the use of factors that are normally suppressed by rational thinking and represents a reflection of the limits to rational thought;

- calculation, including the use of models that in cooperation with thought allow unambiguous decisions in defined conditions;

- moral or ethical evaluation, projecting certain tabus based on generally accepted rules projected into the decision process;

- other components (as argued in F. Hayek (1995,1980), the human psyche is too complicated to fit all its components and their functional connections into simple compartments).

2. The sole fact of using factors that are not purely rational (only logical deduction and mathematical methods would fit the strictest delimitation of rationality) and fall beyond the rational domain (even simple term-based mental processing falls within this scope), does not automatically mean the absense of rationality, using the unrestricted meaning of the word. In other words, it does not automatically mean we will be unable to choose the best alternative, or that we are resigning on doing so. Different components of our mind create a mutually-connected functional structure, which has always been evolutionarily selected even in the realm of the animal kingdom to allow optimal decision making in respect to our goals and preferences. We will soon define ”optimal preferences“.

3. The fact that the entire complicated structure of our mind has been conditioned and calibrated by natural and historic development to be as functional as possible and to enable us to recognize external conditions and subsequently select the best strategy for further actions, does not mean it does not evolve further and cannot become better adapted. Partial, even systematic failures are possible, though the results of a decision may markedly differ from the preferences the decision was based on.

4. The basis for our personal preferences also evolves, together with the general values recognized by the society we live in, and so does our own quest for better life, emotions and experiences. In other words, if we say we behave to maximalize our experieces, it does not mean the structure of these experiences remains constant throughout the life of the individual in question. They constantly change under the influence of various factors, even if they contain a genetically imprinted relation between an individual and his family. This quality has been inherited from our animal roots, it is related to our need to search for meaning in life, the physiological processes of ageing and the necessity of meeting the needs one has in every phase of their lives.

In principle, the limited rationality assumption of H. Simon (1955, 1959) states that:

1. Description, analysis and evaluation of human behavior,in terms of predicting the behavior and providing recommendation for optimal behavior, should be based on a model which maximizes the benefits of rational decision after an optimal choice from several alternatives.

2. Rationality, in terms of choosing the best alternative, is always more or less limited:

- by a limited amount of information available to the individual or organism;

- by a limited possibility to process the available information and use it to make decisions;

- by a limited ability to define the preferences, or the ability of the individual to reflect on them.

In short, in the case of ”on-line“ decisions, one must acknowledge that information will be limited and cannot be fully processed. Even if we decided to carry out precise decisions, our ability to

evaluate them might be limited as well. In our further treatment of this problem, we argue that by realizing these limitations we understand that our model of a rationally behaving individual maximizing their gain is only an approximation of reality, but as such it can be a good starting point. Just like a ”material point“ in physics is a good initial, but not necessarily final approximation of a real body.

2. Theory of contextual games and the apparent paradox of the rationality assumption

The possibility to apply contextual game theory, which is part of the game theory, was discovered by a team of researchers from the College of Finances and Governement. They were trying to explain apparent differences between theorethical prediction based on a rationally behaving individual maximizing their gain, in comparison with the experimental findings focusing on specific cases of human behavior. To resolve these differences, in the next chapter we will try to explain, how the extended model of an individual behaving rationally with limitations can be reconciled with behavioral analysis based on the contextual game theory; the latter approach does not necessarily have to be in conflict with the neoclassical assumption of rationality. We will explain this by using examples which further specify the assumptions of rational behavior of individuals or organisms.

Briefly, we revisit two well-known examples:

- Example 1: Two people need to divide a certain amount of money. The first has the right to propose how to split the money, the other can agree or disagree. This is an example of a so-called ultimate game. The assumption of rationally behaving individuals maximizing their gain suggests that the second player should agree anytime they can gain, regardless of the exact amount, ignoring how much the other player will keep for themselves. Experiments suggest that the first player is usually afraid to suggest a division too different from a 50:50 division. And rightly so, since the other player may refuse the proposed division. This happens more often with splits that are too far from the ”fair“ 50:50 split.[2]

- Example 2: Two people are playing a game of the prisoner's dilemma type. Each of them may have two strategies to filow, such as to cooperate by observing a given promise or not to keep the promise eventually. Each player can gain most by breaching the agreement, but only if the other one does not do so. Still, each player loses the most, if they both break the agreement. The highest gain can be obtained when both players cooperate and behave according to the agreement. If both break the agreement, each will lose, but less so than by cooperating in the absence of mutual cooperation. In experiments with this kind of games, cases were observed where neither of the player knew what the other player would do, but also cases, where the players always learned what the other player

[2] Compare to Michl (2009) and Valenčík and Budinský (2010, 142-145).

had done. Sometimes this would mean learning that the other player broke the promise, sometimes that he cooperated. The assumption of a rationally behaving individual rules that each player can guarantee the highest gain for himself by breaking the promise given to the other player. The players should behave the same even if they found out what the other player had done, regardless of what the actual action of that player was. However, the experiments show that a high number of people keeps the promise in all three scenarios (not knowing the other player's decision; knowing the promise was not kept; knowing the promise was kept). These do not have to be the same persons, necessarily.[3]

Experiments of this kind have been conducted in many countries, at different times by respected expert teams. Even though some studies were popular in nature, their results point towards the unsustainability of the assumption of a rationally behaving individual maximizing their gain. This undermines all theorethical results based on such assumption. It could simply be argued that people are governed by other factors than just rational thinking. The other factors include emotions, such as love, hate, compassion, envy, pride or humility. Consequently, theorethical tools created with the assumption of a rationally behaving individual maximizing their gain are not entirely suitable for the description of real individuals.

We know, however, that a number of sciences often use a simplified assumption as a theorethical basis. Let us use just a few examples: a body is replaced with a material point; gas is arbitrarily compressible; the Earth is considered to be a perfect sphere. All this serves to create an elementary model to be further extended by omitting some of the limiting assumptions. This simplification leads to gradual improvement of the model until it describes a ”real“ body, ”real“ gas or the real ”Earth“, etc. Of course, even the extended models may not be complete, but perhaps sufficient to solve an array of practical questions, which could not be addressed otherwise.

We tried to apply the above described approach to the problem of human economic behavior. First we had to find an appropriate concept that would help to clarify why real human behavior as described by exact mathematical models of rationally behaving individuals maximizing their gain differs from theorethical expectations. Instead of dealing with paradoxes arising from the confrontation of theory and the real world, we would have a theory that would allow us to clarify the mysteries of human behavior.[4] We have proposed the following explanation to be tested:

1. Each specific decision made by an individual takes place in an environment where many different games are being played (in the game theory sense of the word).

[3] See Li and Taplin (2002), Shafir and Tversky (1992).

[4] The effectivity of such approach in experiments motivated by the prisoner's dilemma game has been proven in several papers, see for example, Heissler and Valenčík (2010), Heissler (2011).

2. The games are interconnected in different ways.

3. The individuals are only partially aware of the games they are participating in; which ones they enter, which ones they are drawn into and which ones count on them as an object that does not reflect on their position or role, etc.[5].

4. The individuals play each of the games to the extent they are informed about their participation, with concsious or subconscious awareness of the context provided by other games, i.e. they project the other contexts originating from rational or sensed reflection of the other games that have any effect on the current game.

5. To use the assumption of rationally behaving individuals maximizing their gains to create models reflecting reality as well as possible, we need to uncover the relationship between the individual games.

6. Such analysis should consider both, individual games as well as the compound ones, the relationships among them, anatomy of standard situations the players may encounter.

7. The proposed analysis should respect the important fact of partial awarness of individuals about the games they participate in. The players are only partially informed about the games, while some games remain totally hidden to them.

8. The above-mentioned assumptions allow us to develop technical means, a theory of contextual games, which allow us to make significant progress in uncovering the human behavior and formulate practical recommendations and a body of knowledge.[6]

The available theoretical literature provides certain studies dealing with the contextual aspects of the game theory. However, the majority of the representative theoretical literature does not take interactions among games into account in their treatment of the real-world behavior.[7] This, of course, limits the scope of possible applications. The eight points listed above can be seen as a research plan. We will show that bringing this plan to life will allow us, among other things, to address the paradox of evaluating categories of ”specifically human“ behavior such as empathy or envy and the category of ”purely rational“ behavior.

[5] Identifying the level, to which people recognize their participation in one game or another is extremely important. This regards a wide range of cases, from not knowing about their participation in a game, through mere notions , all the way to precise knowledge of game parameters that can be used to construct a mathematical model. As players gain knowledge the type of gam may change as well.

[6] We present such detailed characteristic of contextual games for the first time here. Previous works suggested it would not be a trivial task.

[7] Scientific monografies and standard textbooks used to teach game theory worldwide do not contain chapters dealing with interconectedness of games in real world and how it can be described by adequate models. Still, analysis of these relationships between games appears to be crucial for any practical application of the theory to common life situations.

3. Contextual game theory: typical cases of bad decisions

In the previous chapter, we have shown how the assumption of limited rationality can be weakened, so that errors in human decision making could be explained in a way that does not necessarily contradict the rational decision-making. If we take into account the complexity of the real world, it is practically impossible to obtain relevant information on all the contextual games individuals are participating in or playing. However, limited rationality in individuals' decision making is not only caused by the complexity of the real world, but also by the internal cognitive limits of the human mind, which distort the observed reality. This is where we will base our key arguments and to explain errors in individuals' decision making using the theory of limited rationality. An explanation follows.

Analysis of the following game will provide a good example of what the consequences might be of not projecting or unnecessarily projecting a reality context into the game being played at the moment. This can be shown using the prisoner's dilemma as an analogy of a game which describes the gain or loss of reputation in ecomomics. The same applies to the game "Tragedy of public ownership" and its relationship to reputation gain or loss:

1. If there is a community or environment where the gain or loss of reputation plays an important role, then the behavior or strategy of behavior where agreements are not kept while ignoring the game context will harm the ignoring players significantly. The players will lose more than they can possibly gain.

2. If on the other hand, gain or loss of reputation does not play a significant role in a community and the community simply ignores this parameter, then the behavior or strategy of keeping a promise puts the players in a disadvantage. They will lose without being compensated. In certain cases righteousness may become disqualifying for the players. This is when the community or system creates structures based on mutual cover-up of dishonest behavior and this influence becomes the dominant context component in other games.

A similar situation occurs when decisions are made about projecting a game based on positional investment into the contexts of other games. To bring the desired effect, conditions for positional investment into a certain environment or community must be favorable. If the conditions are not met and positional investment does not bring the desired effect, any behavior assuming the existence of positional investment opportunity may evoke undesired reactions. In the opposite situation, when positional investment plays an important role, the failure to project the relevant context into the appropriate games may signify big losses for the individuals playing the game.[8]

[8] With a bit of simplification we can see the person in the role of the "Man from the first century" (in the movie with such role played by M. Kopecký in 1961).

The ability to appropriately project a context of a hidden parallel game into decisions or, on the other hand ignoring it if needed, has an important consequence for decisions about coalition participation and negotiations of payouts in basic games. Based on this line of argument, there are two extreme possibilities:

1. A case with a hidden parallel game, which significantly affects the parameters of the base game. This game is not seen by one of the players. It can even be purposefully ignored. All attempts of the player may be in vain, if outcome has been decided by a hidden game. This is a fairly common situation, simply because many people are not able to recognize the effect of structures based on mutual cover-up of breaking generally accepted principles. Even if they are able to detect the cover-up, they would not admit its importance. This behaviour is governed by the tendency of people functioning in a given environment, professional, sport or among friends, to rather enjoy the activities they participate in. This is a natural human need, strong enough to ignore the internal inhibitions which register the contexts, such as the structures that mutually cover up the breaking of generally accepted principles. They would spoil the gratifying effect of their activities.

2. The case where a hidden parallel game imagined by players and used to make decisions does not actually exist in the given system. This is an often-encountered case of conspiration theories. Conspiration theories usually enter the scene when individuals feel that there is an external effect on the base game which they cannot identify. Also, the players do not have the ability, knowledge and experience to find the source of this effect. Therefore they substitute the real source with some product of their fantasy or someone else's fabulation, which often seems to explain everything they encounter. This leads to incorrect evaluation of all situations which means suffering losses, but can also affect the psychology of the players making the errors.[9]

Generally, the above-described errors are caused by the fact that in a new situation, people tend to subconsciously transfer their knowledge and experience from previously played or attended games into the new situation. It is this rigid evaluation of new situations that may lead to decision errors and cause dire consequences for the individual. There can be several causes of a changed life situation:

- changed geographical location, when one enters an environment with different traditions, participates in games with different rules than the ones they were prepared to play;

[9] Theorethical analysis shows that the influence of structures based on mutual support in breaking commonly accepted rules differs from various conspiration theories by a much higher level of spontaneity. Both involved and non-involved players are subject to common rules that can be extracted from analysis of such games more than they are ready to admit.

- a change of social status after career advancement at work or in public life, or on the contrary, a loss of social status e.g. retirement or health problems;

- a loss of friends or family that were close and played an important role in helping to obtain information or evaluating life situations;

- last but not least, the reasons could be in the overall change of an era one lives in, its character. New games may appearand the long term spontaneously observed rules are not followed or relevant any more, etc.

All of this, especially in combinations, may lead to errors in projecting or not projecting properly contexts of other games into the games where one needs to make decisions. These are the most frequent causes of errors that can occur when making decisions about a strategy or how to behave in a particular situation.

4. Different types of relationships between contextual games and the root of error in optimal behavior strategy choice

Research in the area of contextual games has discovered a small number of frequently occuring connections between different games. In this chapter we will summarize these results, building on previous theorethical arguments. We will classify contextual games into different types that have newly been described by mathematical models or at least in a form of graphically expressed concepts using established terms.

1. Games connected via payout matrix summation. Under this scenario, whatever happens in one game with a defined payout matrix, is projected into the results of another game with a defined payout matrix. The prisoner's dilemma game is a good example, since it can lead with certain probability to an increase in reputation for one of the players, depending on their ability to follow the original agreement, or a faliure to do so. This kind of interconnectedness can be expressed by a mathematical model to test different parameters for their effects. The use of such model led to an explanation of the apparent conflict between the theory and experiments in the prisoner' dilemma game. This kind of connection between games is relatively common. A married couple conflict game is another such example. In this type of game the payout matrices are summed and valued based on the couple living together, while payouts reflect whether the place they live in brings them satisfaction and joy.

2. Games connected via tied dilemmas. These games belong to the category of multi-round games where the outcome of the later rounds determines the payout values from the initial round.[10]

[10] A detailed treatise on this kind of relationships between games can be found in Valenčík and Budinský (2010).

Because the outcome of the following rounds is probabilistic, it is common to use Bayesian apparatus to describe the system. The system is quite common and can easily be described by a mathematical model.[11] Decision-making by players in some of the game nodes can often be described by a different type of game.

3. Continuation of a game connected to positional investment of resources obtained in an initial game. A positional investment-based game is usually simple, but occurs very frequently. The probability of winning the game increases in relation to resources invested by the individual players. If a game is followed by a game with positional investment, payouts which do not compensate losses from the positional investment game are unsatisfactory, even if the initial game ended with a gain. The relationship between the two subsequent games can be described by a mathematical model. An apparent deviation from theory of ultimative games where an amount is divided only if approved by the other players can be explained by the projection of the positional investment game context into the initial game by the players. One could argue that the ultimative game rules do not mention any following positional investment game, therefore none of the players should think in such terms. However, people tend to transfer real-life experiences into situations where they are subject to experiments. We wish to point out the existence of an important phenomenon in this kind of connection between games specific for this situation, even though it may be encountered in examples of other games as well.

4. Redetermination of coalitions and payout distribution via a hidden parallel game. This is an example of a combination of several games, where specific cases can be recognized depending on:

- the type of basic game played;

- the relationship between the environment of the basic game and the environment of the parallel game;

- the mode of coalition redetermination and payout distribution.

Some cases are described by existing mathematical models, and some can only be expressed as concepts and example schemas. Cases where the basic game was played in a redistribution system were studied in extra detail. In this system the resources that can be divided between players depend on the mode of division and individual gains. The final payout is determined by a winning coalition with controlling power. In parallel games, structures based on mutual cover up of rule-breaking are often formed. These structures form a connection between the original and the parallel game.

[11] Can be found son-line as a worksheet in Valenčík et al. (2011).

We can rightly expect that many more associations exist between different types of games, their list can be further expanded and better structured based on criteria not yet available. In other words, we are just at the beginning of a significant research program of mapping the relationships between contextual games.

Before specifying how the contextual character of games leads to error, let us return to the comments of the game continuation connected with positional investments. If positional investment games enter real life, then it is clear that the participants of the games will be driven by envy. By envying another player, they use their own psychological evaluation to evaluate that the gain of one player most likely means a loss for the players themselves. This leads to relationships when players welcome losses of the other players. In the words of Helmut Schoeck: ”The envious man thinks that if his neighbour breaks a leg, he will be able to walk better himself.”

Please, note, that a typically human characteristic, such as envy can be explained as a result of experience or imprinting obtained by players in games of a certain type. The phenomenon of envy can thus sometimes play a positive role in effective individual decision making. Under different circumstances, envy may represent an inadequate reality evaluation and people should follow the feelings of solidarity and help others when needed. Naturally, it is entirely logical for a player of an ultimative game to offer division 90:10 to evoke a feeling of unjustice in the other player who declines the offer, even at the cost of their own loss, as a result.

We used the presentation of different kinds of connections between contextual games to show what may appear as typical human characteristics, such as love, hate, pity, envy, pride or humility, are at the same time certain psychological phenomena that help people in their interpretation of particular life situations. The interpretation is made on the background of games played by the participants. People are incapable of evaluating a huge amount of data, that they have at their disposal at any moment in their lives without an interplay of individual parts of their psyche, including emotions and senses. The kinds of emotions experienced largely depend on the type of games the given individuals have played,whether consciously or not, was influenced by or adopted experiences from. A model based on the assumption of rationally behaving individuals maximizing their profit is not only in accordance with specific human characteristics, but also shows how and why these specific human characteristics form and what role they have in decision making.[12]

[12] Some theorists consider the ”typical human characteristics“ to be the factor that lowers the expressive power of the theorethical approach based on the assumption of a rationally deciding individual maximizing their gain. In our aproach, on the contrary, we consider this assumption to be the cornerstone of understanding these typical human qualities and the understanding of their role in social conditions, when they become important, etc. The research program, presented together with our ideas can also be formulated this way: We will provide a complete and concise list of all the key human qualities of the above type, find their appropriate basic games and contexts, where the effect of human psycholgy is important. This also shows that

Let us now concentrate on the main question posed in this paper: What is the essence of error? The answer has been hinted in previous paragraphs. To show the contribution of the contextual game theory, we will first provide a simplified answer. As postulated by Herbert A. Simon (1955, 1959) and Friedrich Augustem von Hayek (1995, 1980) the cause of error lies in the incompleteness of information used to make decisions. This incompleteness may on one hand be caused by the absense of information, on the other hand by our inability to process the information adequately. It is because human beings lack the means for adequate processing. The case where we make a wrong decision under the influence of desinformation is a special case of incomplete information.

Errors made because of incomplete information may be useful. We could go even further and say that erroneous decisions in relation to other people originate from the following:

- lack of consideration for an important game or part of game entering the context we operate in;

- projecting the contexts of other games into a game where decisions take place, even though the context is not present.

The first case can be determined by lack of experience, the second may be a result of our imprinting from previously played games, which are transferred inertially to situations where they are not played any more.

An error in the most important game at any moment is therefore usually a wrong reflection of its contexts, given by other games related to the first one. This is why we may not pay attention to selected information, why we may incorrectly process some information, and why parameters get evaluated inappropriately. This may also include the inability to tell apart players playing with us from players playing against, and telling appart friend from foe. The identification, description, analysis, modelling and classification of connections between different types of games therefore brings very important, valuable and practical knowledge that can help us understand the anatomy of error and, even more importantly, the limits to our erroneous decision making.

Conclusions

As history teaches us, meaningful progress in theory usually comes when social circumstances are ripe, when the times “ask for new solutions“ by accumulating problems that need to be addressed. Current problems definitely represent such challenges. We attempted to react to some of them in this paper. Briefly, and with certain opinion, we described the current results in using game theory,

our approach does not ”bring elements of psychology“ into the field analysed by theorethical economics (microeconomics) and game theory, but on the contrary, that it uses the theory and its methods to achieve a complex analysisq of human behavior.

especially the contextual game theory, to describe and analyse human behavior in real situations. While doing this, we stressed the need to discover the causes and types of human error.

One of the most important conclusions in this area for subsequent theorethical work is the identification, description, modelling and classification of contexts in different games provided by other types of games. Each step in this field is important for further progress and development of the theory, while providing opportunities for practical use. This has also been proved by the fact, that from our perspective, the explanation error by limited rationality of H. Simon and the theory of limited information by F. Hayek may not be sufficient. This is because among people with identical information set some will make more errors than others, particularly because of different experiences, not necessarilly lack of them, since too much experience may also lead to error. Current results make us believe that more unintuitive conclusions of this kind will be possible in this field with further research.

One of the important aspects of our treatment of this subject in this paper is that our presentation of the scientific results will be useful even for those who are not experts in this field. Any progress in a theory must be accompanied by its popularization, which does not need to be in the form of applying the results, but also by verification of its applicability. This, in turn, brings feedback into the further development of the theory itself.[13] The presented parts should therefore also be viewed as a preparatory step leading towards a popular explanation of the game theory for wider public. Interested readers should be able to accept the theory not only as a set of new findings, but also as a new part of their competences helping them with better and more effective real-time decisions. In other words, simply, but explicitly stated, the game theory should be adopted as a form of martial art.

[13] For example, the paper by Heissler and Valenčík (2011) published in a prestigious Czech magazine Vesmír was accepted positively.

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